ISSN 2279-9362

Collegio Carlo Alberto

Italian Industrial Production, 1861 1913: A Statistical Reconstruction. F. The Engineering Industries

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No. 419
June 2015

Carlo Alberto Notebooks

www.carloalberto.org/research/working-papers

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A STATISTICAL RECONSTRUCTION

F. THE ENGINEERING INDUSTRIES

2015

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F. THE ENGINEERING INDUSTRIES

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F01. Introduction

F01.01 The output data and estimates

In the 1911 *Censimento demografico* and *Censimento industriale* all metal processing from ore to finished product is included in category 4. The transformation from ore to semi-finished metal, here considered "metalmaking" (section E above), is covered by *classi* 4.1 and 4.2; subsequent metal processing is distributed over *classi* 4.3 (hardware, metal furniture, other fabricated metal), 4.4 (structural components, industrial and agricultural machinery, and transport equipment other than wood carts, carriages, and sleighs, and wood boats not built in yards, counted in categories 3.15 and 3.16, respectively), and 4.5 (precision instruments, clocks and watches, office equipment, firearms and ordnance, metal musical instruments, and jewelry and related articles).

Both the census legends and the census data. imply that these census categories cover maintenance and repair as well as new production. While only a few of the legends actually refer to such activity (most just list types of products), the *Censimento industriale* did not distinguish between *arti* (crafts), *mestieri* (trades), and industries strictly defined (*regio decreto 6, 1910, n. 776*, art. 23); and there are no other census categories where specialized maintenance and repair workers could reasonably be included, even in the *Censimento demografico*. The wholesale and retail trades (categories 9.1 – 9.3) seem narrowly defined to exclude the processing of materials, not illogically attributed entirely to industry: there are no separate service-sector categories for repair work, and the listed trades include only owners, white-collar workers (*impiegati*), cleaning staff and the like (*personale di servizio*), and porters (*facchini*, carriers of burdens), to the exclusion of dependent workers who process goods (*operai*) as of independent artisans (*artigiani indipendenti*). Tellingly, category 9.15, bread and pasta shops, is specifically said to refer only to the (re)selling of goods manufactured by other concerns. By the same token, the many thousand "watchmakers" counted in industry (4.53) were no doubt very largely traditional shopkeepers who sold watches but mostly repaired them; the selling of watches is specifically included with that of other luxury goods in (trade) category 9.116, but (as with the selling of bread and pasta) the intent of the census was surely to count there only those whose activity was strictly, or at least overwhelmingly, mercantile. The quantitative evidence is even more compelling: the very size of the labor force attributed to the engineering industry implies that much of it was perforce engaged in repair work, for as will be made clear below only about half of it sufficed to transform all the available metal into new products, and the very rapid rise in production over the preceding years rules out significant unemployment.

The engineering industry is here defined as the set of activities that characterize census categories 4.3, 4.4, and 4.5. This industry is substantially that covered by *ISIC* category 38 (manufacture of fabricated metal products, machinery, and equipment); the principal differences are that the present industry excludes the manufacture of wood carts, carriages, and sleighs (part of 3849), and wood boats not built in yards (part of 3841), but includes the manufacture of jewelry and related articles (3901), metal musical instruments (part of 3902), knitting needles, pen nibs, and the like (part of 3909) as well as the repair of electrical appliances (9512), motor vehicles (9513), watches, clocks, and jewelry (9514), and other consumer durables (9519). The general repair services of blacksmiths and the like, the specialized services of shipyards and railway repair shops, and the repair of agricultural, industrial, business machinery, aircraft, and precision instruments are included in the present industry and also in *ISIC* category 38 (3811; 3841-3842; 3821-3829, 3831; 3845; 3851); the typically low-level maintenance carried out

within households, or within firms that lacked a separate maintenance shop (and therefore employed no professional mechanics, to judge from the similarity of the *Censimento demografico* and *Censimento industriale* figures for category 4.4), are excluded from the present industry and also from *ISIC* category 38.

The main conceptual difference between the *ISIC* definition of the engineering industry and the present one is that the latter includes the maintenance of all the industry's products, where the former includes that of some and excludes that of others. The *ISIC* specifically includes in manufacturing (Major Division 3, p. 28) "the repair of [agricultural,] industrial, commercial, office and similar machinery and equipment," while "the repair of household appliances, equipment and furnishings, motor cars and other consumer goods [is instead included in] major group 951 (Repair services) [or major group 620, Retail trade, as specified on p. 39]." The *ISIC* notes that it (quite properly) "does not draw distinctions according to kind of ownership, type of economic organization or mode of operation" (p. 7). Nonetheless, as in the present exception, it attributes relevance to "criteria relating to economic agents (e.g., households, producers) and purposes (e.g., final consumption, capital formation)" because so doing supposedly "improved the triangulation of data" (p. 13) -- which it visibly does not, because to identify the output of the engineering industry with investment the industry needs excludes the manufacture, as well as the repair, of consumer durables. The present definition of the industry is internally consistent, where the *ISIC* makes no sense at all.

The importance of the repair services it includes makes the engineering industry somewhat *sui generis*. In principle, maintenance is production like any other, transforming a physical input (a good in a certain condition) into a physical output (a good in a different condition); in practice, at the relevant levels of aggregation the heterogeneity of inputs and outputs is such that a meaningful physical measure of production can hardly be obtained. "Real" maintenance is accordingly indexed by physical stocks (allowing, where possible, for intensity of use), but typically expressed directly in 1911 lire, with all the ambiguities that implies (above, chapter A04); new production is instead represented, as usual, by physical output. Because new parts can be used for maintenance as well as new production (and also, as usual, because parts can be traded internationally), secondly, one should in principle distinguish systematically between the production of new parts from semi-finished metal, the assembly of new machines from parts, and the maintenance (partial disassembly and reassembly) of existing machines. In practice, this vertical disaggregation within individual sectors is rarely carried out: in general, the production of parts for new machines is included in machine production, the production of replacement parts is included in maintenance, and the mere assembly of imported parts is separately considered only where the trade data identify significant flows.

The State was heavily involved, as regulator or direct owner, with the railways, the merchant marine, and, obviously, the Navy; but the engineering industry is otherwise very poorly documented (*Rilevazioni statistiche*, vol. 7, pp. 361 ff). Because of these data limitations, the engineering industry is here disaggregated, somewhat unusually, into the following major components: fabricated metal; seagoing vessels; rail-guided vehicles; general equipment; precision equipment; and precious-metal products. The sea-going vessels industry includes the construction of new naval vessels and seagoing merchant vessels, estimated in considerable detail from direct evidence, and the maintenance of the naval and merchant fleets, tentatively estimated by extrapolating value added in 1911 on the basis of the size of the fleets maintained (and, for merchant vessels, traffic). The rail-guided vehicles industry includes new production, also estimated in relative detail from evidence on gross acquisitions and imports, and maintenance, tentatively estimated by extrapolating value added in 1911 on the basis of vehicle weights and mileages. The poorly documented fabricated metal, (residual) general equipment, and precision equipment industries cover all other working of non-precious metal; with the aid

of scattered and largely indirect evidence (on employment, aggregate and unit value added, input-output coefficients, metal consumption, and international trade), these are here estimated together in limited detail, tentatively separating new production on the one hand and maintenance (by the producers, or specialized repair shops) on the other. The production series are jointly constrained by the net flow of metal available to the industry, and reflect, together, its cyclical variations; maintenance is instead assumed to be stock-related, and thus to vary smoothly over time. Finally, the production (including maintenance) of precious-metal goods is estimated by deducting net imports from consumption, itself directly estimated in 1911 and extrapolated in proportion to that of a better-documented luxury good.

All these major components of the engineering industry are considered to be vertically independent, with one exception: the seagoing vessels industry is taken to fabricate the vessels' hulls, but only to install hardware and machinery obtained from the fabricated metal and general-equipment industries. In principle, the construction of electric locomotives should similarly allow only for the installation of ("purchased") electrical equipment; in practice, electric locomotives are here simply assimilated to the far more numerous steam locomotives.

F01.02 The factor-employment data and estimates

Since there is so little direct evidence on the composition of the industry's output, and unit value added can vary within broad limits, aggregate value added in 1911 is here estimated from the activity levels suggested by the census reports. The relevant data are taken to be those for categories 4.3, 4.4, and 4.5, on the understanding that these cover (practically) all the relevant maintenance and repair work as well as new production.

The census labor force and factor employment data for categories 4.3, 4.4 and 4.5 are collected in Table F.01; the *Censimento industriale* data for all shops, large shops, and small shops are taken from vols. 4, 3, and 2, respectively. In the industrial census, the members of the owner's family are separately counted (and particularly numerous, not surprisingly, in the small shops), and the listed blue-collar workers are by implication only hirelings. In the demographic census, the members of the owner's family are not separately counted; but in category 4.4 the demographic census lists no artisans (curiously, not even in category 4.43, which includes bicycles), and the differences between the two sets of aggregate census labor figures are exceedingly small (ca. 2%). One notes that in category 4.4 the demographic census counts 14,429 owners (none under 15, but 752 under 21), 8,580 white-collar workers, and 136,392 blue-collar workers, while the industrial census lists 9,002 owners, 8,438 white-collar workers, 4,748 family members, and 133,814 blue-collar workers: it is apparent from these numbers that the demographic census counted the members of the owner's family as owners (with the possible exception of those under 15), and that the listed blue-collar workers are only (or almost only) hirelings in that census as well.

Since the quoted industrial-census figures are to be inflated by the relevant employment in integrated shops (counted in categories 4.ω, ω.31, and ω.71), the industries of category 4.4 appear to have been completely covered by the industrial census; and this in turn implies that their shops were (almost always) well separate from their owners' dwellings (above, section A03.02), perhaps because of their noxious sounds and smells (the relative differences between the two sets of census figures are greatest in the case of the aircraft industry, category 4.45, which at that time involved wood and cloth far more than metal; but they are readily accounted for by category ω.31).

Last but far from least, too, the similarity between the two sets of census figures for category 4.4 clearly implies that in those branches of the engineering industry, at least, unemployment was altogether negligible. In categories 4.3 and 4.5 the differences between the corresponding sets of census figures are much more significant than in category 4.4, even

allowing for employment in integrated shops; but it seems reasonable to assume that unemployment was negligible in categories 4.3 and 4.5 as well, and accordingly to interpret those differences as employment in works the *Censimento industriale* simply missed, either because they were one-man shops, or because regardless of size they shared their owner's residential address. One reason is that the differences between the census figures are particularly significant in categories 4.31 and 4.32 (smiths), where very small-scale operations were no doubt numerous, another, that the time series evidence suggests that over the preceding years production had grown far beyond its previous levels; but the strongest is that it is very hard to imagine that unemployed workers with metal-bashing skills would not have spread themselves throughout the industry, that there could have been a long queue for jobs in some sectors of the engineering industry (4.3, 4.5) even as there was no queue in others (4.4). Neglecting unemployment, then (or, more precisely, letting unemployment compensate for the undercounting of the workers the rapidly-growing industries borrowed from other sectors, above, section A03.02), total employment in the industry is simply equated to the labor force figure in the *Censimento demografico*; but a disaggregation of that total to separate the operations covered by the *Censimento industriale* from those it missed serves both to illustrate the structure of the industry and to refine the estimates of (unduplicated) horsepower in use and value added.

The data in Table F.01 are here recombined, and partly aggregated, into the estimates of actual factor employment presented in Table F.02. Cols. 1 – 3 and 4 – 6 refer to the large shops and small shops, respectively, covered by the *Censimento industriale*; in general, these estimates inflate the census data for specialized shops to absorb the workers and horsepower of the non-specialized shops. Cols. 7 – 9 refer in turn to the shops missed by the *Censimento industriale*, and cols. 10 – 12 to the industry totals. The industry-total figures for blue-collar and total workers in cols. 10 and 11 are taken directly from the *Censimento demografico*, and the corresponding estimates of the workers missed by the *Censimento industriale* (cols. 7 and 8) are obtained as residuals (respectively as col. 10 less cols. 1 and 4, and col. 11 less cols. 2 and 5). The industry-total horsepower figures in col. 12 are instead obtained as the sum of those the *Censimento industriale* covered, in cols. 3 and 6, and those it missed, in col. 9; these last are estimates that extrapolate (rather than merely reproduce or reallocate) the census data. All these estimates are rounded, to the nearest 50 units.

The non-specialized-shop labor and horsepower included by the *Censimento industriale* in the mixed categories and here allocated to the various components of the engineering industry include all of those in the narrow categories 4.3ω, 4.4ω, and 4.5ω, which must of course be retained within the higher-level group (respectively 4.3, 4.4, 4.5), all of category 4.ω2 (which straddles those three groups), and only part of those in category 4.ω1 (which includes metalmaking as well as engineering) and again of the broader categories ω.31 and ω.71 (which straddle category 4 and 3 or 5). Allowing metalmaking and engineering together all the workers and horsepower in category 4.ω1 and half of those in categories ω.31 and ω.71, one obtains totals of 33,279 blue-collar workers, 35,664 total workers, and 31,579 horsepower in large shops and 730 blue-collar workers, 1,298 total workers, and 385 horsepower in small shops, or, in all, 34,009 blue-collar workers, 36,962 total workers, and 31,964 horsepower; deducting the 4,500 plus 1,600 blue-collar workers, 5,000 plus 1,900 total workers, and 14,700 plus 1,500 horsepower assigned above to ferrous and non-ferrous metal production (categories 4.1 and 4.2, on large and small shops together), one obtains residuals for the engineering industry of 27,909 blue-collar workers (ca. 82.1% of the total for metalmaking and engineering together), 30,062 total workers (ca. 81.3%), and 15,764 horsepower (ca. 49.3%). Applying for simplicity these percentage shares to the separate figures for large shops and small shops, one obtains engineering-industry estimates of 27,310 blue-collar workers, 29,006 total workers, and 15,574

horsepower in large shops, and 599 blue-collar workers, 1,056 total workers, and 190 horsepower in small shops. Adding to these the (engineering-industry) workers and horsepower in category 4.ω2, finally, one obtains engineering-industry totals in categories 4.ω, ω.31, and ω.71 that round to 37,450 blue-collar workers, 39,950 total workers, and 20,800 horsepower in large shops, and 2,200 blue-collar workers, 4,450 total workers, and 500 horsepower in small shops.

The allocation of these begins with the elements of category 4.4, for which the *Censimento demografico* reports no artisans, and the coverage of the *Censimento industriale* is in principle complete. In Table F.02, rows 4 and 5 refer to categories 4.42 (railway vehicles) and 4.44 (shipbuilding); since (specialized) small-shop employment was there exiguous, the workers not in the *Censimento industriale* specialized shops are all attributed to large shops. The estimated *Censimento industriale* figures for blue-collar and total workers and horsepower in small shops (cols. 4 – 6) accordingly reproduce, merely rounded, the industrial-census data for specialized small shops; the estimated figures for large-shop blue-collar and total workers are simply the (rounded) totals in the *Censimento demografico*, less those attributed to small shops. The corresponding horsepower estimates in col. 3 are in turn obtained as the estimated number of blue-collar workers (col. 1) times the ratio of horsepower to blue-collar workers in specialized large shops (from Table F.01, so that the large shops in category 4.42, for example, are attributed 43,700 times .753, or, rounded, 32,900, row 4, col. 3). Absent omitted operations cols. 7 – 9 are all zero, and the totals in col. 10 – 12 correspond to the sums of cols. 1 and 4, 2 and 5, and 3 and 6, respectively; these of course return in cols. 10 – 11 the (rounded) blue-collar and total-worker figures in the demographic census.

Row 6 refers to the rest of category 4.4. The small-shop figures needs include, in addition to the sums of the specialized small-shop data for categories 4.41, 4.43, and 4.45, all those for non-specialized small shops in category 4.4ω, as none of these were attributed to categories 4.42 or 4.44; one notes that these non-specialized small shops employed just .11 horsepower per total worker, much like those in 4.43 (bicycles, automobiles), and far less than the others. The residual workers counted by the demographic census in categories 4.41, 4.43, and 4.45 but not included by the industrial census in the specialized large shops of those same categories, or in the small shops of those categories and category 4.4ω together, number 4,829 blue-collar and 5,388 total workers; and their ratio suggests that they were essentially in large shops. The small-shop figures in cols. 4 – 6 are therefore the simple sums of categories 4.41, 4.43, 4.45, and 4.4ω, and the estimated numbers of blue-collar and total workers in large shops in cols. 1 and 2 are all the other workers counted by the demographic census in 4.41, 4.43, and 4.45 (col. 10 less col. 4 and col. 11 less col. 5, respectively). As before, the large-shop horsepower estimates in col. 3 are obtained as the estimated number of blue-collar workers (col. 1) times the ratio of horsepower to blue-collar workers in specialized large shops (48,150 times .574, rounded). Again as before, absent omitted operations cols. 7 – 9 are all zero, and the totals in col. 10 – 12 correspond to the sums of cols. 1 and 4, 2 and 5, and 3 and 6, respectively.

The sums of the present estimates for small shops (cols. 4 – 6) in rows 4 – 6 return, by construction and within rounding error, the industrial-census totals for category 4.4. The sums of the corresponding estimates for large shops (cols. 1 – 3) instead exceed those totals by some 2,550 blue-collar and 3,400 total workers, and 2,000 horsepower. Of the engineering-industry components of categories 4.ω, ω.31, and ω.71 estimated above, therefore, there remain for categories 4.3 and 4.5 some 34,900 blue-collar workers, 36,550 total workers, and 18,800 horsepower in large shops, and (as before) 2,200 blue-collar workers, 4,450 total workers, and 500 horsepower in small shops.

The components of category 4.5 are estimated next. This group is divided into five components, which refer respectively to (ordinary) equipment and machinery, (ordinary)

weights and scales, precision (optical, scientific, and musical) instruments, clocks and watches, and precious-metal work. The first of these (Table F.02, row 7) covers categories 4.54, 4.55, 4.57, and 4.58; in these categories, as in all of category 4.4, the *Censimento demografico* reports no artisans. Category 4.5ω includes only small numbers; they are attributed entirely to this first group, on the presumption (or simplifying assumption) that specialization was altogether more likely among the manufacturers of precision equipment and precious-metal products (and even within these last, judging from the very different power-intensities of the large shops in categories 4.59 and 4.5$\underline{10}$). Summing over the categories attributed to this group, the *Censimento demografico* reports some 28,000 blue-collar and 33,700 total workers, as against 26,100 and 30,700, respectively, in the *Censimento industriale*. The differences equal 1,900 blue-collar and 3,000 total workers, for a ratio of 1.58 total workers per (hired) blue-collar worker, against 1.11 in specialized large shops and 1.67 in specialized small shops, suggesting that these workers were overwhelmingly in small shops. In consequence, the large-shop estimates in Table F.02, row 7, cols. 1 – 3 are the (rounded) simple sums of the industrial-census specialized-shop data for the five categories at hand. The small-shop blue-collar and total worker estimates in cols. 4 and 5 are the demographic-census totals in cols. 10 and 11 less the large-shops figures in cols. 1 and 2, equal to the industrial-census specialized-small-shop figures (respectively 3,250 and 5,400) plus the differences between the census totals (1,900 and 3,000, respectively, as noted). The small-shop horsepower estimate in col. 6 (1,300) is the rounded product of the total number of small-shop workers (col. 5) and the industrial-census specialized-small-shop ratio of horsepower to total workers (.153, from Table F.01). Cols. 7 – 9 are all zero, as for category 4.4, and col. 12 is the simple sum of cols. 3 and 6.

Table F.02, rows 8 – 11 cover the other four components of category 4.5; these refer respectively to weights and scales (4.52), precision instruments (4.51, 4.56), clocks and watches (4.53), and precious-metal work (4.59, 4.5$\underline{10}$). Given the presumption of specialization in all the shops concerned, the large- and small-shop estimates in cols. 1 – 3 and 4 – 6, respectively, simply round the appropriate (sums of the) industrial-census data, and the estimates of the workers missed by the *Censimento industriale* are obtained as residuals (col. 7 as col. 10 less cols. 1 and 4, and col. 8 as col. 11 less cols. 2 and 5). The estimates of total horsepower in col. 12 are instead the simple sums of the census-shop figures in cols. 3 and 6, and the estimates of the horsepower missed by the industrial census (col. 9); the latter are derived, rather tentatively, on the assumption that both power-intensity and the hired (blue-collar) share of the total work force increased systematically with shop size.

Using the unrounded underlying data in Table F.01 (aggregating as necessary over the appropriate categories), one obtains for weights and scales (row 8) .88 blue-collar workers and .18 horsepower per (total) worker in industrial-census large shops, and .57 blue-collar workers and .042 horsepower per worker in industrial-census small shops; for precision instruments (row 9), respectively .84 and .31 in the large shops, and .63 and .13 in the small ones; for clocks and watches (row 10), respectively .89 and .35 in the large shops, and .40 and .017 in the small ones; in precious-metal products (row 11), respectively .88 and .12 in the large shops, and .58 and .033 in the small ones. In the omitted shops, using the rounded estimates in Table F.02, cols.7 and 8, the blue-collar share of the work force works out to .64 in weights and scales (row 8), .67 in precision instruments (row 9), .38 in clocks and watches (row 10), and .55 in precious-metal products (row 11).

In precision instruments (row 9), as is obvious from Table F.02, cols. 4 – 5 and 7 – 8, the blue-collar share of the work force in omitted shops is within rounding error of that of the census small shops; the omitted shops' horsepower is accordingly estimated as their work force (col. 8) times the census-small-shop horsepower per worker indicated above (.13, with the result again rounded to the nearest 50). In clocks and watches (row 10) and in precious-metal

products (row 11), the blue-collar share of the work force in omitted shops is marginally lower than that of the census small shops, and somewhat more so in the former industry than in the latter; the omitted shops' horsepower is here estimated as their work force (col. 8) times the census-small-shop horsepower per worker, simply rounded down (from .017 to .015 in the case of clock and watches, from .033 to .030 in that of precious-metal products, with the results again rounded to the nearest 50). In weights and scales (row 8), finally, the blue-collar share of the work force of omitted shops (.64) is perceptibly higher than that of the census small shops (.57), though still well below that of the census large shops (.88). Taking the first of these figures as a weighted average of the latter two, and applying those weights (.77 and .23, respectively) to the corresponding horsepower per worker (.042 and .18, respectively), the omitted shops are here attributed .074 horsepower per worker, for a rounded total of 50 (Table F.02, col. 9).

Table F.02, rows 1 – 3 cover category 4.3, here disaggregated to distinguish only blacksmithing (4.31), other smithing (4.32), and other metal fabrication (4.33 – 4.3$\underline{11}$). Since smithing is by nature general-purpose and not specialized by product, the industrial-census workers and horsepower in 4.3ω are here attributed directly to the other activities; the estimates in cols. 1 – 3 and 4 – 6 are accordingly the corresponding figures in Table F.01 for categories 4.31 (to line 1), 4.32 (to line 2), and 4.3 net of the preceding (to line 3), augmented by the corresponding elements of the engineering-industry components of categories 4.ω, ω.31, and ω.71. Of these last, as estimated above, category 4.5 was allowed no workers and horsepower in large shops, and just 1,900 blue-collar and 3,000 total workers, and (rounding) 450 horsepower, in small shops; category 4.3 is thus left to absorb all the 34,900 blue-collar workers, 36,550 total workers, and 18,800 horsepower in large shops allowed earlier for categories 4.3 and 4.5 together, and the remaining 300 blue-collar workers, 1,450 total workers, and 50 horsepower in small shops. These small-integrated-shop residuals are themselves small, and accordingly subject to considerable relative error; by the same token, however, their misallocation introduces only small relative errors in the final estimates. Taking them at face value, for what they may be worth, they point to a very low ratio of horsepower to workers (ca. .03). Next to the detailed data in Table F.01, that ratio appears to be an order of magnitude lower than those observed in small non-smithing works, near half that in small blacksmithing works, and comparable in fact only to those in small other-smithing works. These integrated-small-shop workers and horsepower are accordingly attributed entirely to these last: in Table F.02, cols. 4 – 6, therefore, row 2 is the (rounded) sum of these residuals and the (specialized-small-shop) data for category 4.32, while lines 1 and 3 simply round the (specialized-small-shop) data in Table F.01 for categories 4.31 on the one hand and 4.3 net of 4.31 and 4.32 on the other.

The large-shop estimates in rows 1 – 3, cols. 1 – 3 are instead obtained as follows. As can be seen from Table F.01, the differences between the demographic-census data and the corresponding industrial-census aggregates in specialized shops equal some 66,650 blue-collar and 100,300 total workers in blacksmithing (4.31), 19,650 and 29,750, respectively, in other smithing (4.32), and just 5,100 and 9,500, respectively, in other fabrication (4.33 – 4.3$\underline{11}$, plus, as noted, 4.3ω). The absolute numbers for categories 4.31 and 4.32 are large, those for the residual small, next to the large-integrated-shop figures these need together to reabsorb; moreover, the above pairs of figures yield ratios of blue-collar workers to total workers equal to .66 in categories 4.31 and 4.32, well between the corresponding ratios for specialized large shops and small shops (respectively .89 and .37 in 4.31 and .90 and .44 in 4.32, from Table F.01), and .54 for the residual, marginally below the corresponding ratio for specialized small shops (.55, against .92 in specialized large shops, again from Table F.01). In short, the non-smithing workers not in the specialized shops counted by the industrial census appear to be not

in the large integrated works covered elsewhere by the industrial census, but in small shops; and not in industrial-census integrated small shops, all of which have already been allocated, but in small shops the industrial census missed altogether. On the strength of these considerations, therefore, the present estimates for non-smithing works (Table F.02, row 3) simply round the industrial census totals for specialized large shops (cols. 1 – 3) as well as for specialized small shops (cols. 4 – 6), and the entire differences between the census worker totals noted above are attributed to small operations the industrial census missed altogether (cols. 7 – 8). The horsepower corresponding to these last (col. 9) is in turn estimated as their total workers (col. 8) times the horsepower per worker in counted small shops (col. 6/col. 5), discounted by a third. This last correction allows for the knife-grinders missed by the industrial census: Table F.01 suggests that these were a very small part of the industrial-census workers in Table F.02, row 3, cols. 2 and 5, but near a third of the omitted workers in col. 8, and these were presumably itinerant workers who used no machine power at all. With these estimates in place, the industry-total horsepower figure in col. 12 is then obtained as the simple sum of the partial figures in cols. 3, 6, and 9.

The considerable numbers of workers and horsepower in integrated large shops attributed to category 4.3 thus remain to be distributed between categories 4.31 and 4.32. Since smithing is intrinsically not specialized by output, as already noted, the integration at hand was presumably between metalmaking and subsequent fabrication. Evidence of such integration is provided by the metalmaking data furnished by the Corpo delle miniere, which refer as noted not to throughput at a particular stage of production, but to the actual output of the metalmaking firms; and the product data in the *Rivista mineraria 1911*, pp. LVIII-LIX point to a far greater incidence of such integration in the case of ferrous metals, where some 50,000 tons of output were fabricated goods ranging from military hardware and railway accessories to nails, than in that of non-ferrous metals, where only 600 tons or so of the listed products were in fact fabricated. That the integrated shops worked ferrous metals is also suggested by the relatively low power-intensity suggested by the present estimates (.54 horsepower per blue-collar worker, against .60 for the large specialized works in category 4.31 and .75 for those in category 4.32); and in light of the above-noted discrepancies between the data in the two censuses it also bears notice that the 34,900 blue-collar and 36,550 total workers (with 18,800 horsepower) here attributed to the engineering component of integrated shops are readily absorbed in 4.31, but not, save perhaps in part, in 4.32. Here, for simplicity, these integrated-shop workers and horsepower are all attributed to category 4.31, raising the large-shop blacksmithing totals to the (rounded) figures transcribed in Table F.02, row 1, cols. 1 – 3; by the same token, the estimates for other large smithing works in row 2, cols. 1 – 3, merely round off the corresponding specialized-shop figures in Table F.01.

The omitted-worker estimates in Table F.02, rows 1 and 2, cols. 7 and 8 are then obtained as residuals, again as col. 10 less cols. 1 and 4, and col. 11 less cols. 2 and 5, respectively. Here too, as in row 8, the omitted shops appear to lie between the included large and small shops; but the absolute numbers involved are altogether larger. In blacksmithing (row 1), the large shops had some .95 blue-collar workers per total worker (col. 1/col. 2), and .52 horsepower per worker (col. 3/col. 2), the small shops .37 blue-collar workers per total worker (col. 4/col. 5), and .067 horsepower per worker (col. 6/col. 5), the omitted shops an intermediate .50 blue-collar workers per total worker. Reasoning as above, one can treat this last ratio as a weighted average of the corresponding figures for the large and small shops covered by the industrial census, and apply these weights (.22 and .78) to the corresponding horsepower per worker; the resulting figure equals .167 horsepower per omitted worker, or some 10,650 horsepower in all. But this calculation implies that over 14,000 omitted workers were in large, power-intensive shops; and it is hard to believe that the industrial census could have missed

hundreds of large shops (because they were attached to their owners' homes?) in blacksmithing, even as it missed none or nearly none in the no more noisome production of machinery. On the other hand, if all the omitted workers were simply assigned the small shops' .067 horsepower each, the corresponding horsepower would be just 4,250. The present horsepower figure in col. 9 is simply a compromise estimate that allows the omitted shops a weighted average of these two alternative estimates, with a double weight on the lower and less implausible one. The industry-total horsepower figure in col. 12 is again the simple sum of the partial figures in cols. 3, 6, and 9.

In other smithing (row 2), similarly, the large shops had some .90 blue-collar workers per total worker (col. 1/col. 2), and .67 horsepower per worker (col. 3/col. 2), the small shops .42 blue-collar workers per total worker (col. 4/col. 5), and .037 horsepower per worker (col. 6/col. 5), the omitted shops an intermediate .68 blue-collar workers per total worker. Proceeding as before, one can treat this last ratio as a weighted average of the corresponding figures for the large and small shops covered by the industrial census, and apply these weights (.54 and .46) to the corresponding horsepower per worker; the resulting figure equals .379 horsepower per omitted worker, or some 10,700 horsepower in all. Again as before, however, the calculation implies that the industrial census missed hundreds of large shops (with over 15,000 workers). If, instead, all the omitted workers were simply assigned the small shops' .037 horsepower each, the corresponding horsepower would be just 1,050. The present horsepower figure in col. 9 is again simply a compromise estimate that allows the omitted shops a weighted average of these two very different estimates, with a double weight on the lower one.

F01.03 The labor-cost estimates

Table F.03, panel A presents the estimates of labor costs, capital costs, and value added obtained here for the various components of the engineering industry, defined as in Table F.02. The estimates of labor costs are derived from the employment figures in Table F.02 on the basis of standard costs per worker, allowing for the age- and gender-composition of the work force and its distribution by shop size; for simplicity, the large shops are identified directly with those counted by the *Censimento industriale*, and all the others are considered small. In the case of the railway rolling-stock and shipbuilding industries, value added is calculated directly (in chapters F.02 and F.03 below), and capital costs are estimated by deducting labor costs. For the other components of the industry value added is calculated as the sum of labor costs and capital costs, built up from the factor-employment estimates in Table F.02.

Labor costs are estimated as follows. In the case of large shops they are calculated on the basis of the here standard annual salary of 2,000 lire for 10% of the total work force. The actual proportion of owners, managers, and other white-collar employees was typically higher than that, at times by a considerable margin, but this presumably reflects the incidence of relatively small-scale operations whose owner-managers earned little more than blue-collar wages. The standard annual wage for adult males is estimated at 1,200 lire (300 days at the 4 lire per day suggested by the *Annuario 1911*, pp. 222-224, *1913*, p. 268); it is applied both to actual adult male blue-collar workers, and to any male owners or managers in excess of the 10% allowed above (regardless of age and gender). Boys (to age 15) and all women and girls (letting the latter offset the former in clerical and managerial positions) are allowed half the adult male standard wage, or 600 lire p. a. Simplifying, the annual labor costs of large shops are calculated as 1,280 lire times the total number of workers, less 600 lire times the number of boys, girls, and women. The labor costs of small shops are similarly estimated, but without the allowance for salaried managers. Again allowing 600 lire p. a. for boys, girls, and women and 1,200 lire p. a. for the rest of the (male) work force, the annual labor costs of small shops are normally calculated as 1,200 lire times the total number of workers, less 600 lire times the number of

boys, girls, and women; in rows 9 – 11, exceptionally, these figures are raised to 1,350 and (minus) 750 lire, respectively, on the presumption that adult male small-shop watchmakers, jewelers, and the like were highly skilled artisans, and earned (12.5%) more than standard wages. The total numbers of boys, girls, and women are transcribed in Table F.03, col. 1; these figures are taken directly from the *Censimento demografico*, aggregating over the census categories indicated in Table F.02, and again simply rounded to the nearest 50.

Table F.03, rows 4 and 5 refer to the railway rolling-stock and shipbuilding industries. Since they were utterly dominated by large shops (Table F.02), their employment is attributed for simplicity entirely to the latter, and their labor costs are calculated directly from the estimated industry totals and the large-shop unit labor costs noted above. For the rolling stock industry, therefore, labor costs are estimated as 1,280 lire times 48,150 workers (Table F.02, row 4, col. 11), less 600 lire times 2,300 (Table F.03, row 4, col. 1), for a total of 60.25 million lire (Table F.03, row 4, col. 4, and zero in col. 8). For the shipbuilding industry, similarly, labor costs are estimated as 1,280 lire times 31,350 workers (Table F.02, row 5, col. 11), less 600 lire times 1,350 (Table F.03, row 5, col. 1), for a total of 39.32 million lire (Table F.03, row 5, col. 4, and again zero in col. 8).

For the other industries, large and small shops must perforce be distinguished, and the estimating algorithm is perforce more complex. It is simplest for the industries where total large-shop employment was taken to coincide with that recorded in (relatively) specialized shops: other smithing (Tables F.02 and F.03, row 2), other fabricated metal (row 3), other ordinary machinery (row 7), weights and scales (row 8), precision instruments (row 9), clocks and watches (row 10), and precious-metal products (row 11). In these cases, the numbers of girls and women and of blue-collar boys are taken as the category-specific figures reported in the *Censimento industriale* (including 4.3ω in row 3 and 4.5ω in row 7); since the latter census does not separate out other boys, the figures for the latter are taken from the *Censimento demografico*, on the assumption that the males under 15 in clerical work were all in large shops. The (rounded) sums of these figures are here transcribed in Table F.03, col. 2, and the small-shop figures in col. 3 are obtained as residuals (col. 1 less col. 2). In the case of other heavy equipment and machinery, the present large-shop estimate of 53,500 total workers (Table F.02, row 6, col. 2) includes 48,100 total workers in (totally) specialized shops (categories 4.41, 4.43, and 4.45); considering the other 5,400 as 72% of the 7,500 in category 4.4ω, the total number of women, boys and girls in large shops is taken as all the women, girls, and blue-collar boys in categories 4.41, 4.43, and 4.45 plus 72% of those in category 4.4ω listed in the *Censimento industriale*, plus all the white-collar boys in categories 4.41, 4.43, and 4.45 listed by the *Censimento demografico*. The (rounded) sums of these figures are here transcribed in Table F.03, col. 2, and the small-shop figures in col. 3 are again obtained as residuals (col. 1 less col. 2). In the case of blacksmithing, finally, the present large-shop estimate of 39,750 total workers (Table F.02, row 1, col. 2) includes only 3,200 total workers in (totally) specialized shops (category 4.31); treating the residual 36,550 as 92% of the 39,850 in category 4.ω, the total number of women, boys and girls in large shops is taken as all the women, girls, and blue-collar boys in category 4.31, plus 92% of those in category 4.ω listed in the *Censimento industriale*, plus all the white-collar boys in category 4.31 listed by the *Censimento demografico*. The (rounded) sums of these figures are here transcribed in Table F.03, col. 2, and the small-shop figures in col. 3 are again obtained as residuals (col. 1 less col. 2).

With the estimates of women, boys, and girls in large and small shops thus in place, the corresponding labor costs in rows 1 – 3 and 6 – 11, cols. 4 and 8 are obtained using the algorithms described above.

F01.04 The capital-cost and value added estimates

The rail-guided rolling stock and shipbuilding industries were exceptionally well documented by industry-specific sources. Value added is estimated directly at 125.16 million lire in the rolling-stock industry (chapter F.03), and 75.12 million lire in shipbuilding (chapter F.02); as noted, it is all attributed to large shops (Table F.03, rows 4 – 5, cols. 7 and 11). Deducting the above estimates of labor costs equal to 60.25 and 39.32 million lire, respectively (col. 4), one obtains estimates of capital costs equal to 64.91 million lire for the rolling-stock industry, and 35.80 million lire for the shipbuilding industry (col. 5). Divided by the corresponding horsepower estimates, equal to 34,700 and 18,750, respectively (Table F.02, rows 4 – 5, col. 12), these crude residuals yield estimates of capital costs per horsepower equal to 1,871 lire p. a. in the rolling-stock industry and 1,909 lire p. a. in the shipbuilding industry; and these last are within some 2% of each other. These initial ratios are here refined to distinguish labor-related and other, essentially machine- and power-related, capital costs; allowing 12.5% of labor costs to the former and obtaining the latter as a residual, machine-related capital costs work out to some (64.91 – 7.53) = 57.38 million lire in the rolling-stock industry, and (35.80 – 4.92) = 30.88 million lire in shipbuilding, or 1,654 lire per horsepower in the one and a virtually identical 1,647 lire per horsepower in the other.

For the other components of the engineering industry value added is estimated as the sum of labor costs, as estimated above, and capital costs. The capital costs of the large shops are derived from the estimates in Table F.02 on the basis of capital costs per worker (again set at .125 times total labor costs) and industry-specific capital costs per horsepower extrapolated from the rolling-stock and shipbuilding industries in 1911, using interindustry relatives drawn in the main from industrial-census data for 1938 (a year fortunately much like 1911, in the sense that metal consumption in general, and the railway rolling-stock and shipbuilding in particular, were setting new highs, *Sommario*, pp. 129-130, *Almanacco navale*, so the relative earnings of capital should not be visibly distorted by differences in cyclical circumstances).

The engineering industry is covered by the *Censimento i. e c.*, vol. 3, pp. 56-114. The census distinguishes "artisanal shops" and "industrial shops" (actually the "industrial shops" with more than 10 total workers, as the smaller "industrial" works were counted with the artisanal shops, p. 57; asymmetrically, however, a small number of the latter group had more than ten workers, p. 61); Table 1 alone reports industry-wide (employment) data, Tables 2 – 3 refer to the "artisanal" shops alone, and Tables 4 – 21 to the "industrial" shops alone (with annual data referred to 1937 for the former and 1938 for the latter, p. 57). The industry was further subdivided into no fewer than 56 activity-specific categories (78 – 133, including the here irrelevant categories 78 – 79, foundries, and 132, installation of equipment); unfortunately, as an economy measure, category-specific data were published only in Table 21 (sales), and all the other evidence was presented only for 17 subaggregates (of which one refers to categories 78 – 79, the other to 132 by itself).

Table F.03, panel B transcribes the census data for the 15 subaggregates relevant here. The first (unnumbered) columns report the 1938 census codes, and the content of the corresponding subaggregate. Col. 1 transcribes the corresponding 1911 census code, as reported in panel A, with the actual or at least dominant content of the subaggregate identified from the detailed, category-specific sales data in the *Censimento i. e c.*, vol. 3, Table 21; one notes in particular that category 133 (row 15) corresponds essentially to the armaments.industry. Cols. 2 – 6 refer to the (large) "industrial" shops: cols. 2 and 3 transcribe the (total) employment, and (installed) horsepower, reported in census Table 1, cols. 4 and 5 the wage bill, and value added, reported in census Table 15. Net (non-labor-related) capital costs per horsepower are estimated by deducting from value added the reported wage bill, a further 20% of the wage bill to allow for salaries (a ratio calculated allowing as in 1911 salaries of 200 lire per worker and a wage bill

of 1,080 lire per worker less 600 lire per woman, noting from census Table 4 that 93,000 of the industry's 651,000 total workers were females), and .125 times wages and salaries together to allow for labor-related capital costs. Dividing these residuals by reported horsepower (col. 3) one obtains the per-horsepower estimates transcribed in Table F.03, panel B, col. 6.

The corresponding estimates for 1911, Table F.03, panel A, rows 1 – 3 and 6 – 11, col. 6 are derived from these last, despite some troublesome discrepancies between the two censuses. One such is that the horsepower data refer in 1911 to those in use, and in 1938 to those installed; the share of those installed actually in use can well vary across industries and over time, but no evidence can here be brought to bear. Another is that the 1938 census presents the here requisite data only for the "transport equipment" group as a whole. In 1911 that group (categories 4.42 – 4.45) was thoroughly dominated by the rolling-stock and shipbuilding industries (Table F.01); in 1938, judging by the detailed sales data (*Censimento i. e c.*, vol. 3, p. 68), the automotive industries had grown to represent some 40% of the group, and aircraft another 20%, with the rolling-stock and shipbuilding industries accounting for just 10% and 25% or so of the total, respectively. Since the limitations of the published data preclude the here desirable disaggregation, the 1938 benchmark for "transport equipment" of 3,702 lire per horsepower (panel B, row 12, col. 6) is here simply considered analogous to a 1911 benchmark for railway vehicles and shipbuilding together of 1,650 lire (the rounded average of the figures in panel A, rows 4 and 5, col. 6); in principle, therefore, the capital-cost estimates for 1911 (panel A, rows 1 – 3 and 6 – 11, col. 6) are the corresponding figure estimated for 1938 (panel B, col. 6), multiplied by the resulting scale factor, or (1,650/3,702).

In practice, the procedure is often complicated by the need to reconcile the categories of the two censuses. In the case of the precious-metal-processing industry, there is a relatively direct correspondence between categories 111 – 112 in the later census (panel B, row 11) and categories 4.59 – 4.510 in the earlier one (panel A, row 10); the per-horsepower estimate in panel A, row 11, col. 6 is simply the corresponding 5,000-lire figure in panel B, row 11, col. 6, suitably scaled. In the case of the precision-equipment industries, the correspondence is less close: categories 105 – 110 in the later census (panel B, row 10) appear dominated by optical and precision instruments (4.51 in 1911); they further include weights and scales (4.52), clocks and watches (4.53), business machines (4.54), and medical equipment (4.58), but omit musical instruments (4.56). The approximation between this set of industries and those in 1911 census categories 4.51 and 4.56 is here deemed close enough, and the per-horsepower estimate in panel A, row 9, col. 6 is simply the 7,169-lire figure in panel B, row 10, col. 6, suitably scaled. For simplicity, this same estimate is attributed to the clocks-and- watches industry as well (panel A, row 10, col. 6); the *U.S. 13th Census VIII* points to similar capital costs per horsepower (net of .125 times wages and salaries) in "clocks and watches" and "optical goods," but the reported horsepower are primary horsepower only, and this evidence carries little weight.

Categories 80 – 96 and 123 – 126 of the 1938 census appear to correspond, together, to 1911-census category 4.41, which is in turn much the dominant element of 4.4 net of railway vehicles and shipbuilding. The present estimate for the (other) heavy equipment and machinery industry (panel A, row 6, col. 6) is accordingly obtained by calculating the aggregate horsepower, wage bill, and value added of the industries in panel B, rows 1 – 6 and 13 (using cols. 3, 4, and 5), deriving the combined capital cost per horsepower (3,723 lire, comfortingly close to the transport-equipment benchmark), and multiplying it, as before, by (1,650/3,702).

Panel A, row 7 covers the residual (ordinary) machinery industries covered in the 1911 census by categories 4.54, 4.55, 4.57, and 4.58; as is clear from the large-shop data in Table 1 the second of these was then very small, while the other three were about equally large. In the 1938 census, category 133 (row 15) corresponds closely, as noted, to 1911-census category 4.57 (armaments), and categories 97 – 98 (row 7) correspond to at least a large part of 4.58 (other

apparatus and instruments); those that correspond to categories 4.54 and 4.55 in 1911 were instead buried in broader aggregates. In 1938, moreover, the armaments industry was much the dominant element of rows 7 and 15 together, and their simple aggregation would attribute to the entire group the relative power-intensity that seems instead peculiar to the armaments industry. In the circumstances, to allow for the changing composition of the relevant group, the present estimate is obtained not by aggregating the underlying data, but by averaging the lire-per horsepower figures in panel B, col. 6, counting that in row 7 twice and that in row 15 once. The resulting weighted average equals 2,733 lire per horsepower; the estimate in panel A, row 7 is this last figure, again multiplied by (1,650/3,702).

Together, categories 99 – 104 of the 1938 census (panel B, rows 8 and 9) appear to correspond relatively closely to 1911-census category 4.3 net of smithing (4.31, 4.32), that is, to panel A, row 3. As in the case of panel A, row 6, col. 6, the present estimate in row 3, col. 6 is obtained by calculating the aggregate horsepower, wage bill, and value added of the relevant industries in panel B (rows 8 and 9, using cols. 3, 4, and 5), deriving the combined capital cost per horsepower (a relatively low 2,416 lire), and multiplying it, as before, by (1,650/3,702). This same figure is here inserted in row 8, col. 6, even though as noted above the 1938 census include weights and scales in the precision-equipment group, because in 1911 the industry was presumably producing, in the main, not the later standard automatic balances, but traditional steelyards and weights: not so much machinery, in essence, as common hardware.

The 1938 census included blacksmithing and other smithing in category 128, among the general trades in panel B, row 14 (127 – 131; 127 referred to vehicle repair, 129 to non-specialized machine shops, 130 to welding and the like, and 131 to the demolition of ships and other metal structures). These activities loomed large in the relevant group's artisanal shops (Table 2), but rather less so among its large "industrial" shops, at least judging from the sales figures in Table 21. On the other hand, for categories 127 – 131 those sales figures sum to far more than the value of production quoted in Table 15, with two possible implications. One is that the value and value added data in Table 15 (and panel B) exclude repair work (127 and much of 129), thus raising the share of smithing in the reported totals; the other is that the labor and horsepower counted in Table 1 (and panel B, cols. 2 and 3) exceed those relevant to the wage bill, and value added, in Table 15 (and panel B, cols. 4 and 5). The internal evidence does not clarify the point: the average wage (the ratio of the wage bill to the blue-collar workers listed in Table 4, discounting females by 50%) for the "general trades" is low but within the norm, suggesting that the data are in fact consistent. With some misgivings, therefore, the estimate in panel B, row 14, col. 6 is here simply scaled in the usual way, and, in the absence of further evidence, attributed to both blacksmiths and other smiths (panel A, rows 1 – 2, col. 6).

With the large-shop estimates of capital costs per horsepower thus in place (panel A, col. 6), aggregate capital costs are estimated by multiplying them by total horsepower (Table F.02, col. 3), and adding .125 times the total labor costs (Table F.03, panel A, col. 4). The resulting estimates are transcribed in Table F.03, panel A, rows 1 – 3 and 6 – 11. Total large-shop value added (panel A, col. 7) is then obtained directly as the sum of labor and capital costs (panel A, cols. 4 and 5).

Three comments may be added, specific to these large-shop estimates. The first is that the estimates of total capital costs (excluding the rolling-stock and shipbuilding industries) are sensitive to the assumed split between labor- and power-related capital costs, but not, in the aggregate, very much; replicating the above algorithm with all capital costs tied to horsepower, and none to labor, the sum of the capital costs attributed to the industries involved would fall by some 10%, from the near 116 million lire obtained here to 105 million lire, and the corresponding value added by 4%, from 293 million lire to 279. The second is that the census data point to a general rise in the horsepower-labor ratio from 1911 to 1938, inflated no doubt

by the shift from horsepower in use to horsepower installed, but surely real enough; even assuming that the horsepower in use were just 60% of those installed (well under the ca. 75% ratio suggested by the metalmaking data, above, section E01.02), average horsepower per worker practically doubled, from (126.4/229.3), or ca. .55 (from Table F.02, cols. 2 and 3), to .6(1,054.0/606.2), or ca. 1.04 (from Table F.03, panel B, cols. 2 and 3). The third is that the census data (and the present estimates) suggest that the share of labor costs in value added was generally higher in 1911 than in 1938, averaging some 56% in 1911 (from Table F.03, panel A, separately aggregating cols. 4 and 7), and just 47% in 1938 (from panel B, 1.2 times the aggregate of col. 4 divided by the aggregate of col. 5). Together, these last two considerations point to the substitution of machinery for labor as technical progress reduced the relative cost of equipment (in efficiency units).

The census of 1938 reports data for the other, "artisanal" operations, subaggregated exactly as for the large shops. For these it again reports, by industry – or by region, but not both – aggregate (and subordinate) employment and (installed) horsepower, the wage bill, and the value both of the materials consumed and of the products sold, but not value added (*Censimento i. e c.*, vol. 3, pp. 59, 61). Two aspects of these data bear comment. One is the remarkable variation in the mean wage by region, with the highest over four times the lowest (and a general decline from North to South, but with Latium aligned with the North); average wages also vary across industries, but rather less, with the result that differential skill premiums cannot in fact be estimated (and used to improve the present estimates of labor costs). The other is that the census seems to provide all the elements needed to calculate value added, labor costs, and capital costs in the census year, and thence to derive the corresponding capital-cost estimates for 1911 essentially as was done above for the large shops; but that is not in fact the case. One problem of course is that the reported wage bill refers to only a minority (ca. 30%) of the actual workers, so that the calculation of total labor costs is subject to considerable uncertainty; but the more fundamental difficulty seems to be in the very significance of the reported data, which explains why value added figures were not published at all..

The reported aggregate employment and calculated value added figures (the value of the products sold less that of the materials consumed) are transcribed in Table F.03, panel B, cols. 7 – 8; and their anomalies are immediately apparent. In row 14, which refers predominantly to smithing (Table 3), for example, calculated value added per worker is under 2,900 lire, well below not only the equivalent large-shop figure of 8,100 lire, but even the large-shop wage bill per (total) worker, near 4,400 lire. The main reason for this peculiar result, and the apparent reason the census did not itself present value added figures for the "artisanal" shops, is that the reported "value of goods sold" seems to be exactly that (see the reproduction of the artisanal-shop census form in *Rilevazioni statistiche*, vol. 8, p. 143): the value of the artisanal shops' repair services was not recorded at all (whereas they apparently were in the case of the industrial shops, *Censimento i. e c.*, vol. 3, pp. 73-106), and if so the aggregate value added that actually corresponds to the reported labor and horsepower could not and cannot be calculated at all. It bears notice that the (here irrelevant) foundries did not engage in repair work, and within that group the calculated value added per worker of the artisanal works is practically identical to that obtained for the industrial works (itself, oddly, fractionally greater than the reported figure, p. 67). One also notes that in row 15 (armaments) the calculated value added per worker is an impossibly high 36,500 lire, against 10,400 in the corresponding large shops; and a mere typographical error is to be excluded, as the disaggregated figures in Table 3 sum to the reported totals.

In the face of these difficulties, the capital costs of the small shops are here estimated, exactly like those for the large shops, as .125 times the estimated total labor cost, plus their aggregate horsepower (Table F.02, cols. 6 plus 9) simply multiplied by the estimate of net

capital cost per horsepower in the corresponding large shops (Table F.03, panel A, col. 6). The resulting figures are transcribed in Table F.03, panel A, col. 9. As before, small-shop value added (col. 10) is obtained as the simple sum of labor costs (col. 8) and capital costs (col. 9). Aggregate value added (col. 11) is in turn the sum of the separate estimates for large shops (col. 7) and small shops (col. 10) Summing finally over the elements of col. 11 one obtains the industry-wide aggregate of 827 million lire; of this total, scarcely one quarter can be traced to the well-documented shipbuilding and railway-vehicles industries.

F02. Seagoing vessels

F02.01 Introduction

In the *ISIC*, the fabricated metal products, machinery and equipment division (38) includes the manufacture of transport equipment (major group 384); group 3841 covers the building and repairing (and eventual breaking-up) of all ships and boats, save only rubber boats, and the manufacture of specialized marine engines and ship parts. In the 1911 *Censimenti* the construction of machinery and transport equipment is grouped in *classe* 4.4; *sotto-classe* 4.44 includes shipyards and boatyards, but the non-yard production of wood ships and boats is separately considered in *sotto-classe* 3.16 (part of the broad wood-working sector, *classe* 3.1). Unlike the *ISIC*, too, the 1911 *Censimenti* would appear to include in shipbuilding only the installation of otherwise complete subassemblies: the descriptions of *sotto-classi* 4.41 (structural components and general machinery) and 4.57 (firearms and the like) mention engines and cannon, respectively, without separating out those destined for shipboard use.

Here, the shipbuilding component of the engineering sector is defined much as in *sotto-classe* 4.44 of the 1911 *Censimenti*. On the one hand, it includes the installation, but not the original construction, of complete subassemblies. On the other, it includes the new construction and maintenance of seagoing vessels, and excludes the new construction and maintenance of inland or inshore craft; one presumes that the former are in general the larger, yard-built vessels (of wood or metal), and the latter the smaller ones (of wood) that were typically produced off-yard.

This industry is here divided into four parts that reflect the twin distinctions between new construction and maintenance on the one hand, and between naval and merchant ships on the other.

The new construction of seagoing naval vessels is represented by separate series for the following types: armored frigates; frigates and corvettes; battleships; armored cruisers; colonial, protected, and scout cruisers; despatch boats, scouts, and torpedo cruisers; destroyers; submarines; torpedo boats; gunboats; tugs; bulk transports; and other auxiliaries. These series are built up from estimates of the annual displacement tonnage constructed, from laying-down to completion, for each naval vessel built in Italy; the main source is the collection of volumes on the ships of the Italian navy recently published by the Ufficio storico della marina militare, while a variety of other sources provide the complementary information on exports. These (13) type-specific displacement-tonnage-constructed series are aggregated with 1911-price estimates of value added per displacement ton, themselves derived from evidence on the cost of completed ships, materials' prices and input-output coefficients, and the cost of major subassemblies.

The construction of seagoing merchant vessels is represented by separate series for sail- and engine-powered vessels. Both series are obtained from annual data on register tonnages launched, with tentative corrections to reduce heterogeneity over time; the corrected tonnage-launched series are then simply shifted to approximate current construction. These two register-tonnage-constructed series are also aggregated with 1911-price estimates of value added per displacement ton derived from evidence on the value of completed ships, materials' prices and input-output coefficients, and the cost of major subassemblies.

The maintenance series are altogether more tentative. In the case of naval vessels, an estimate of maintenance value added in 1911 is derived directly from (somewhat ambiguous) public budget data, and extrapolated to other years in proportion to the displacement tonnage of the fleet to be maintained, allowing for the armor of protected vessels and the cargo of bulk transports.

In the case of merchant vessels, finally, the maintenance estimates again distinguish

between sail- and steam-powered vessels. Value added in 1911, per register ton, is extrapolated from the naval-vessel estimates to merchant steamers, and from these to sailing vessels. Steamer maintenance is then divided into two components of comparable weight: one refers to the maintenance associated with the (partly documented) throughput of beaching slips and dry-docks, which served foreign ships as well as Italian ones, the other to the residual maintenance of Italian ships alone, indexed by the aggregate tonnage of the steamer fleet. The maintenance of sailing ships is similarly indexed by the total tonnage of the fleet in service, with what turn out to be very minor corrections for imports and exports (maintenance abroad of Italian ships, and maintenance in Italy of foreign ships).

F02.02 New construction of naval ships and boats

Aggregate measures of naval vessel construction, as such, appear to be extremely limited. Annual displacement-tonnage-launched totals are available for 1892 ff. in the *U.S.B.N. Report* (e.g., *1894*, p. 219); but these figures cover only warships over 100 tons, and do not of course reflect the very different construction times of different vessels. On the other hand, there is abundant information on naval fleets, and on individual vessels, from which aggregate construction can be estimated with a reasonable degree of confidence. The type-specific annual aggregate construction estimates in Table F.16 are accordingly built up by summing over the appropriate vessel-specific estimates in Tables F.04 – F.15.

These estimates simply distribute each vessel's displacement tonnage over its period of construction at an even rate from laying-down to completion; the resulting figures are intended to measure the flow of construction-yard services, and need not correspond to the "percent completed" figures that occasionally appear in the literature (the latter measure actual accrual of weight or value, without separating the contribution of such major purchased subassemblies as engines and armament).

In principle, such estimates are provided for every Italian-built naval vessel, including exports and auxiliary vessels as well as fighting ships for the Italian navy; in practice, the Italian fighting fleet is relatively well documented, but both exports and auxiliaries are somewhat uncertain. Information on exported vessels is gleaned from a variety of sources (*Marina mercantile 1891* ff.; *Movimento commerciale 1897* ff.; *Brassey's*; *Jane's*; Fraccaroli, 1970), which mention exported fighting ships only from the 1890s, and hardly mention exported auxiliaries at all (two vessels only, 1911 ff.); systematic or random omissions are certainly possible, but on general grounds one can reasonably assume that they were not significant. In the case of Italian naval auxiliary vessels, on the other hand, the main difficulty stems from the possible second-hand acquisition of vessels initially built for the merchant marine (and therefore counted as such below); the present list can thus err by excess as well as by default. Information on a vessel's displacement and construction period is at least partially available in a wide variety of sources, which often disagree in detail (especially on displacement tonnages, which can be measured according to a variety of conventions, and sometimes vary with alterations over the ship's life). Contemporary sources on the Italian navy include the fleet lists in the *Annuario* (e.g., *1884*, pp. 394 ff.), the *Italia economica 1873* (pp. 204 ff.), the *Annuario navale* (e.g., *1897*, pp. 409 ff.), and the *Rendiconto consuntivo* (e.g., *1914-15*, parte II, pp. 63 ff.) as well as *Brassey's* and *Jane's* for the later period; retrospective ones include Fraccaroli (1970) and, most usefully, the volumes of the *Navi d'Italia* series published by the Ufficio storico della marina militare: *Navi di linea*, *Sommergibili*, *Torpediniere*, *Incrociatori*, *Cacciatorpediniere*, *Esploratori*, and *Almanacco navale*. The latter series, based directly on naval records and compiled on consistent criteria, is here accepted as authoritative; Fraccaroli (1970) is considered a close second (where these two sources overlap, they typically correspond exactly, and many of what differences there are appear to be a matter of transposed digits); and early sources are

quoted only as a last resort.

Specifically, Tables F.04 – F.15 are constructed as follows. Italian naval ships are listed first, with exports second, by country; each list is alphabetical (by the name given the vessel at commissioning; earlier or later names are indicated in brackets), without distinguishing between titles, first names, or family names. The displacement figures are for the vessel at normal operating loads; for the sake of consistency, exported vessels are normally attributed the same displacement as their Italian sisters (if any), rather than the typically different figures in the sources. Dates are in the order day-month-year; the date of completion is that given in the sources for either completion or commissioning (these normally appear to be equivalent). The source of the displacement tonnage and construction dates is identified, vessel by vessel; where more sources are cited, the later are normally relied on only for information lacking in the first. The annual construction estimates are obtained by distributing the displacement tonnage over the indicated construction period, measured to the nearest half-month in both the initial and terminal year (if the rounding off of fractional tons in the annual figures introduces an error in the vessel's cumulative total, the initial and terminal-year estimates are adjusted to eliminate it: not to pursue spurious accuracy, but to provide a check on the similarly unrounded series in Table F.16). Where the dates are incomplete, the calculations enter the 15th of the month for the missing day, June 30 for the missing day and month, and an *ad hoc* estimate (based on the building times of comparable vessels) for a date that is missing altogether.

Table F.04 lists the armored frigates, frigates and corvettes; these were traditional fighting ships, wood-built and fully rigged (albeit with auxiliary engines). The *Re Galantuomo* is excluded, even though the *Navi di linea* indicates 1861 as the completion date: it was launched in 1850 as a sailing vessel, and appears to have been returned to the yard in 1858 to be fitted with an auxiliary engine (*Navi di linea*, pp. 85-86); this is here considered improvement (assimilated to major maintenance, section F02.04 below) rather than new construction. Following the *Incrociatori*, pp. 133 ff., the transition vessels *Cristoforo Colombo*, *Flavio Gioia*, *Amerigo Vespucci*, and *Savoia* are here considered cruisers (Table F.07); in fact, the *Colombo* was wood-built and fully rigged, and the *Savoia* alone was a metal-hulled vessel with no more than auxiliary sails.

Table F.05 lists the battleships. While none were built for export, two were rebuilt in Italy for foreign navies: the Portuguese (coastal battleship) *Vasco de Gama* of 2,972 tons, apparently rebuilt in 1902-03 (*Brassey's 1913*, p. 265, *Jane's 1919*, p. 433), and the Turkish *Messoudieh* of 9,120 tons, apparently rebuilt in 1901-02 (*Brassey's 1913*, p. 274, *Jane's 1914*, p. 413; the other Turkish battleships rebuilt by Ansaldo were actually rebuilt in Turkey, *Jane's 1905-06*, p. 353). These are included here, with their displacement reduced by 50% before being distributed over the period of construction.

Table F.06 lists the armored cruisers. The Greek *Averoff* was a sister of the *Pisa* (*Brassey's 1913*, pp. 252-254). The Japanese *Kasuga* and *Nisshin* were actually transferred from Argentina, who had named them *Rivadavia* and *Moreno*; they appear in the *Movimento commerciale 1904* (p. 232) under their Argentine names, but Fraccaroli (1970, p. 31) suggests they were transferred to Japan before they were exported. The Spanish *Colón* was apparently still incomplete when lost in the battle of Santiago (July 3, 1898; Fraccaroli, 1970, p. 31); it appears in the *Movimento commerciale 1897* (p. 158) at a value that is 96.5% of that quoted the following year for the Argentine *Pueyrredon* (*Movimento commerciale 1898*, p. 166; note that the values of the *San Martín* and the *Belgrano* both appear to omit the first digit, undervaluing the total by 20 million lire). The corresponding construction estimates assume the *Colón* was exported 96.5% complete (equivalent to 7,093 displacement tons) in December 1897.

Table F.07 lists the colonial, protected, and scout cruisers, including the transition *Colombo* class, the first of which was wood-built (the normal displacement of the first *Colombo*

is estimated as 92% of the reported full-load figure, by analogy to the *Gioia* and *Vespucci*; *Incrociatori*, p. 133). Fraccaroli (1970, p. 40) indicates that the *Calabria* had a zinc-sheathed timber hull; in fact, it appears to have had a zinced timber sheathing (to reduce fouling in colonial waters) over an otherwise ordinary metal hull (*Jane's 1914*, p. 305). The Portuguese *Adamastor* is included here, while the smaller Moroccan *El-Baschir* (later the Colombian *Almirante Lezo*) is included with the torpedo cruisers in Table F.08, essentially on the basis of size and appearance (see the illustrations in *Jane's 1914*, pp. 399, 447; the *Marina mercantile 1897*, pp. 36-37, identifies both as armored cruisers, *Brassey's 1895*, p. 284, *1913*, pp. 265, 281, identify the *Adamastor* as a cruiser and the *El Baschir* as a cruiser or torpedo cruiser, and the *Movimento commerciale 1897*, p. 158, *1899*, p. 210, identify the *Adamastor* as a cruiser and the "*Bascyr*" as a colonial ship). The Mexican *Progreso* is also identified as a cruiser by the *Movimento commerciale 1907*, p. 296, but other sources (*Brassey's 1908*, p. 166, *Jane's 1914*, p. 451) suggest that it was essentially an armored merchantman rather than a true naval cruiser; it is here accordingly included with the gunboats in Table F.12.

Table F.08 lists the scouts and torpedo cruisers (and the "torpedo launcher" *Pietro Micca*). The normal displacement of the *Barbarigo* and the *Staffetta* is estimated as 1.19 times the quoted empty displacement, by analogy to the *Colonna* (*Esploratori*, pp. 151, 165). The launch and completion dates of the *El-Baschir* are taken to be those suggested by the *Marina mercantile* (*1897*, pp. 36-37) and *Movimento commerciale* (*1899*, p. 210); the 1892 construction date quoted by *Brassey's* (*1895*, p. 284, *1913*, p. 281) and *Jane's* (*1914*, p. 447) is here taken to refer to laying-down.

Table F.09 lists the destroyers, including the early scout torpedo boats that were essentially proto-destroyers (*Cacciatorpediniere*, p. 4). No destroyers appear to have been exported (the *Ascaro*, laid down to Chinese order, was taken over by the Italian navy); the *Movimento commerciale 1906* (p. 296) refers to seven destroyers for Turkey, but all the available descriptions suggest that these were in fact enlarged *Condore*-class torpedo boats (see below). The *Espero* and *Zeffiro* are attributed a building time of 3.5 years, against 3 years for the *Nembo* and *Turbine* and 4 years for the *Aquilone* and *Borea* (all of the same class: *Cacciatorpediniere*, p. 80); the *Folgore* and *Saetta* are also assumed to have taken 3.5 years to build.

Table F.10 lists the submarines; the quoted measures refer to surface displacement. Information on the *Delfino* is taken from Fraccaroli (1970), rather than from the *Sommergibili*: this was an experimental craft used extensively by the builders before being commissioned, and the Navy's record of its early life appears to be relatively poor. Information on exports is spotty, and particularly uncertain in the case of Brazil's *F* series. Fraccaroli (1970, p. 118) states that these were the last of the Italian *F* series first laid down in 1915, but *Brassey's* (*1912*, p. 253, *1915*, p. 174, *1924*, p. 467) and *Jane's* (*1914*, p. 439, *1919*, p. 462) both suggest an earlier date, and the early references can hardly have anticipated later events. The FIAT-San Giorgio advertisement in *Jane's 1914* (p. xxxv) indicates that submarines had been supplied to the American, Brazilian, British, Danish, German, Italian, Portuguese, Russian, and Swedish navies; while the German and Russian boats appear to be those listed in Table F.10 as the *Balilla* and *Argonauta*, respectively, the British and American boats appear to have been the *S* class and the *G4*, respectively, built in those countries to FIAT (Laurenti) design (*Jane's 1914*, pp. 92, 193; *Brassey's 1913*, pp. 287, 302). All the exported submarines are assumed to have been built in 27 months.

Table F.11 lists the torpedo boats. The normal displacement of the *Pellicano* is estimated as 93% of the reported fully-loaded displacement, by analogy to the *Gabbiano* (*Torpediniere*, pp. 163, 205). The *Arturo*, *Clio*, *Lira*, and *Vega* are assumed to have been built in 36 months; the *Acquario*, *Cassiopea*, *Castore*, *Cigno*, *Idra*, *Polluce*, *Procione*, *Regolo*, *Rigel*,

Spica, *50T-55T*, *105S*, *132S-136S*, *139S-141S*, and *145S-154S*, in 24 months. The Turkish boats are identified as in *Brassey's 1911*, p. 282; different transliterations may be found in other sources (e.g., *Jane's 1906-07*, p. 355, *1914*, p. 418, *1919*, p. 593). These boats also are assumed to have been built in 24 months, with the date of completion in (the middle of) the reported year launched (note the reference to seven "destroyers" for Turkey in the *Movimento commerciale 1907*, p. 296).

Table F.12 lists the gunboats (built as such; the *Scilla*, *Cariddi*, *Ammiraglio Magnaghi*, *Castore*, and *Polluce*, apparently first built as unarmed auxiliaries, are listed elsewhere). The armored, powered floating batteries *Guerriera* and *Voragine* are also included here; the *Confienza*, *Curtatone*, *Montebello*, *Palestro*, *Varese*, and *Vinzaglio*, all launched in 1860, are instead taken to have been completed (or practically so) before Unification (*Almanacco navale*, pp. 678-679). The displacement of the armored vessels *Audace*, *Cappellini*, *Faà di Bruno*, *Guerriera*, *Risoluta*, and *Voragine* is reduced by 20% before being distributed over the period of construction; the data are is taken from the *Almanacco navale* (pp. 706-707; see also p. 696), but earlier starting dates (and heavier displacements for the *Guerriera* and *Voragine*) appear in the *Italia economica 1873*, pp. 204-205. The *Provana* and *Veniero* are allowed a construction period of three years; a year-end completion is assumed for the *Audace*. Information on exports is particularly uncertain. *Brassey's* mentions two Bulgarian "armored gunboats for the Danube," of unspecified name and size; these are simply noted in *1895* (p. 284), described as "building" from *1896* (p. 314) to *1902* (p. 272), as "completing" from *1903* (p. 328) to *1910* (p. 272), and as "built" from *1911* (p. 262). Such a long construction period is most unlikely; the estimated construction dates reflect the assumption that such information about minor fleets was only sporadically revised. The Mexican vessels include the cruiser-transport *Progreso* as well as the *Bravo* and *Morelos*; for all three, the export date is here taken to be the date of completion (*Movimento commerciale 1905*, p. 272, *1906*, p. 296). Finally, *Brassey's 1899* (p. 342) to *1901* (pp. 370-371) mention a Moroccan 450-ton gunboat "completing," with a second laid down; but later issues (e.g., *1902*, p. 272) suggest that this second vessel came to naught. The Mexican and Moroccan gunboats are assumed to have been built, like the *Progreso*, in two years.

Table F.13 lists the tugs, excluding of course those bought from merchant marine. The *Rosetta*, named in the *Annuario 1887-88*, p. 661, is here identified with the *N.18* listed in the *Almanacco navale*, pp. 832-833 (of identical dimensions), bought used. The *Porto Torres*, launched in 1891 and ostensibly not completed until 1912 (*Almanacco navale*, pp. 816-817), is also taken to have been bought used. The Portuguese *Lynce*, described as a "fishery protection vessel" in *Brassey's 1913*, p. 265, is included here; it is mentioned in the *Marina mercantile 1911*, pp. 78-79 as a steamboat of 105 gross tons, 33 net tons, and 300 indicated horsepower (suggesting that it was in fact a tug); it is here attributed a displacement of 200 tons (compare the *Porto d'Anzio*, *Marina mercantile 1914*, pp. 78-79). Where the construction period is unknown, it is assumed equal to two years; the *Murano* is assumed to have been essentially completed within 1874, the *N.14* to have been laid down in mid-1887.

Table F.14 lists the bulk carriers (water carriers, collier/oilers, and barges). Where the construction period is unknown, it is again assumed equal to two years. The *Simeto* is assumed to have been laid down with the *Crati*; the *Betta N.10*, *Betta N.11*, *Betta N.12*, and the *Viterbo* are assumed to have been sisters, and contemporaries; the *Malaussena* is assumed to have been sister to, and contemporary of, *Betta N.7*.

Table F.15 lists the remaining auxiliaries. The *Miseno* is attributed the same construction period as the *Palinuro*; the *Polluce* and *Vulcano* are allowed construction periods of three and two years, respectively. The Brazilian submarine tender *Ceara* (*"Caera"* in the early *Brassey's* and *Jane's*) is also included here; its construction dates are estimated from *Brassey's 1913*, p. 289 ("to be built") and *1915*, p. 195 ("has been built").

The 1911 unit value added estimates corresponding to the above output figures are presented in Table F.18, col. 2; they are derived from the sample estimates in Table F.17, col. 12, themselves obtained as follows. The *Rendiconto consuntivo 1914-15*, parte II, pp. 63 ff. lists the vessels of the Italian navy (on June 30, 1915) and indicates their value (both current and when new). The value data are disaggregated into hull and engines on the one hand, and weapons and munitions on the other (the latter include electrical and underwater equipment; but the pattern of values across armed and unarmed vessels suggests that these were relatively unimportant). The when-new values of the selected sample of vessels building in or near 1911 are transcribed in Table F.17, cols. 9 and 10; value added (col. 11) is obtained as the reported value of the hull and engines (col. 9) less the estimated value of the corresponding materials (including purchased subassemblies; col. 8), plus 15% of the reported value of weapons and munitions (col. 10). Value added per ton (col. 12) is the ratio of value added (col. 11) to normal displacement (col. 3, from Tables F.04 – F.15); and the ratio of value added to value (col. 13) is the ratio of col. 11 to the sum of cols. 9 and 10.

The estimate that the labor and capital costs of installing the weapons and munitions were 15% of the latter's total (installed) value is based on the Royal-yard ship-construction figures in the *Rendiconto consuntivo* (e.g., *1908-09*, parte I, pp. 1839-1845; *1913-14*, parte II. pp. 155-159). From 1908-09 to 1913-14, the reported cost of weapons and munitions for new ships includes a total 50.2 million lire for materials and 3.1 million for wages. Overhead costs (presumably salaries and capital costs) are allocated to weapons and munitions only through 1910-11; from 1908-09 to 1910-11, these total 1.8 times the corresponding wage bill, suggesting an aggregate overhead of perhaps 5.6 million lire from 1908-09 to 1913-14. The ratio of wages and overhead (8.7 million lire) to total cost (58.9 million lire) in 1908-09 to 1913-14 is the 15% figure used in the present calculations. This estimate is relatively uncertain: the ratio of materials to wages is quite variable from year to year, and overhead costs are obviously arbitrary within fairly broad limits. On the latter point, one notes the sudden increase in the reported total ship-construction overhead costs from about 2 million lire p. a. in 1910-11 and preceding to about 6 million lire p. a. in 1911-12 and following, total expenditures remaining at 30 to 40 million lire p. a. Because of this and other changes noted below, the share of value added in total value shows a parallel jump (from .2 to .4), suggesting that (some of) the reported values of Royal-yard-built ships may be seriously distorted. Of the ships in the present sample, however, most were built in private yards (Table F.17, col. 2; builders are identified, e.g., in Fraccaroli, 1970), and the few built in Royal yards do not appear to be outliers (cols. 12 and 13; overall, again according to the *Rendiconto consuntivo*, naval ship construction costs from 1908-09 to 1913-14 averaged 56 million lire p. a. in private yards, against 35 million lire p. a. in the Royal yards).

The hull-and-engines materials cost estimate in col. 8 is itself obtained as the sum of the engines and hull tonnages (cols. 5 and 7), weighted by estimated costs per ton. Engines are assumed to cost 2,500 lire per ton, from the import price (plus tariff) of marine engines in the *Movimento commerciale 1911*. Hulls are attributed a unit materials cost of 365 lire per ton for auxiliaries, and 900 lire per ton for fighting ships (other than gunboats, allowed an intermediate figure of 600 lire per ton). The 900 lire figure allows 800 kg of ordinary hull metal (including 5% waste) at 240 lire per ton (for relatively high-quality steel), 230 kg of ordinary equipment at 2,500 lire per ton, 10 kg of instrumentation at 10,000 lire per ton, and 33 lire for fuel and other costs; the unit prices are congruent with those (gross of tariff) in the *Movimento commerciale*, and the weight distribution with that in Breyer (1973), p. 378. Fortunately, armor plate also appears to have cost close to 900 lire per ton (see the note to the Terni figures in the *Rivista mineraria 1911*, pp. XXXII-XXXIII), so the relative weight of armor in the hull (reaching 25% of the empty displacement on the *Cavour*-class battleships: *Navi di linea*, p. 269) is here a

matter of indifference. The 365-lire figure allows 915 kg of ordinary hull metal (including 5% waste) at 225 lire per ton (for ordinary steel), 95 kg of fabricated metal fittings at 750 lire per ton, 40 kg of auxiliary engines at 1,470 lire per ton, and 29 lire for fuel and other costs; the unit prices are again congruent with those (gross of tariff) in the *Movimento commerciale*, and the weight distribution with that estimated for merchant vessels in section F02.03 below.

The weights of the engines and hull (Table F.17, cols. 5 and 7), in turn, are estimated *ad hoc*, ship by ship. The engines' weight is estimated from the reported horsepower, allowing (following *Brassey's 1913*, p. 98) 55 kg/hp for battleships, 36 kg/hp for light cruisers, 19 kg/hp for destroyers, and analogous coefficients for other vessels. The weight of the hull is instead obtained as a residual, deducting the weight of engines and weapons from the displacement of the empty vessel (cols. 4 – 7). The latter displacement figure is sometimes found in the sources, but is more often estimated by deducting the fuel (and cargo, where relevant) load, and an allowance for other stores, from the normal displacement. Unless otherwise indicated, the weapons' weight is estimated by dividing the corresponding value figure in col. 10 by a standard coefficient (7,560 lire per ton) obtained from the reported weapons-value and weight figures (cols. 10 and 5) for the *San Marco* (see below).

The figures for individual vessels are to be annotated as follows. The *Navi di linea*, pp. 260-261, report the empty weight and power (32,000 hp) of the *Dante Alighieri*; the weapons' weight is estimated as 92% of that of the *Cavour*-class battleships (armed with thirteen 12-inch guns to the *Dante Alighieri*'s twelve). The *Cavour*-class ships' empty weight and power (31,000 hp) are from the *Navi di linea*, pp. 265, 269; the estimated engine weight is very close to the figure in Breyer (1973), p. 378. The latter source indicates 3,317 tons as the weight of weapons and munitions together; weapons are here estimated to account for 85% of that (the corresponding figure for the *San Marco*, from the data in the *Incrociatori*, p. 351, is 77%, but the battleships' heavier guns presumably had a smaller endowment of munitions, in view of their lower rate of fire; Fraccaroli, 1970, pp. 281-282). The values cited for the *Cavour*-class ships (cols. 9 and 10) are an average of the very similar figures reported for the *Giulio Cesare* and the *Leonardo da Vinci*; it is not clear why these ships (and especially their weapons) were quite so much cheaper than the *Dante Alighieri* (2,200 v. 2,800 lire per normal displacement ton). The *Incrociatori*, p. 351, provides information on the weights of the *San Marco*. The present empty weight is the normal displacement less the reported weight of coal (700 tons) and munitions (378 tons) and an allowance of 215 tons for engine water (leaving 1,100 tons for the 23,000-hp engine itself) and 7 tons for other stores; the weapons' weight is the reported figure. The empty displacement of the *Quarto* (*Incrociatori*, p. 365) is the normal displacement less the reported 450 tons of fuel and an allowance of 250 tons for other stores; the engine weight is based on the reported horsepower (25,000 hp, at 36 kg/hp). The empty weight of the *Indomito* (*Cacciatorpediniere*, p. 107) allows the reported 100 tons for fuel and an estimated 72 tons for other items; the engine weight allows 19 kg/hp for the reported 16,000 horsepower. The empty weight of the *Argo* is assumed to be 80% of its normal displacement; the engines (totaling 950 hp: *Sommergibili*, p. 45) are assumed to be relatively heavy, in view of the relatively low specific power of diesel and especially electric motors; and the weight of the weapons is considered negligible. The weights of the *Nautilus* class (*Sommergibili*, p. 53) are estimated altogether similarly; the values in cols. 9 and 10 are the average of those reported for the *Nautilus* and the *Nereide*. Again, it is not clear why these boats were so much cheaper than the *Argo* and her sisters (3,500 v. 5,200 lire per normal displacement ton). Comparing the submarines and the battleships, one notes that the cheaper vessels were, in both cases, the later ones; but the cheaper submarines were the ones built in smaller numbers and in Royal yards, while the cheaper battleships were those built in larger numbers in private yards. The *PN* series torpedo boats (*Torpediniere*, p. 209) are attributed an empty weight of 103 tons, estimated as

95% of the reported standard displacement (108 tons); the engine weight allows 19 kg for each of the reported 3,200 horsepower. The value figures in cols. 9 and 10 are the average of those reported for the *1PN – 4PN* and *6PN – 9PN*. The empty weight of the *Caboto* (Fraccaroli, 1970, p. 167) allows 100 tons of coal (*Brassey's 1913*, p. 256) and 177 tons of other stores (a relatively large figure, suggested by its appearance and colonial-service destination: *Jane's 1919*, p. 364); the engine weight allows 30 kg/hp for the reported 1,200 hp. The *Titano* (Fraccaroli, 1970, p. 239) was a tug armed with two 3-inch guns. The empty weight allows 160 tons of coal (*Jane's 1919*, p. 368) and 88 tons of other stores, and the engine weight allows 50 kg/hp for the reported 1,971 hp. The empty weight of the *Adda* (Fraccaroli, 1970, p. 237) is the normal displacement less the reported water capacity (120 tons) and an estimated 20 tons of other stores, and the engine weight allows 50 kg/hp for the reported (approximately) 165 hp. The *Bronte* (Fraccaroli, 1970, p. 231) was a fleet collier/oiler armed with four 3-inch guns. Its empty displacement is the normal displacement less the reported 6,000-ton cargo, 550 tons of fuel (*Jane's 1919*, p. 366), and an estimated 440 tons of other stores; the engine weight allows 50 kg/hp for the reported 4,000 hp. The reported volume (4,769 gross tons) and the value added estimate (1,315,000 lire) yield a unit value added figure of 275 lire per gross ton, compared to 325 lire per gross ton estimated for engine-powered seagoing merchant vessels in section F02.03 below; part of this difference appears attributable to this vessel's particular size and configuration, and part to its actual construction date (mostly 1904-05, when prices were rather lower than in 1911). The *Eridano* (Fraccaroli, 1970, p. 237) was a high-powered water carrier armed with two 47-mm. guns. Its empty displacement is the normal displacement less the reported water capacity (400 tons), 120 tons of fuel (*Jane's 1919*, p. 368), and an estimated 80 tons of other stores; the engine weight allows 50 kg/hp for the reported 1,200 hp.

Overall, the pattern of value added estimates seems quite reasonable; one notes in particular that value added per normal displacement ton is lowest for relatively large, specialized bulk transports, progressively higher for other bulk transports, tugs and gunboats, and armored vessels, and highest for the small flotilla boats. The ratios of value added to value -- rising from about .4 for the heavily armed capital ships through .5 – .6 for other surface fighting ships and auxiliaries to a peak of .7 or more for submarines -- also appear to be acceptable. Given the preponderant role of capital ships (Table F.18), these figures agree well with the aggregate figures for new construction in public dockyards in the *Rendiconto consuntivo* for 1911-12 to 1913-14 (annual average wages and overhead: 15 million lire; average total expenditure, 37 million lire). Curiously, however, the corresponding figures for 1908-09 to 1910-11 yield a value added/value ratio of just .2 (annual average wages and overhead, 7.5 million lire; average total expenditure, 33 million lire); the reason for this shift (traceable to an increase in the wage bill and overhead on the one hand, and a decline in the materials cost of armaments on the other) is far from clear.

The final estimates of type-specific 1911-price value added per displacement ton in Table F.18, col. 2 are obtained from the sample values in Table F.17, col. 12, as follows. The figures in rows 4, 5, 7, 9, 10, and 11 are simply the sample values obtained for the corresponding single vessel or class in Table F.17, rounded to the nearest 50 lire per ton. The figure in row 3 is a weighted average of the estimates for the *Dante Alighieri* and *Cavour*-class ships, the weights (.24 and .76) corresponding to the estimated relative tonnages built in 1911 (Table F.05). The figure in row 8 is a similar weighted average of the estimates for the *Argo* and the *Nautilus*-class boats, with weights (.91 and .09) corresponding to the estimated relative tonnages of the two classes built in 1911 (Table F.10). The figure in row 12 is rather more tentative. The estimates for the *Adda*, *Bronte*, and *Eridano* are relatively far apart; the *Adda* and *Bronte* were built respectively a few years after, and before, the desired date (Table F.14); and the *Eridano* was technically not representative of its class. Overall, the *Bronte* and its sister

Sterope accounted for about two thirds of the entire tonnage of the bulk transports; weighting the *Bronte* estimate by .66 and the *Adda* and *Eridano* estimates by .17 each, one obtains the overall 200-lire-per-ton figure used here for the class as a whole. On the other hand, the *Eridano* does appear to be fairly representative of at least the significant "other auxiliaries" in Table F.15; the corresponding value added estimate is accordingly entered in Table F.18, row 13. The estimate in row 6 is even more tentative, since ships of that type were not built after 1900 (at least not until the *Pepe*, *Poerio* and *Rossarol* were laid down in 1913; but their final cost would appear too influenced by war-induced price changes to be useful here). A 1911-price estimate for this type is accordingly obtained indirectly, by rough analogy to those for neighboring types. The protected cruiser *Puglia*, building in 1899, had a value (when new) that works out to 2,058 lire per ton; applying the appropriate ratio of value added to value (.48) from Table F.17, one obtains a 1900-price value added estimate of 1,000 lire per ton (against 1,350 in 1911). The destroyer *Borea*, building in 1900, had a value (when new) that works out to 3,739 lire per ton; applying the appropriate ratio of value added to value (.55) from Table F.17, one obtains a 1900-price value added estimate of 2,050 lire per ton (against 2,000 in 1911). The torpedo cruisers *Agordat* and *Coatit*, completed in 1900, had a value when new that works out to 2,587 lire per ton; applying a ratio of value added to value equal to the average of those for protected cruisers and destroyers, one obtains a 1900-price value added estimate of 1,350 lire per ton. Multiplying this estimate by a 1911-price/1900-price ratio equal to the average of those for protected cruisers and destroyers, one obtains the "1911-price" estimate in Table F.18, row 6. The 1911-price value added per ton for armored frigates (row 1) and frigates and corvettes (row 2) -- wood-built fully rigged fighting ships, of a technology abandoned in the 1870s -- can hardly be calculated with any hope of precision; it is here simply set equal to the corresponding estimates for the most directly comparable modern fighting ships (rows 3 and 5, respectively). The evidence for these figures, such as it is, is this: the hull and engines of the earliest modern battleships (*Dandolo*, *Duilio*, *Italia*, *Lepanto*) and cruisers (*Vespucci*, *Gioia*, *Savoia*) cost some 1,650 and 1,550 lire per (normal displacement) ton, respectively, against 1,050 and 1,250 lire for the latest armored frigates (*Palestro*, *Principe Amedeo*, *Roma*, *Venezia*) and corvettes (*Caracciolo*, *Vettor Pisani*; *Rendiconto consuntivo 1891-92*, parte II, pp. LXXIII-LXXXIII, and Table F.04). The differences between these figures for old and new armored vessels on the one hand, and old and new cruising vessels on the other, are plausibly attributed to the relatively greater materials cost (hull metal, engines) of the new vessels; therefore, value added per ton (in both current and "real" terms) can be considered equivalent for old and new armored vessels on the one hand, and old and new cruising vessels on the other.

These estimates yield an aggregate value added in the construction of naval vessels of 39.3 million lire in 1911 (Table F.18).

The consumption of lumber and semi-finished metal in the construction of sea-going naval vessels is calculated here for later use. The metal-consumption estimates are presented in Table F.20, col. 1; they estimates are obtained by summing the type-specific displacement series in Table F.16, suitably modified, with the weights derived in Table F.19. The estimates of metal consumption per displacement ton, transcribed in col. 3, are obtained by adding the unit weight of armor (col. 2) to the unit consumption of ordinary hull metal, itself obtained as the unit weight of unarmored hull (col. 1 minus col. 2) times metal consumption per ton of unarmored hull (.915 tons for auxiliaries and .800 tons for fighting ships, save gunboats, attributed an intermediate .865 tons, and of course the wood-built armored frigates, frigates, and corvettes, attributed none; see the preceding discussion of the unit cost estimates underlying Table F.17, col. 8). The unit hull weights in Table F.19, col. 1 are normally (rows 4, 5, 7, 9, 10, and 11) derived from Table F.17, as the ratio of the corresponding figures (col. 7 to col. 3) for the appropriate vessels; those in rows 3 and 8 are simple averages of the two ratios for vessels of

that class in Table F.17; that in row 12 is an average of the ratios for the *Adda*, *Bronte*, and *Eridano*, with weights .17, .66, and .17, respectively; that in row 13 is taken from the figures for the *Eridano*; that in row 6 is a simple average of those in rows 5 and 7: and those in rows 1 and 2 are direct estimates. The unit armor weights in Table F.19, col. 2, rows 1, 3, and 4 are based on Giordano (1864, p. 47) and Table F.04, the *Navi di linea* (pp. 180, 218, 228, 259, 269), and the *Incrociatori* (pp. 330-331, 351), respectively; that in row 5 is directly estimated; and the others (for lightly protected or totally unprotected vessels) are assumed to be negligible.

The modifications to the series in Table F.16 reflect ships that are somehow exceptional within their assigned class. The aggregate displacement tons in cols. 5, 11, and 13 are thus recalculated to exclude the wood-built ships in Tables F.07, F.13, and F.15; those in col. 10 are also recalculated, allowing the armored metal-hulled vessels 150%, and the armored wood-built vessels 50%, of the (discounted) annual displacement tons estimated in Table F.12. The possible distortion from the different time profiles of construction and metal consumption is neglected. While most ordinary hull metal was obviously consumed prior to launching, most armor plate was apparently applied after that; given the significant share of armor in the total weight of semi-finished metal consumed by armored ships, and the preponderance of armored ships in total construction, the net distortion would not appear to be too severe.

The corresponding lumber-consumption estimates are presented in Table F.20, col. 6. For simplicity, they ignore the possible lumber content of metal ships, and accordingly reflect the construction of wood vessels alone; they further assume that lumber waste approximately offset the weight of the non-lumber components of the hull; and they too ignore the slippage between construction and materials consumption. On the basis of the coefficients in Table F.19, therefore, lumber consumption in the construction of the traditional vessels listed in Table F.04 is estimated directly as .6 times the displacement tonnage in Table F.16, col. 1, and .7 times that in Table F.16, col. 2. Again for simplicity, the latter coefficient (for unarmored vessels) is also applied to the tonnage-contructed estimates for the first *Colombo* in Table F.07 (ignoring the wood sheathing of the *Calabria*), the three wood-built gunboats in Table F.12 (as their displacement there already excludes armor), the seven wood-built tugs in Table F.13, and the ten wood-built auxiliaries in Table F.15.

F02.03 New construction of merchant ships

Data on the output of merchant vessels are available from 1861, in an appendix to the annual *Navigazione marittima* through 1886 (e.g., *1884*, p. 433), and as a chapter in the annual *Marina mercantile* from 1882 (e.g., *1911*, p. 73; see also *1881*, p. 4). These sources typically report the number and register tonnage (i.e., cubic capacity) of the vessels launched in the calendar year, disaggregated by size or (increasingly) by type; variously detailed excerpts appear in the *Sommario* (p. 130) and in the *Annuario* (e.g., *1878*, parte II, p. 21, *1886*, pp. 1046-1047, *1900*, p. 664, *1915*, p. 158; the 1874-76 totals in the *Annuario 1878*, parte II, p. 21 include steamers, the table heading notwithstanding, and the 1884 steamer net tonnage in later issues, e.g., *1900*, p. 664, is actually gross tonnage, with the sailing vessel figure incorporating an offsetting error).

The intended coverage of these figures is not entirely unequivocal, from at least two perspectives. First, and for reasons that remain unclear, the data include a few naval vessels, exported and not (e.g., *Marina mercantile 1897*, pp. 31, 35, *1914*, pp. 71, 79; compare *1903*, p. 26). Second, at least the later figures clearly exclude the numerous very small vessels, built for inshore waters, that were registered locally rather than nationally (e.g., *Marina mercantile 1882*, p. 28, *1894*, pp. 38, 172, 249, *1914*, pp. 71, 85-93, 343). These output data thus appear to document the construction of seagoing vessels, but not that of inshore vessels.

Register tonnage can be net, or gross, of the space devoted to the vessel's own

machinery, fuel, crew and navigation. The reported net and gross tonnages built, disaggregated only to reflect the basic distinction between sail- and engine-powered vessels, are transcribed in Table F.21, cols. 1 – 2 and 5 – 6. These figures are simple sums of the national data for the appropriate types reported in the *Navigazione marittima* from 1865 through 1880, and the *Marina mercantile* from 1881, with the following caveats, corrections and exceptions.

The current national data cover the Venetian and Roman coasts only from 1867 and 1870, respectively (*Navigazione marittima 1881*, p. 351). Data for the Venetian coast are available in a subsequent retrospective (*Navigazione marittima 1867*, p. LII); no steamers are mentioned, and in 1861-66 those reported tonnages are here added to the sailing-ship total reported for the Kingdom. No equivalent figures are available for the Roman coast in the 1860s, but the omission appears insignificant (no vessels were counted through the 1870s and most of the 1880s: e.g., *Navigazione marittima 1875*, p. 208).

The sources distinguish sailing vessels with auxiliary engines only in 1913 (83 net tons, 211 gross tons) and 1914 (93 net tons, 201 gross tons); these are here included in the sailing-vessel total, following what appears to have been the practice in the preceding years. On the other hand, the mixed-propulsion vessels were built in 1867 and 1869 are here considered steamers with auxiliary sails.

In 1914, col. 5 includes the 240 net tons, omitted from the national summary, of the water carriers (*Marina mercantile 1914*, pp. 71, 78); even without these, the reported grand total of 29,967 net tons (p. 71) seems incorrect, as does the corresponding figure for 1913 (36,379 tons, *1913*, p. 73). In 1911, col. 6 includes 62 gross tons for the motor-boats; that tonnage, omitted from the national summary, is here set equal to the net tonnage (*Marina mercantile 1911*, p. 73, *1912*, p. 73). In 1908, col. 6 includes 200 gross tons for the ferry-boat; that tonnage, omitted from the national summary, is here estimated as twice the reported net tonnage (*Marina mercantile 1908*, pp. 35, 40, *1905*, p. 28). In 1895, the included cruiser is allowed 347 net tons, returning the reported total (*Marina mercantile 1895*, pp. 38, 41). The *Marina mercantile 1881*, p. 4, provided only the aggregate net tonnages by motive power transcribed in cols. 1 and 5, and an overall total of 12,221 gross tons.

In the 1860s and 1870s, the *Navigazione marittima* typically fails to distinguish between net tons and gross tons. In the case of sailing vessels, the distinction was then relatively insignificant; following such later sources as the *Marina mercantile* (e.g., *1914*, pp. 80-81), the *Annuario*, and the *Sommario*, these early sailing-vessel data are here taken to refer to net tons. In the case of steamers, on the other hand, the only unequivocal data are those for 1870-72 (when the steam tonnage figures are said to exclude 40% of the total) and 1873 (when the figures are labeled "net register tons"); these figures are accordingly transcribed in col. 5. The data for 1866-69 and 1874-79 appear instead to refer to gross tons, and are correspondingly transcribed in col. 6. In 1874 and 1875, there is some ship-specific evidence that speaks to the point (compare *Navigazione marittima 1874*, p. 168, *1875*, p. 209, and the list of steamers in the *Navigazione marittima 1883*, pp. 459-463, noting in particular the *Assiria*, the *Emma*, and the *Ortiglia*). More generally, over these years the product of the reported average dimensions, times the number of ships, is a relatively low multiple of the reported tonnage. In 1880, when both net and gross tons are reported, that multiple works out to about 10.1 using net tons, and 4.9 using gross tons; in 1870 and 1873, when the quoted tons are clearly net tons, it equals 6.3 and 7.6, respectively. In 1866-67, 1869, and 1874-79 the corresponding figures lie between 1.5 and 5.2. In 1868, that statistic is high enough to be ambiguous (6.3); but it is clearly low in 1867 and 1869 (3.8 and 3.9, respectively), and it is hard to imagine that the unit of measurement did not remain the same for at least a few years at a time.

In 1870-71, the sailing-ship figures in col. 1 are obtained as a residual, deducting the steam-ship subtotals (here in col. 5) from the reported grand totals. In 1865-66, as noted, the

figures in col. 1 are the current totals reported for the Kingdom, plus the separate figures for the Venetian coast.

In 1862-64, the tonnages launched are not distinguished by type. The reported totals for the Kingdom are 25,271 tons in 1862, 37,462 in 1863, and 38,395 in 1864; a single steamer, of 241 tons, is identified in a note (*Navigazione marittima 1864*, pp. 291, 296). The earliest list of steamers that includes the date of construction appears to be that in the *Navigazione marittima 1881*, pp. 354-357; those built in Italy before 1866 are only the *Calabrese* (ex *Monitore*, *Marina mercantile 1883*, pp. 14-21), the *Tifeo*, and the *Umbria*, all of 1864. The current lists of steamers allow these three vessels net tonnages that exclude 40% of the total equal to 53.28, 64.00, and 144.44, respectively (*Navigazione marittima 1864*, pp. 282-283); these correspond to 89, 107, and 241 tons, respectively, confirming that the steamer tonnages launched were in fact gross tons. The sum of these three last figures is accordingly inserted in col. 6 in 1864. The sailing-ship figures for 1862-64 in col. 1 are the totals reported for the Kingdom, plus the separate Venetian tonnages mentioned above, less, in 1864, the steamer tonnage in col. 6.

Finally, the Kingdom's output in 1861 is calculated from the relatively detailed frequency distribution in the *Navigazione marittima 1863*, p. 216, taking the mid-point of the class ranges as the class means. The resulting estimate (22,458 tons), plus the reported figure for the Venetian coast (766 tons), is included in col. 1.

Since the ratio of net tons to gross tons varies even within the present sail-powered and engine-powered groups (Table F.21, cols. 1 – 2, 5 – 6), the net tonnage and gross tonnage series are not equivalent indices of construction. In the case of sailing vessels, some of the secular decline in that ratio may be due to the appearance of auxiliary propulsion and deck machinery, larger crew quarters, and the like; but the major, abrupt change from 1905 to 1906 appears to be due to a switch from the Moorsom measuring system to the British 1894 Merchant Shipping Act measuring system (*Annuario 1905-07*, p. 629). The impact of this change was evaluated by comparing the gross and net tonnage listed in *Lloyd's Register 1899-1900* and *1910-11* for a sample of twenty "ordinary" and seven "large" vessels (under and over 1,000 gross tons, respectively) registered in Italy at both dates. The intervening remeasurement yielded a decline in the net/gross tonnage ratio from .96 to .85 for the "ordinary" vessels (A63, A92, A108, A112, A682, A685, A728, A902, B150, B174, B244, B336, C252, C506, D188, E357, E431, F234, G76, and G198 in the 1910-11 edition) and from .96 to .91 for the "large" vessels (A869, B87, C86, C232, F155, G226, and T72 in the 1910-11 edition); significantly, the decline was due to a reduction of net tonnage (by 11.4% for "ordinary" vessels and 6.2% for "large" vessels), while gross tonnage was much less affected (it actually declined too, by .8% for "ordinary" vessels and 1.8% for "large" vessels). Both these technical and legal changes thus appear to affect the net tonnage series adversely (reducing the registered tonnage of vessels of unchanging size); the gross tonnage series, in contrast, is much more nearly homogeneous (the likely error is particularly small in view of the relatively small average and aggregate tonnage of the sailing vessels launched in Italy after 1905).

In the case of engine-powered vessels, a similar sample of twenty merchant steamers from *Lloyd's Register 1899-1900* and *1910-11* (A212, A222, A515, A829, A907, A1472, A1668, A1671, B176, B871, B892, B1116, C297, C970, C971, C977, C1748, D368, E626, and E838 in the 1910-11 edition) yielded a 2.8% decline in gross tons and a 3.5% decline in net tons as a result of re-measurement; but the most significant changes in the net/gross tonnage ratios appear due to changes in the mix of tugs, liners, and bulk carriers (while both these last are listed simply as "steamers," one notes the construction of a fleet of fast passenger ferries for the State railways in 1910: *Marina mercantile 1910*, p. 62; Fraccaroli, 1970, pp. 247-249). While both the net and gross tonnage series thus appear sensitive to legal changes, gross tonnages appear relatively unaffected by technical differences, while net tonnages again tend to react

adversely (declining as complexity increases, given vessel size). In sum, gross tonnage appears to provide the superior index of actual construction for both sail-powered and engine-powered vessels; the present estimates accordingly seek to reconstruct annual gross tonnages launched, which are then shifted to approximate current (rather than completed) construction.

Cols. 3 and 7 transcribe the reported gross tonnage of the metal-hulled vessels launched in each year. The present output estimates do not distinguish between wood- and metal-hulled vessels; these time series serve to estimate metal consumption, and also to improve the statistics on aggregate tonnages launched. The figures for 1882-1914 are taken from the *Marina mercantile 1914*, p. 82. Annual ship-specific data are available for the later decades; these suggest that the same naval steamships were normally included in cols. 5, 6 and 7 (e.g., *Marina mercantile 1889*, pp. 31-32, *1891*, pp. 78-79, *1914*, pp. 71, 76-79). The earlier figures are derived from the *Navigazione marittima*. In 1869 half, and in 1874 all, of the currently launched steamers are taken to have been metal-hulled (*Navigazione marittima 1869*, p. 117, *1874*, p. 168); in other years, the current output of metal-hulled steamers is taken from the national list of steamers in the *Navigazione marittima 1883*, pp. 459-463 (in effect assuming that none were exported). The construction of metal-hulled sailing vessels before 1882 is considered negligible, as no more than a few hundred tons appear to have been involved (*Enciclopedia italiana*, vol. 24, p. 360).

The sailing-vessel construction estimates in Table F.21, col. 4, are obtained as follows. The first step derives interim estimates of the missing gross tonnage figures for 1861-79 and 1881 from the net tonnage data in col. 1, correcting for changes in the measuring system (but not in geographic coverage, given the apparent insignificance in the 1860s of the omitted Roman coast). Tonnage figures were calculated on the Moorsom system only from 1874; since this system yielded measures about 5% below those yielded by its predecessor (*Annuario 1900*, p. 664; similarly *Marina mercantile 1883*, p. 35), the net tonnage figures for 1861-73 are here reduced by 5% (the series in the *Sommario*, p. 130, incorporates a similar correction in 1871-73 only). On the other hand, judging by the post-1874 data in cols. 1 and 2, gross tons were some 104% of the corresponding net tons; combining these opposite corrections, these interim estimates of gross tonnage launched in 1861-79 and 1881 are the figures in col. 1 times .988 in 1861-73, and 1.04 in 1874-79 and 1881.

The second step refines these interim estimates to allow for changes in the types of vessels covered by the data. Some inshore craft were not excluded until 1874; on the other hand, no vessels under 11 tons appear to have been counted at all until 1865 (e.g., *Navigazione marittima 1863*, p. 216, *Marina mercantile 1882*, p. 25, *Annuario 1878*, parte II, p. 21, *1900*, p. 664; note the trebling of the total number of vessels counted from 1864 to 1865). In 1865-73, the reported tonnage of the vessels under 11 tons (which excludes the Venetian coast in 1865-66) averaged just over 1,400 tons, with no apparent trend. In 1871-73, in particular, the annual averages were 1,475 tons for 424 vessels; in 1874-76, with the exclusion of inshore vessels, the comparable annual averages drop to 665 tons (inflated by 5%, as above) for 107 vessels. This suggests that the inshore craft excluded in 1874 averaged some 800 tons p. a. (810 tons for 317 vessels, for an average of just 2.6 tons per vessel), leaving some 600 tons p. a. for small seagoing vessels; the final estimates of gross tonnage launched in 1861-79 and 1881 that complete the series in Table F.21, col. 2 are accordingly the data in col. 1, scaled as described above, plus .6 in 1861-64 and minus .8 in 1865-73.

The third step introduces a single correction to the gross tonnage data, prompted by the uniquely low ratio of reported net tons to gross tons in 1911 (.7 tons, against .8 or more in all other years). The disaggregated evidence (*Marina mercantile 1911*, p. 73, *1912*, p. 73) points to an anomaly in the 1911 data for hermaphrodite brigs: the implied very low net/gross tonnage ratio (.57, against .86 in 1912) appears due to an overstatement of gross tonnage (rather than to

an understatement of net tonnage, or to a very high proportion of vessels with auxiliary engines), since the value per gross ton is exceptionally low (under 200 lire, against 270 to 340 for other vessels; in 1912, it was 330 lire, against an average of 340), and the value per net ton is also relatively low (345 lire, against 345 to 510 for other vessels). The gross tonnage of the hermaphrodite brigs launched in 1911 is accordingly estimated at 1,387 tons (the net tonnage divided by .86) instead of 2,094, thus reducing the aggregate 1911 sailing-vessel gross tonnage to 5,660.

The fourth step inflates the (corrected) gross tonnage figures for 1906-14 by 0.8%, to offset the change in the measurement system discussed above. The fifth and final step shifts the series in Table F.21, col. 2, thus completed and corrected, half a year backward; the resulting figures are the construction estimates transcribed in col. 4.

The steamer construction estimates in Table F.21, col. 8, in turn, are obtained as follows. First, gross tonnages launched in 1870-73 are estimated by dividing the net tonnage data in col. 5 by .6. In 1881, gross tonnage is estimated as the reported total (12,221 tons) less the estimated sailing-ship total (105% of 10,994, or 11,544); the implied ratio of net tons to gross tons is near 54%, against 48% in 1880 and 73% in 1882. Second, the naval ships included in col. 6 are excluded. These are, on the one hand, the cruisers identified as such in the ships-launched tables in 1895 and 1897, and, on the other, those identified as naval ships in the list of metal-hulled vessels. The former amount to 717 (the *Caprera*) and 2,093 gross tons (the exported "*Bascir*" and *Adamastor*), respectively; exceptionally, the 1895 cruiser does not also appear among the metal-hulled vessels (*Marina mercantile 1895*, pp. 41-44). The latter (further) include 90 gross tons in 1894 (one water carrier), 55 tons in 1907 (one tug), 110 tons in 1908 (two tugs), 415 tons in 1911 (six tugs, of which one exported), 1,159 tons in 1912 (two water carriers), 910 tons in 1913 (one tug and six water carriers), and 570 tons in 1914 (one tug and four water carriers). Third, the (corrected) gross tonnage figures are reduced by 5% in 1861-73, and inflated by 2.8% in 1906-14, to offset the change in the measurement system discussed above (and reduce the steamer figures, like the sailing-ship figures, to a consistent (Moorsom-system) basis. The fourth and final step shifts the series in Table F.21, col. 6, thus completed and corrected, half a year backward; the resulting figures are the construction estimates transcribed in col. 8.

The estimation of unit value added at 1911 prices is complicated by the change in the construction subsidy schedules in mid-July of that year (*legge 13 luglio 1911, n. 745*; earlier applicable legislation includes *legge 23 luglio 1896, n. 318*, *legge 16 maggio 1901, n. 176*, *legge 28 giugno 1906, n. 260*, and *legge 13 giugno 1910, n. 306*). The sailing vessels constructed in 1911 (actually, the average of those reported for 1911, as corrected above, and 1912) were worth 1.7 million lire for 5,200 gross tons, for a unit value of 327 lire per gross ton. Almost all of these were wood-built ships, attributable a light displacement of perhaps .6 tons per gross ton (say .54 tons for the hull proper, and .06 tons for fittings), taking account of their small average size and the apparent diseconomies of scale in wood construction (*Enciclopedia italiana*, vol. 24, p. 360; White, 1894, pp. 411-413). At the 1911 import price of 95 lire per ton of ordinary sawed wood (the kind recovered by scrapping ships: *Movimento commerciale 1913*, p. 170), and allowing 10% for waste, the hull material is estimated to have cost 57 lire per gross ton. Fittings appear to have been largely fabricated iron and steel (*Movimento commerciale 1913*, pp. 206-207), worth perhaps 750 lire per ton, for a further cost of 45 lire per gross ton. Allowing a further 10 lire per gross ton for neglected items, total materials cost is here estimated at 112 lire per gross ton. From mid-July 1911, the unit construction subsidy (normally paid to the builder) apparently totaled 25 lire per gross ton for all wood-built seagoing sailing vessels, yielding a value added of 240 lire per gross ton. Under the earlier legislation, the unit subsidy was limited to 13 lire per gross ton for all wood-built seagoing sailing vessels, plus 10 lire per

gross ton for those exceeding 100 gross tons. The disaggregated figures in the *Marina mercantile* (*1911*, p. 73, *1912*, p. 73) suggest that this norm was exceeded only by the hermaphrodite brigs, which accounted for an estimate of some 1,500 gross tons, or 29% of the total; the average subsidy thus appears to have been some 16 lire per gross ton, yielding a value added of 231 lire per gross ton. Taking the average of these two estimates (weighted by the tonnages launched in 1912 and 1911, respectively), value added in 1911 is here estimated at 235 lire per gross ton; in view of the uncertainties surrounding the cost estimates, one is reassured by the plausibility of this figure as a proportion of gross value and of value added in steamship construction.

The engine-powered vessels constructed in 1911 (i.e., once again, the average of those reported for 1911 and 1912, including the naval auxiliaries, with the tonnage inflated by 3%) were worth 13.4 million lire for 22,200 gross tons, for a unit value of 604 lire per gross ton. Almost all of these were metal-hulled vessels, attributable perhaps .48 tons of hull metal (including waste), .07 tons of fittings, and .08 tons of propulsion machinery per gross ton (from the Italian legislation cited above, and the data for a standard awning-decked steamer in the *Encyclopaedia Britannica*, vol. 24, p. 882; see also *Enciclopedia italiana*, vol. 32, p. 651, Lovett, 1920, ch. 3, and White, 1894, p. 413). From mid-July 1911, one quarter of the hull metal could be imported duty-free; given an import price of 160 lire per ton (for plates and beams) and a unit tariff of 60 or 70 lire per ton, the cost of hull metal appears to have been close to 100 lire per gross ton. The .07 tons of fittings per gross ton are assumed to include .05 tons of fabricated metal, worth perhaps 38 lire, and .02 tons of auxiliary engines, worth perhaps 27 lire; the latter figure allows these engines the import price plus tariff of 1,470 lire per ton cited for the ordinary steam engines recovered from scrapped ships (*Movimento commerciale 1913*, p. 221), less the unit subsidy of 135 lire per ton. Propulsion equipment may have cost some 178 lire per gross ton, from the import price plus tariff of 2,520 lire per ton for marine engines, less the subsidy of 15 lire per horsepower, here estimated to equal 300 lire per ton. Allowing 15 lire per gross ton for neglected items, total materials cost is here estimated at 358 lire per gross ton; deducting the unit construction subsidy (87 lire per gross ton, calculated as the specified 90 lire times .97 to allow for the correction to measured tonnage), value added is estimated at 333 lire per gross ton. Under the earlier legislation, one third of the hull metal could be imported duty-free, reducing hull-metal costs to 98 lire per gross ton; and propulsion machinery received a subsidy of 12.5 lire per horsepower (equivalent to perhaps 250 lire per ton of engine), raising its cost to some 182 lire per gross ton. Allowing 29 lire per gross ton for auxiliary engines (which do not appear to have been subsidized), and, as above, 38 lire for fabricated metal fittings and 15 lire for neglected items, total materials cost is estimated at 362 lire per gross ton. The corresponding construction subsidy was 35 lire per gross ton for all seagoing steamers, plus 40 lire for those exceeding 400 gross tons. The disaggregated data in the *Marina mercantile* (*1911*, p. 73, *1912*, p. 73) suggest that this norm was exceeded by all but the tugs, which accounted for some 1,300 gross tons, or 6% of the total; this suggests an average subsidy of 70 lire per gross ton (again multiplying by .97 to allow for the correction to measured tonnage), and a corresponding value added of 312 lire per gross ton. Again taking the average of these two estimates (weighted by the tonnages launched in 1912 and 1911, respectively), value added in 1911 is here estimated at approximately 325 lire per gross ton.

These unit value added estimates yield aggregates of 1.2 and 7.0 million lire in the construction of seagoing sail-powered and engine-powered merchant vessels, respectively, or 8.2 million lire for all seagoing merchant vessels together.

The consumption of lumber and semi-finished metal in the construction of sea-going merchant vessels is calculated here for later use. The estimates of semi-finished metal consumption are presented above in Table F.20, col. 2; they are obtained from the

tonnage-launched series in Table F.21, cols. 3 and 7, as follows. First, the steamer figures in col. 7 are reduced by the tonnage of naval vessels already subtracted from col. 6 in 1894, 1897, 1908, and 1911-14 (as noted, in 1895 col. 7 already excludes the cruiser counted in col. 6). Second, to allow for the change in measuring system, cols. 3 and 7 are multiplied by .95 in 1861-73, and by 1.008 and 1.028, respectively, in 1906-13 (no further correction is needed in 1911, as the troublesome hermaphrodite brigs were not metal-hulled). The resulting series are simply summed, shifted half a year backward to approximate actual construction, and multiplied by .48 tons of hull metal consumed per gross ton; this figure, estimated above for metal-hulled steamships, is here applied to sailing vessels as well.

Aggregating over 1909-13, these estimates yield a total metal consumption of some 69,000 tons and a value added (in metal-ship construction) of some 46 million lire, or some 1,500 tons of metal per million lire of value added. In naval construction, the corresponding estimates sum to a metal consumption of some 85,000 tons and a value added of 187 million lire, or some 450 tons per million lire. The much higher metal consumption per unit value added in merchant vessels does not appear unreasonable, in light of the far greater complexity of naval vessels.

The corresponding lumber-consumption estimates are presented in Table F.20, col. 7. For simplicity, these too ignore the lumber content of metal ships; they are accordingly obtained by weighting wood-ship-construction series obtained as residuals (the unrounded estimates of total gross tonnage constructed, Table F.21, cols. 4 and 8, less the metal-hulled components of these obtained as described in the last paragraph but one). Again allowing for waste, lumber consumption is estimated at .6 tons per gross ton; this coefficient is derived from the sailing-ship evidence cited above, and applied here to steamers as well.

F02.04 Maintenance of naval ships and boats

The present estimates of the maintenance of seagoing naval vessels cover their progressive improvement as well as their simple conservation. They refer to the Italian navy alone, on the presumption that foreign naval vessels were not ordinarily worked on in Italy; a few foreign ships were rebuilt, but such reconstruction is here assimilated to, and counted above with, new construction (section F02.02 and Table F.05).

An apparently direct index of the relevant activity is provided by the maintenance expenditure data in the *Rendiconto consuntivo* (e.g., *1876*, p. 266, *1899-1900*, parte I, p. 1026); but the time path of these figures, relating to work done overwhelmingly in Royal yards, appears to be dominated by changes in accounting procedures rather than in activity or prices. Major, and apparently spurious, shifts appear between the budgets for 1886-87 and 1887-88 (a 64% increase in the wage bill: *Rendiconto consuntivo 1886-87*, parte I, p. 642, *1887-88*, parte I, p. 642), 1904-05 and 1905-06 (a 59% decrease in expenditure on materials, and a 31% decrease in total expenditure: *Rendiconto consuntivo 1904-05*, parte I, pp. 1152, 1154, *1905-06*, parte I, p. 1285), 1910-11 and 1911-12 (increases in expenditure on materials, and total expenditure, that essentially restore the levels of 1904-05: *Rendiconto consuntivo 1910-11*, parte I, p. 2011, *1911-12*, parte I, p. 2209), and 1912-13 and 1913-14 (a trebling of overhead expenditure, against a 30% increase in other costs: *Rendiconto consuntivo 1912-13*, parte II, p. 190, *1913-14*, parte II, p. 183); other changes similar in kind, but smaller and therefore not manifest, may of course be scattered throughout the period at hand. This financial time series is accordingly rejected.

Maintenance at constant prices is here indexed, very simply, by the size of the fleet, crudely corrected to reflect its composition by age and by type. The distinction between minor maintenance, major maintenance, and more extensive reconstruction is instead ignored, for a variety of reasons. One is that these categories shade into each other, and the quantitative

equivalents of the available ship-specific descriptions are difficult to specify; another, that minor and major maintenance were both relatively frequent, and thus unlikely to display significant bunching; yet another, that over the period at hand no major Italian vessels appear to have been as thoroughly rebuilt as the foreign vessels noted above (or, in the 1930s, the four surviving *Cavour* and *Duilio* class battleships), and what reconstruction did take place does not appear to have cost much more than ordinary major maintenance (e.g., *Relazione marittima 1886-87*, pp. 70-73, *1900-01*, pp. 44-46, *Rendiconto consuntivo 1907-08*, p. 1749, *1908-09*, p. 1841).

Detailed data on the fleet in service are available from 1864 in the *Annuario navale* (e.g., *1864*, pp. 209 ff., *1884*, pp. 210 ff., *1911*, pp. 464 ff.), and a broad sample was reproduced in the *Annuario* (e.g., *1881*, pp. 478-487, *1889-90*, pp. 400-409, *1905-07*, p. 1033, *1911*, p. 332, *1913*, p. 404). The retrospective *Almanacco navale* is comprehensive and more convenient, and is accordingly used here.

Table F.22 presents the estimates of the aggregate equivalent displacement of the fleet to be maintained. To allow for the varying incidence of types with different maintenance burdens per ton, different weights are assigned to the displacement of armored vessels, protected vessels, ordinary unprotected vessels, and bulk carriers. The allowance for the vessels' varying age is even simpler. Presumably, average maintenance (and improvements) per ton tended to rise as a ship aged, and then fall when it lost its usefulness and was headed for retirement; here, this path is replaced by a simple step function that assumes negligible maintenance in each ship's early years and again (if it retired afloat) in its late years, and constant maintenance over its middle years (or until it was lost). For present purposes, therefore, the fleet to be maintained is a simple subset of the fleet in service.

Cols. 1 – 8 transcribe the estimated total normal displacement of the vessels annually added to, or subtracted from, the fleet to be maintained, separately identifying the four groups identified above. On the above simplifying assumptions, they altogether ignore the ships that were retired before 1866, completed after 1909, or less than nine years old when retired (four years old when lost). Other ships enter cols. 1 – 8 as follows. In cols. 1, 3, 5, and 7 ships acquired new and completed in year t are entered in $(t + 4)$; those completed in year t and acquired used in year T (including those inherited from the pre-Unification navies) are entered in the later of T or $(t + 4)$, allowing one year from launch to completion if the latter date is unknown. In cols. 2, 4, 6, and 8 ships that left the fleet in year t are entered in $(t - 4)$ if they were retired, and in t itself if they were lost.

Cols. 1 – 2 refer to armored ships. These include the ships of the line listed in the *Almanacco navale* (12 vessels on pp. 220-221, 12 on pp. 222-223, and 11 on pp. 224-225, excluding the unarmored *Re Galantuomo* and of course the *Re d'Italia* and *Palestro*, both lost at Lissa shortly after they joined the fleet); the *Morosini* is taken to have been retired in 1909, as suggested by the fleet lists in the *Annuario navale*. The armored cruisers so identified on pp. 290-291 (8 ships) are also included here.

Cols. 3 – 4 refer to protected ships; these are the cruisers so identified on pp. 284-285 (4 ships), 286-287 (3 ships), and 288-289 (7 ships).

Cols. 5 – 6 refer to bulk transports. These include the water carriers listed on pp. 796-797 (the last 14 vessels listed, with the *Giglio* allowed 30 tons and assumed, like the *Tevere*, to have been completed in 1884) and 798-799 (the first 11 vessels listed, with the *Simeto* assumed in service as long as the *Crati*), the oilers listed on pp. 804-805 (the first two), and the barges listed on pp. 842-843 (17 vessels; of these, the first 9, inherited from the Piedmontese navy, are counted from 1861, the tenth is counted from 1873, and the others are presumed to have been bought new).

All other ships are counted in cols. 7 – 8. These include the *Re Galantuomo* on pp. 220-221 (assumed completed in the early 1850s: above, section F02.02), 4 inherited old corvettes

(excluding the *Aurora*, retired in 1866 but apparently withdrawn from service before 1861) on pp. 272-273, 6 inherited old corvettes on pp. 274-275, the 6 inherited old corvettes on pp. 276-277, the (single) inherited old corvette and the 5 new corvettes on pp. 278-279, the 7 inherited old frigates on pp. 280-281, and the (single) old, 4 inherited almost new, and 2 new frigates listed on pp. 282-283. The included unarmored and unprotected cruisers are the first 4 vessels on pp. 284-285, and the *Tripoli*, the 4 *Goitos*, the 8 *Partenopes*, the *Colombo* and the 2 *Agordats* on pp. 286-291. The included destroyers are the 14 vessels on pp. 350-351, and, from pp. 352-353, the 4 *Bersaglieres* completed in 1907. The included torpedo boats are all 54 on pp. 418-421, 101 on pp. 422-425 (excluding the *56 S*, *105 S* and *117 S* lost or retired new, and allowing a 1910 retirement date for the *113 S*), and all 36 on pp. 426-429. The included submarines are the first 7 boats on pp. 492-493. The minor and auxiliary vessels are of course a mixed bag. Those included here are all 21 despatch boats on pp. 672-677 (including, from 1861, the Garda steamers on pp. 674-675) and 24 gunboats on pp. 678-681 (all save the *Vinzaglio*); the Garda gunboats, pp. 684-687 -- built around 1860 and purposeless after 1866 -- are ignored. Also included, with a completion date of 1860, are the 8 (initially Austrian) lagoon gunboats on pp. 686-687; the *N. 6* is taken to have been retired in 1906. Of the sailing vessels listed on pp. 688 ff., 8 are included from pp. 688-689, 7 from pp. 690-691, and 2 from pp. 692-693; the dhows operating in the Red Sea are excluded. Of the tugs and (ordinary) transports listed from p. 790, the included vessels are the sail-powered *Sparviero* and 10 steamers from pp. 790-791 (with the *Rosolino Pilo* included from 1861), 3 tugs and 14 transports from pp. 792-793 (with the *Oregon* and *Ferruccio* included from 1861, the *Tevere* included from 1861 through 1870, and the *America*/*Trinacria* included from 1887, as indicated on p. 793; compare p. 729 and Fraccaroli, 1970, p. 242), and the first 4 transports from pp. 794-795 (from, respectively, 1913, 1887, 1911, and 1912). Also included are the royal yacht *Savoia* from pp. 806-807 (the *Trinacria* is the former *America*), one cable ship from pp. 808-809, the *Eridano* (but not the *Pietro Micca*, *Diligente* and *Vigilante*, already counted from pp. 350-351 and 692-693) from pp. 810-811, three more (the first three tugs) from pp. 812-813, two more (the last two tugs, with the first counted from 1861) from pp. 814-815, another two (the *Porto Torres* and the *Lerici*, both old when purchased) from pp. 816-817. Another 15 tugs are taken from pp. 830-831, and 18 more from pp. 832-833 (from *N. 18 I* through *N. 21 II*, with the first three included from 1893, 1890, and 1891, respectively, and the ninth, tenth, and eleventh from 1902, 1901, and 1908, respectively).

Cols. 9 and 10 report the estimated annual equivalent displacement added to, and substracted from, the fleet to be maintained. These are obtained as sums of cols. 1, 3, 5, and 7, on the one hand, and 2, 4, 6, and 8 on the other. On the presumption that armor required little maintenance, and the cargo of bulk carriers none at all, cols. 1 – 2 are weighted by .8, cols. 3 – 4 by .9, and cols. 5 – 6 by .4. The net increment in the fleet to be maintained is estimated as col. 9 less col. 10, and then cumulated to obtain the year-end stock. That cumulation is in turn shifted forward half a year, leaving the initial value unchanged, to obtain a mid-year estimate. The estimated (mid-year) stock maintained in col. 11 is a three-year moving average of that shifted cumulation, with the series' initial and terminal values also left unchanged.

In the absence of useful alternatives, the estimate of value added in 1911 is obtained from the dubious figures in the *Rendiconto consuntivo 1910-11*, parte I, p. 2011, *1911-12*, parte I, p. 2209. Averaging the sums of expenditure on primary resources (wages, overhead) net of those expended on inshore vessels, and including half the payments to private industry, one obtains an estimated total for 1911 of 7.05 million lire, or 32.13 lire per estimated displacement ton in col. 11.

The consumption of lumber and semi-finished metal in the maintenance of sea-going naval vessels is calculated here for later use. The estimates of semi-finished metal consumption

are presented above in Table F.20, col. 3, and obtained as follows. The first step is to estimate the equivalent displacement tonnage of the metal-hulled vessels maintained; this is done in Table F.23, which replicates Table F.22 with a data-base limited, at least approximately, to the metal-hulled vessels. Cols. 1 – 2 of Table F.23 replicate those of Table F.22, excluding all the ships acquired through 1879 save the metal-hulled *Formidabile*, *Terribile*, *Regina Maria Pia*, *San Martino*, *Castelfidardo*, *Ancona*, *Affondatore*, and *Varese*. Cols. 3 – 4 of Table F.23 exactly replicate those of Table F.22. Cols. 5 – 6 of Table F.23 replicate those of Table F.22, excluding all the ships acquired through 1875, and also the little *Giglio* acquired in 1885. Cols. 7 – 8 of Table F.23 replicate those of Table F.22, excluding all the ships acquired through 1876 save the metal-hulled *Baleno*, *San Paolo*, *Conte di Cavour*, *Dora*, *Tanaro*, *Volturno*, and *Washington* acquired in 1861, the *Sesia* (1863), the gunboats *N. 1* to *N. 6* and the *Europa* (1866), the *Vedetta* (1869), and the *Guardiano* and *Sentinella* (1875), and further excluding, in later years, the wooden *Chioggia* (1878), *Diligente* (1883), *Vigilante* (1884), and *Capraia* (1889). Cols. 9, 10, and 11 are then calculated as in Table F.22.

Second, metal consumption in 1911 is extrapolated from the corresponding new-construction figures. Cumulating over 1909-13, naval new construction is attributed some 85,000 tons of metal consumption, and a value added of 187 million lire, or some 450 tons per million lire. In maintenance, one might expect perhaps a sixth of that, or some 75 tons per million lire; allowing 32.13 lire per ton maintained, metal consumption (in tons) is estimated as .075 (tons per thousand lire) times 32.13 (lire per ton) times 218.9 (thousand tons, from Table F.23, col. 11) for a total of 527 tons in 1911. The metal-consumption estimates in Table F.20, col. 3 are obtained by extrapolating this point estimate for 1911 to 1861-1913 in proportion to Table F.23, col. 11.

The corresponding lumber-consumption estimates are presented in Table F.20, col. 8. Metal consumption is estimated at 527 tons to maintain 218,900 equivalent displacement tons (in 1911), or some 2.4 tons of metal per year per thousand equivalent displacement tons. Allowing for wood's much lower durability, lumber consumption is here estimated at an even 10 tons per thousand equivalent displacement tons; Table F.20, col. 8 is accordingly obtained as .010 times the difference between Table F.22, col. 11, and Table F.23, col. 11.

F02.05 Maintenance of merchant ships

The present estimates of the maintenance of seagoing merchant vessels are based on the size of the domestic fleet to be maintained, allowing for maintenance performed in Italy on foreign vessels, and on Italian vessels abroad. The relevant evidence includes data on the domestic fleet, on the throughput of beaching slips and dry-docks, and port movements.

The size of the merchant fleet is documented in Table F.24. The year-end vessel numbers and aggregate net tonnages in cols. 1 – 4 transcribe the annual data for 1880-1913 in the *Marina mercantile 1914*, p. 105, extended back to 1863 with the comparable series in the *Navigazione marittima 1883*, p. 449. These figures include the Venetian coast from 1866, and the Roman coast from 1869; the sources further note that the (sailing-vessel) figures for 1864, 1871, and 1878 reflect an updating of the register, and the consequent removal of many vessels not in seagoing service. These retrospective figures appear generally to correspond to those in the current reports; the identified exceptions are the steamer figures for 1863, which differ slightly from those in the *Navigazione marittima 1863*, p. 203, and the sailing-ship figures for 1863-71, which are all the revised figures for the previous year published in 1864-72 (*Navigazione marittima*, e.g., *1864*, p. 270, *1872*, p. 158). The present figures for 1862 are, similarly, from the *Navigazione marittima 1863*, pp. 201-203; the steam figures are those cited for 1862, and the sail figures the residual from the corresponding figure for sail and steam together, which is however said to include 1,493 local-service vessels of unspecified tonnage.

The comparable series in the *Sommario*, p. 138, normally coincide with those trancribed here. In 1862, however, the *Sommario* sailing-ship figures are the above-mentioned sail-and-steam totals (less 1,493 vessels), so that the *Sommario* total double-counts the steamers; moreover, the 1863 steamer figures and the sailing-ship figures for 1863, 1865-67, and 1869 are those in the current reports rather than the revised figures published in the retrospectives (the further small discrepancy in the number of sailing ship in 1887 seems to be a typographical error). The steamers' aggregate gross tonnages in col. 5 are instead transcribed from the *Marina mercantile 1882* ff. (e.g., *1882*, p. 10, *1900*, p. 60, *1913*, p. 135); earlier figures, or comparable data for the sailing fleet, do not appear to be available.

The estimated mid-year fleet tonnages in cols. 6 – 8 are obtained by shifting forward, by half a year, the year-end tonnages in cols. 2, 4, and 5, themselves amended to offset the above-noted discontinuities.

The estimated year-end net tonnage of the sailing fleet is derived from col. 2 through the following steps. First, the 1862 tonnage figure is reduced to allow for the 1,493 inshore vessels that were subsequently excluded. Using the data in the *Navigazione marittima 1863*, p. 203, for vessels up to 10 tons, there was from 1862 to 1863 a net decline of 450 vessels and 1,488 tons; with 1,493 struck off, another (net) 1,043 vessels must have been added, equivalent to 5,142 tons at the 1863 class average of 4.93 tons per vessel. The implied tonnage struck off is 6,630, against a reported total of 643,946 tons, of which 10,228 steam-powered, for a corrected figure of 627 thousand tons. Second, the (revised) figures for 1862 and 1863 are reduced by 85,000 tons, to incorporate the revision carried out in 1864 (*Marina mercantile 1883*, p. 449). Third, the resulting figures are increased by 46,000 tons in 1862-65 and 3,000 tons in 1867-68 to allow for the incorporation of the Venetian and Roman coasts' fleets in the reported aggregate in 1867 and 1869, respectively. Using the figures in the *Navigazione marittima 1867*, p. 100, *1870*, p. 103, the reported Roman fleet of 3,000 tons in 1869 is attributed to 1862-68 as well; the reported Venetian fleet of 46,000 tons in 1866 is instead reduced by 3,000 tons to allow for its remeasurement according to Italian law (exactly offsetting the correction for the Roman fleet in 1866), and the revised 43,000-ton figure is attributed to 1862-65 as well. Fourth, to offset the locally registered vessels excluded from 1871 (which totaled 17,633 tons, out of 1,011,545 tons, in 1871: *Navigazione marittima 1871*, pp. 114-115, *1872*, pp. XXXIII, 158-159), the corrected figures for 1862-70 are reduced by 1.74%. Fifth, the resulting figures are adjusted to offset the revision of the register in 1878, which resulted in the exclusion of some 2,100 vessels, of 32,500 net tons, which had been lost, sold abroad, or transferred to inshore work (*Navigazione marittima 1883*, p. 449). Assuming these were all sail-powered, without this exclusion the 1878 sailing fleet would have totaled near 999,000 tons, for an implicit correction of some 3.3%; assuming for simplicity that this error had built up over eleven years, the further reduction applied here equals 3.0% in 1877, 2.7% in 1876, and so on to 0.3% in 1868 and zero in 1862-67. Sixth, to allow for the significant remeasurement in the 1870s (plus 4,000 tons in 1873, and then minus 28,000 tons, 25,000 tons, and 6,000 tons in 1874-76, and minus 4,000 tons p. a. in 1877-79), the calculated figures are reduced by 4,000 tons in 1878, 8,000 tons in 1877, 12,000 tons in 1876, 18,000 tons in 1875, 43,000 tons in 1874, 71,000 tons in 1873, and 67,000 tons in 1872; this earliest figure is then projected back to 1862 as a 6.85% reduction of the (corrected) fleet in 1862-71. Remeasurement appears to have been negligible after 1879; it is assumed to be negligible before 1872 as well, but the evidence here is altogether less clear (*Navigazione marittima 1875*, p. 197, *1883*, p. 450; *Marina mercantile*, e.g., *1882*, pp. 4-6). Seventh, to allow for the significant remeasurement after 1905, the reported figures are increased by 20,000 tons in 1906, 32,000 tons in 1907, 37,000 tons in 1908, and 40,000 tons in 1909-13 (*Marina mercantile*, e.g., *1906*, pp. 48-49, *1909*, pp. 83-84). Eighth and last, the corrected year-end figures in 1860 and 1861 are estimated directly at 510 and 524 thousand tons, respectively,

against the approximately 538 and 552 thousand tons obtained for 1862 and 1863, respectively. Col. 6 is the resulting 1860-1913 year-end series, shifted forward half a year.

The estimated year-end net tonnage of the steamer fleet is in turn derived, altogether more directly, from col. 4. First, the figures are corrected to offset the following spurious changes attributable to remeasurement: an increase of 3,000 net tons in 1878 and 1879, and a decrease of 2,000 tons in 1882 and 8,000 tons in 1883 (*Navigazione marittima 1878*, parte II, pp. 10-11, *1879*, parte II, pp. 10-11, *Marina mercantile 1882*, p. 4, *1883*, p. 4). To restore homogeneity with the later figures, and extrapolating the correction as a proportion of the fleet (rather than a constant figure), the figures in col. 4 are reduced by 8,000 tons in 1882 (effectively eliminating the apparent change in the ratio of net tons to gross tons), 9,000 tons in 1881, 7,000 tons in 1880 and 1879, and 3,000 tons in 1878; by 1877, fortunately, the cumulative changes cancel out. The earlier figures are left unaltered: the lack of evidence on changes due to remeasurement (especially in the *Navigazione marittima 1877*, which reports the equivalent changes for sailing vessels in detail, parte II, pp. 6-7) is taken to mean that they were not significant (though they may have reached a 2,000-ton increase in 1874, and perhaps again in 1876: *Marina mercantile 1881*, p. 8, *Navigazione marittima 1883*, p. 450); and changes due to the incorporation of the Venetian and Roman provinces appear to have been quite insignificant (*Navigazione marittima 1867*, pp. 100-101, *1870*, p. 104, *1883*, p. 449). Second, to allow for significant remeasurement after 1905, the reported figures are augmented by 16,000 tons in 1906, 21,000 tons in 1907, 23,000 tons in 1908-10, 24,000 tons in 1911-12, and 25,000 tons in 1913 (*Marina mercantile*, e.g., *1906*, pp. 48-49, *1910*, pp. 85-86, simply cumulating the reported changes in 1906-13). Third, the year-end figures in 1860 and 1861 are estimated directly at 0 and 5 thousand tons, respectively, against 10, 18, and 20 thousand tons in 1862, 1863, and 1864, respectively. Col. 7 is the resulting 1860-1913 year-end series, shifted forward half a year.

The estimated year-end gross tonnage of the steamer fleet is derived even more directly from col. 5. To allow for significant remeasurement after 1905, the reported figures are augmented by 30,000 tons in 1906, 35,000 tons in 1907, 37,000 tons in 1908-09, 25,000 tons in 1910, and 22,000 tons in 1911-13 (*Marina mercantile*, e.g., *1906*, pp. 48-49, *1910*, pp. 85-86). Col. 8 is the resulting 1882-1913 year-end series, shifted forward half a year.

The throughput of the dry-docks and beaching slips is documented in Table F.25. The figures in cols. 1 – 4 are transcribed from the *Marina mercantile 1885* ff. (e.g., *1885*, p. 114, *1900*, p. 213, *1913*, p. 457); exceptionally, the sailing-vessel numbers and tonnages for 1906 and numbers for 1910, and the steamer tonnages for 1910 and 1912, are the sums of the disaggregated data rather than the manifestly incorrect reported aggregates. These figures cover private docks and slips only: the Royal yards are explicitly excluded in 1892-1905, and in 1899-1905 the number and tonnages of merchant vessels served by the Royal yards are reported separately (cols. 5 – 8). The surge in steamer tonnage from 1890 to 1891 (col. 2) is not spurious: it stems from the reactivation, after enlargement, of the major dry-dock in Livorno (*Marina mercantile 1887*, pp. 258-259, *1890*, pp. 286-287, *1891*, pp. 356-357). The sources do not identify these register tonnages as net or gross; they are here tentatively identified as net tons, on the basis of the following four bits of evidence. First, net tonnages were the measure relevant to most purposes (though perhaps not to the dry-docks and beaching slips), and in these sources unspecified tons are typically net rather than gross (thus for instance the sources of the fleet net tonnages cited above). Sailing-vessel gross tonnages, in particular, were quoted rarely if at all (the only figures appear to be those for individual very large vessels in the *Marina mercantile 1908* ff., e.g., *1908*, p. 79, *1913*, pp. 123-125). Second, some individual figures are extremely small (under 10 tons), suggesting the net tonnage of tugs; boats of less than 10 gross tons were presumably beached by hand. Third, the tonnage of the vessels served by one of the

Royal yards in 1899 is identified as a gross tonnage, suggesting that the other figures were net tonnages. There is, admittedly, at least one significant bit of evidence against the present interpretation, in that the differences between the average tonnages of the vessels served by beaching slips and dry-docks on the one hand and the average tonnages of the vessels in the domestic fleets on the other are much smaller, and therefore more easily explained, if the reported tonnages are in fact gross rather than net; but this consideration would not appear to outweigh the opposite evidence cited above. The estimated aggregate throughput is transcribed in cols. 9 and 10. Since the Royal-yard sailing tonnage seems typically to have been negligible, col. 9 is the simple sum of the reported figures in cols. 2 and 6. The estimated steamer tonnage in col. 10 is similarly the sum of the reported figures in cols. 4 and 8, augmented by an allowance of 50,000 tons p. a. in 1885-98 (implicitly attributed, in the main, to the Venetian works); the Royal-yard tonnage in 1906 ff. is instead neglected, on the presumption that the growing arms race kept the Royal yards fully occupied.

Port movements are documented in Table F.26. The reported aggregate foreign-flag and Italian-flag arrivals in cols. 1 – 8 are transcribed from the *Navigazione marittima 1913*, vol. 2, pp. VIII-XVII; there is again no indication as to whether the reported tonnages are net or gross, but in this case they can be identified as net tons with virtual certainty. These data cover all vessels arriving for commercial purposes (i.e., to load or unload passengers or freight, and not exclusively for pleasure, refuge, or supplies), whether from a foreign port or from another Italian port (respectively 65% and 35% of the foreign-flag steamer tonnage in 1913); the only significant exception appears to be the exclusion of the coasting trade of some minor ports in 1879 and 1880 (*Navigazione marittima 1913*, vol. 2, pp. V-VI, 4-9, *1887*, pp. 344-345), which shows up here in the unusually high mean size of the arriving vessels (col. 6/col. 5, col. 8/col. 7), in those two years. These series include the Venetian and Roman coasts only from 1867 and 1871, respectively (*Navigazione marittima 1867*, p. 56, *1870*, p. 46, *1871*, p. 56). In 1871, the new Civitavecchia district accounted for some 3% of the foreign-flag sail tonnage, 6% of the foreign-flag steam tonnage, 2% of the Italian-flag sail tonnage, and again 2% of the Italian-flag steam tonnage (*Navigazione marittima 1871*, p. 56). In 1867, in turn, the new Venezia district accounted for 192,526 foreign-flag and 210,927 Italian-flag tons; assuming 66% of the former and 29% of the latter were steam-powered, as suggested by the breakdown in 1869, the Venetian coast then accounted for some 7% of the (reported) foreign-flag sail tonnage, 8% of the foreign-flag steam tonnage, 5% of the Italian-flag sail tonnage, and 2% of the Italian-flag steam tonnage (*Navigazione marittima 1867*, p. 56, *1869*, p. 46).

The figures on the international arrivals of Italian-flag vessels in col. 9 – 12 refer in principle to arrivals directly from foreign ports; until 1875, however, this principle was not rigorously applied, and vessels that originated in a foreign port could be counted as an international arrival in every Italian port they entered (e.g., *Navigazione marittima 1887*, pp. 344-345, *Annuario 1898*, p. 224). The present figures are obtained, for different runs of years, as follows. Those for 1901-13 are the data reported in the *Navigazione marittima*, e.g., *1913*, vol. 2, pp. 191-192 (for 1909-13), *1909*, vol. 2, p. 333 (for 1905-09), *1904*, p. 636, *1901*, pp. 692-693; they again refer to arrivals for commercial purposes, and include ships in ballast. Comparable data do not seem to be available for 1897-1900. The apparently comparable figures for 1862-63, 1864-82, and 1887-96 are from the *Navigazione marittima 1863*, pp. 180-181, *1882*, pp. 332, 334, and *1896*, pp. 558-559, which include retrospectives; those for 1861 and 1883-86 from the current issues, e.g., *Navigazione marittima 1861*, pp. 58, 66, *1883*, pp. 420, 422, *1886*, pp. 436, 438. These series again include the Venetian and Roman coasts only from 1867 and 1871, respectively. The detailed data in the *Navigazione marittima 1871*, p. 32, allow the Civitavecchia district a negligible share of the steamer tonnage, and 2% of the sailing-ship tonnage, in 1871; the overlapping series in the *Navigazione marittima 1882*, pp. 332, 334,

allow the Venetian coast some 7% of the steamer tonnage, and 13% of the sailing-ship tonnage, in 1867. Corresponding time series appear in the *Sommario*, p. 142, without the present gaps, but with marked (and largely offsetting) breaks in 1897 and again in 1905. The *Sommario* figures appear to match the present ones in 1861-94, and then to wander above them by, as noted, varying margins. In 1897-1901, in particular, the *Sommario* figures appear to have been obtained from the *Annuario 1904*, pp. 446-449, 454-455, counting, for the steamers, the first, third, and fourth categories (and, in 1897 alone, the fifth as well), and, for sailing ships, the first two categories (and, in 1897 alone, the third as well).

Cols. 13 and 14 report the tonnage of Italian-flag sailing-vessel total arrivals and international arrivals in cols. 6 and 10, respectively, per ton of the corresponding fleet; tonnage ratios are here preferred to vessel-number ratios, as they correct for size, and are less distorted by the progressive exclusion of many small inshore vessels. The fleet tonnages are the reported figures in Table F.24, col. 2, simply shifted forward half a year to approximate the average in service over the year; both the numerator and the denominator reflect the current measuring system. Cols. 15 and 16 are the corresponding steamship figures, obtained from cols. 8 and 12, respectively, and Table F.24, col. 4 (shifted forward half a year). The ratios of col. 14 to col. 13 and of col. 16 to col. 15 are of course the ratios of col. 10 to col. 6, and of col. 12 to col. 8, respectively, that is, the share of international arrivals in the Italian-flag total. These shares were always relatively small, especially in the case of steamships; the sailing-ship share remained near a quarter into the mid-1880s (ignoring the outliers in 1879 and 1880, when the total-arrivals tonnage excludes some cabotage), and then fell to just under one fifth, while the steamer share averaged near one ninth to 1896, and then rose to over an eighth after 1901. The significance of these variations is of course moot, as, for example, the international share may fall with both a decrease and an increase in international carriage (the one with a transfer of ships from foreign to domestic routes, the other with a lengthening of the average international voyage, all else being held constant).

An interpretation is suggested however from the path of cols. 13 – 16 themselves. The steamer figures in cols. 15 and 16 are much higher than the corresponding sailing-ship figures in cols. 13 and 14, pointing to shorter average stages as well as faster speeds and (given the higher cost of the vessel) turnaround times; and they decline sharply over time (with some sharp swings over the early decades, particularly in col. 16, presumably because relatively few ships were involved), suggesting that (domestic and international) stage lengths increased over time as engines improved and specific fuel consumption declined. The paths of the sailing-ship series in cols. 13 and 14 instead decline, and then rise again. The international-arrivals ratio in col. 14, in particular, displays a relatively smooth U-shape; this is consistent with a gradual conversion to steam of a given share of the short routes, then of the medium routes, and finally of the long routes, so that the distribution of the sailing ships is only temporarily skewed toward the longer routes. The total-arrivals ratio in col. 13 moves less regularly (even ignoring the outliers in 1879 and 1880), but regains its initial level by about 1890, and rises past it in the early 1900s, suggesting that by 1913 steamers had taken over a disproportionate share of the longer domestic routes.

Table F.27 presents the estimates of 1911-price value added in maintenance, obtained as follows. The *Inchiesta mercantile*, vol. 7, p. 325 indicates that, around 1880, an iron-hulled sailing ship of 1,174 (net) tons would need to be careened, on average, 1.5 times a year, at an annual cost equivalent to 4.47 lire per net ton and approximately 4.25 lire per gross ton. Elsewhere, the same source (vol. 1, pp. 86-87) indicates that an iron-hulled steamer of 1,310 gross tons would incur annual maintenance costs equivalent to 9.89 lire per gross ton for the hull, and 6.87 lire per gross ton for the engines, for a total of approximately 16.75 lire per gross ton. Assuming equal ratios of value added to value in careening and aggregate maintenance,

equal careening costs per gross ton regardless of propulsion system, and (as usual) constancy over time, careening is taken to represent 25% of the value added in maintenance. On the presumption that some other maintenance was performed during the halt enforced by the careening process, the dry-dock-related value added in maintenance is here assigned 33% of the total; the residual 67% is assumed to be performed only on domestic vessels, on the presumption that a vessel would normally be idled for repairs in its home port, where the crew could be discharged.

An estimate of 1911-price value added in maintenance per gross steamship ton in the domestic fleet is extrapolated from the naval-vessel estimate of value added per displacement ton discussed above in section F02.04 above. That estimate equals 30 lire per corrected displacement ton; the corrections deduct armor and the cargo capacity of the bulk carriers, so that the corrected ton corresponds essentially to the light displacement of an unarmored vessel. The disaggregated figures in the *Rendiconto consuntivo 1910-11*, parte I, p. 2011, in turn allow hulls and engines 62.5% of the total wage and overhead expense (excluding inshore craft); the above estimate of 30 lire per naval light displacement ton thus corresponds to 18.75 lire per merchant light displacement ton, which in turn corresponds to as much again per merchant net ton, and perhaps two-thirds of that, or 12.5 lire, per merchant gross ton (*Encyclopaedia Britannica*, vol. 24, p. 882). The above breakdown thus yields an estimated value added of 4.125 lire per gross ton in dry-dock-related maintenance, and 8.375 lire per gross ton in other maintenance; the former figure, in turn, is equivalent to 2.75 lire per gross ton careened (allowing an average 1.5 careenings p. a.), and, again, approximately 4.125 lire per net ton careened.

Table F.27, cols. 1 – 6 present the estimated series for steam-powered vessels. Cols. 1 and 2 are the estimates of value added in the dry-dock-related and other maintenance, respectively, of the domestic fleet; they are obtained by applying the above estimates of 4.125 and 8.375 lire per gross ton to the series in Table F.24, col. 8, extrapolated back to 1861 in proportion to col. 7. Col. 3 is in turn an estimate of the value added in dry-dock-related maintenance actually performed; in 1885-1913, it is obtained as Table F.25, col. 10, times 4.125 lire per net ton. In 1885, the estimate in col. 3 equals 1.45 million lire, against just .83 million required by the domestic fleet (col. 1); the residual .62 million lire represents net exports of maintenance services. In 1861-84, col. 3 is estimated as the sum of col. 1 and net exports, themselves estimated as gross exports (col. 5) less gross imports (col. 4). Gross imports are estimated from the expenses incurred by the two main Italian steamship operators (Florio and Rubattino) over the 3 or 3.5 years to mid-1881 (*Inchiesta mercantile*, vol. 1, pp. 483-485). Together, the breakdown of their dry-dock fees suggests that they used foreign docks for about one fifth of the necessary work, and mostly for their largest ships, which could not be accommodated in Italy. Assuming therefore that this foreign-source maintenance was fleet-related rather than route-related, and further assuming the minor operators had, on average, smaller ships, the fleet-wide average is here set at one sixth; gross imports in 1861-84 are accordingly estimated as one sixth of col. 1. In 1885, gross exports are estimated as net exports plus gross imports (col. 3 − col. 1 + col. 4), or .76 million lire; in 1861-84, they are estimated by extrapolating this figure in proportion to the foreign-flag arrivals in Table F.26, col. 4, divided by .94 and again by .92 in 1861-66, and by .94 in 1867-70 to correct for border changes. Col. 6 transcribes the estimated aggregate, which is simply col. 2 plus col. 3.

In the case of seagoing sailing vessels, on the other hand, maintenance is assumed to follow a time path represented by a weighted sum of the domestic fleet and foreign-flag arrivals right through the period at hand, and the beaching slip and dry-dock throughput (col. 9) is not taken into account. The *Inchiesta mercantile*, vol. 7, p. 325, suggests that wood- and iron-hulled sailing vessels incurred maintenance costs on a very different basis: the wood vessel

would require major repairs at relatively long intervals, while the iron vessel would require frequent careenings. Total maintenance costs (excluding the replacement of sails and cables) for a vessel of 1,174 (net) tons would average 9.5 lire per net ton with an iron hull and 13.1 lire per net ton with a wood one; since the wood vessel's (major) repairs are presumably far more materials-intensive than the iron vessel's (current) repairs, however, average maintenance value added per net ton was probably similar regardless of the hull material.

Value added at 1911 prices in the maintenance of sailing vessels is here estimated from the reported 9.5 lire per net ton for an iron-hulled sailing vessel in the *Inchiesta mercantile*. Dividing that amount by the analogous figure for an iron-hulled steamer noted above (16.75 lire per gross ton), and multiplying the result by the above aggregate estimate of value added at 1911 prices in the maintenance of steamers (12.5 lire per gross ton), one obtains an estimate of 7.1 lire per net ton.

Since this estimate applies equally to iron-hulled and wood-hulled vessels, there is no need to disaggregate the aggregate fleet by hull material in order to estimate its maintenance. On the other hand, such a disaggregation would appear critical to a proper use of the beaching slip and dry-dock throughput, since iron-hulled vessels were handled altogether more often, but proportionately less extensively per visit; in fact, the relative stability of the slips' and docks' throughput in the face of the rapid decline of the aggregate fleet (particularly puzzling, at first blush, since it is precisely the stock of the relatively large vessels, hermaphrodite brigs and above, that collapses, while that of the smallest craft remains relatively constant) appears attributable precisely to a growth in the stock of iron-hulled sailing vessels (from 32 of 29,433 net tons in 1891, when these data appear, to 154 of 166,419 net tons in 1913: *Marina mercantile 1891*, p. 130, *1913*, p. 115). Since the slip and dock throughput figures are thus difficult to use, and since in any case their coverage seems relatively poor (given the large, indeed growing, share of vessels small enough to be beached by hand), it seems best not to try to make use of them.

Cols. 7 – 10 present the estimated series for sail-powered vessels. Col. 7 is the estimated value added in the total maintenance of the domestic fleet; it is obtained by applying the above estimate of 7.1 lire per net ton to the series in Table F.24, col. 6. Cols. 8 refers to the estimated gross imports of maintenance services, tentatively obtained as follows. As estimated above, the share of the maintenance of Italian-flag steamers performed abroad equaled, in 1879-81, some 6% (col. 4/(col. 1 + col. 2)). Summing over the arrival tonnages in Table F.26, cols. 8 and 12 over 1877-78 and 1881-82 (to avoid the tainted figures in 1879-80), the share of international arrivals equaled some 11% of the steamer total; the comparable figures from cols. 6 and 10 yield a share of international arrivals in the sailing-ship total near 27%. This relatively greater participation of sail-powered vessels in international trade would seem to be more than offset, however, by two considerations. One is that the Italian facilities required to maintain sailing ships do not appear to have been constraining, as they were instead for the (largest) steamers; the other, that (wooden) sailing ships received a larger part of their maintenance at long intervals, and presumably in their home ports, so that maintenance abroad would seem to have been more nearly of an emergency nature after a particularly rough voyage. In the circumstances, around 1880 it seems reasonable to assume that sailing vessels then received abroad, on average, some 5% of their total maintenance. Taking 5% of the estimate for 1880 in Table F.27, col. 7, one obtains an initial benchmark equal to .33 million lire in 1880. Col. 8 is obtained, very simply, by extrapolating this benchmark on the basis of the international-arrival tonnages in Table F.26, col. 10, corrected as follows. To allow for border changes, the figures for 1861-66 are divided by .98 and again by .87, and those for 1867-70 by .98; to allow for remeasurement, those for 1906-13 are increased by 10%; and the missing values in 1897-1900 are obtained by linear interpolation. No attempt is made to allow for the growing share of

metal-hulled vessels, on the assumption that their greater need for careening abroad, on long voyages, was offset by their greater sturdiness, and reduced need for emergency repairs. Nor is any attempt made to allow for varying trip lengths: since the corresponding index is here the inverse of Table F.26, col. 14 (times a constant), and therefore the ratio of fleet tonnages to international-arrival tonnages (times a constant), correcting arrivals by trip length would simply return the total fleet (times a constant), and imports would represent a constant share of total maintenance; with the present algorithm, instead, that share drops from 8-10% in the early years to 4-5% from the mid-1870s through the turn of the century, and then creeps back up to some 7%.

Col. 9 refers in turn to the gross exports of maintenance services, estimated, equally tentatively, as follows. In the case of steamers, from the reopening of the Livorno dry-dock in 1891 to 1913 the ratio of net exports (col. 3 – col. 1) to foreign-flag arrivals (Table F.26, col. 4) varied between .15 and .29 lire per net ton, with a weighted average of .21 lire; allowing gross imports 10% of the dry-dock maintenance of Italian-flag steamers (col. 1), weighted gross exports averaged some .23 lire per net ton. A comparable figure may be assigned to the careening of metal-hulled foreign sailing vessels; given Italy's apparent comparative advantage in wood shipbuilding (*Inchiesta mercantile*, e.g., vol. 1, p. 373), moreover, some major repair work of wooden vessels was also presumably exported. Very tentatively, therefore, a mean of .25 lire per net ton of foreign-flag arrivals is assumed here; col. 9 is that estimate times the net tons in Table F.26, col. 2, divided by .97 and again by .93 in 1861-66, and by .97 in 1867-70, to correct for border changes.

Col. 10 is of course obtained as col. 7, minus col. 8, plus col. 9.

The consumption of lumber and semi-finished metal in the maintenance of sea-going merchant vessels is calculated here for later use. The estimates of semi-finished metal consumption are presented above in Table F.20, col. 4, and obtained as follows. In new (metal-ship) construction, metal consumption was estimated near 1,500 tons per million lire of value added, against 450 tons in naval construction; and in naval maintenance metal consumption was estimated at 75 tons per million lire, or one sixth the corresponding figure in new construction. Since the maintenance of merchant vessels did not involve the constant modifications and improvements of its naval counterpart, one would expect metal consumption per million lire in maintenance to be much less than one sixth the corresponding new-construction figure. In the case at hand, for simplicity, metal consumption is crudely estimated at 75 tons per million lire, or about one twentieth the new-construction estimate, for non-dry-dock steam-ship maintenance (col. 2), and a tenth of that again, or 7.5 tons per million lire, in dry-dock steam-ship maintenance (col. 3); metal consumption in sailing-ship maintenance is presumed negligible. The resulting estimates are transcribed above in Table F.20, col. 4.

The corresponding lumber-consumption estimates are presented in Table F.20, col. 9. The sailing-ship new-construction estimates allow .6 tons of lumber, and 235 lire of value added, per gross ton, or approximately 2,550 tons of lumber per million lire. Lumber consumption in maintenance is here tentatively set at one sixth of that, or 425 tons per million lire of value added; Table F.20, col. 9 is accordingly obtained as .425 times Table F.27, col. 10.

F02.06 Aggregate value added and employment

The estimates of value added in 1911 sum to 39.3 million lire in the new construction of naval vessels, 8.2 in that of merchant vessels, 7.0 in the maintenance of naval vessels, and 20.6 in that of merchant vessels, for an overall total of 75.1 million lire. The corresponding employment estimates are derived above (section F01.02 and Table F.02).

F03. Rail-guided vehicles

F03.01 Introduction

The rail-guided vehicles industry is here defined to cover the new production and repair of railway and tramway rolling stock. This definition appears to correspond exactly to *ISIC* category 3842, and also, in the 1911 *Censimenti*, to category 4.42: the caption to the latter simply lists the various types of vehicles, with no mention of construction or repair, but railway repair shops were traditionally considered part of the industry (e.g., *Riassunto industriale*, vol. 3, p. 122).

In Italy as elsewhere, nineteenth-century railroads attracted an enormous amount of attention, public and private; an exhaustive analysis of the evidence in the sources would require a research effort close to that devoted here to all other industries together. Failing such an effort, the present estimates are based on a limited body of evidence selected for its relative authoritativeness, chronological continuity, and accessibility; they make no use of much equally authoritative information in the published sources, or indeed of the archival material that might provide direct empirical evidence on many of the statistics crudely estimated here.

The industry at hand is here represented by separate construction and maintenance series for locomotives (including rail-cars), passenger cars, and freight cars (including baggage cars and, for new construction, tenders). Since the readily available production-side historical statistics appear limited to a few products and a few firms (e.g., Società italiana Ernesto Breda, 1908, p. 31), the present estimates of aggregate rolling-stock construction are tentative figures obtained by separately estimating the annual numbers of locomotives and rail-cars, passenger cars, and freight, baggage, and service cars acquired by major lines, by standard- and narrow-gauge minor lines, by tramway companies, and by other concerns. These twelve series are converted into units of weight, separating locomotives and tenders, and combined into three type-specific aggregates. Over most of the period at hand, the three type-specific domestic production series are obtained from the weights-acquired series by deducting the corresponding net imports, also reported in units of weight. In the early years, absent the necessary trade data, production is estimated by counting the Italian vehicles acquired by the major lines, as documented by detailed descriptions of their rolling stock, converting them into units of weight, and adding a reasonable share of those acquired by the tramways and minor railway lines. The corresponding type-specific unit value added estimates are in turn obtained directly from output and input prices and technical coefficients.

The maintenance series are instead obtained by first estimating value added in the maintenance of (and in the manufacture of replacement parts for) railway locomotives, passenger cars, and freight cars in 1911, and then extrapolating the results to 1861-1913 on the basis of locomotive, passenger-car, and freight car ton-mileage; comparable value added estimates are obtained for tramway vehicles on the basis of their weight and, in 1909, their mileage, and then extrapolated to 1861-1913 on the basis of the estimated weight of the annual stock of vehicles in service.

F03.02 Acquisitions by major lines: units

The estimated numbers of locomotives and rail-cars, passenger cars, and freight, baggage, and service cars acquired by the major railway lines (Alta Italia, Romane, Meridionali, and Calabro-Sicule, 1865-85, and their immediate predecessors, 1861-65; Mediterranea, Adriatica, and Sicula, 1885-1905; Ferrovie dello Stato, 1905-13) are presented in Table F.28, cols. 1, 5, and 9. The underlying data are abundant but imperfect, and frequently not strictly consistent; the present figures are derived from a minimal set of authoritative publications.

In 1861-84 and 1885-98, the numbers acquired each year are here assumed to equal the

numbers of the appropriate age surviving in 1885 and 1899, respectively, as reported in the *Relazione ferroviaria 1900*, parte I, vol. 2, p. 149 (also *Relazione S.F.I. 1885-87*, vol. 1, pp. LII ff.) and the *Atti ferroviari 1905*, vol. 5, parte 3, pp. 406-407.

In principle, the major weakness of these data is that they omit the vehicles both acquired and retired before 1885, or between 1885 and 1899; but railway vehicles were extremely long-lived, and in practice the likely omissions appear to be minimal. A comparison of the two sources used here indicates that between 1885 and 1899 the major rail lines withdrew the following vehicles: 91 of 289 locomotives acquired through 1860, but only 12 of 311 acquired in 1861-65, 2 of 230 acquired in 1866-70, 1 of 374 acquired in 1871-75, and 1 of 551 acquired in 1876-84; 423 of 1,128 passenger cars acquired through 1860, but only 88 of 1,366 acquired in 1861-65, 14 of 832 acquired in 1866-70, and none of the 1,661 acquired in 1871-84; 353 of 5,570 freight and baggage cars acquired through 1860 and 547 of 4,848 acquired in 1861-65, but only 231 of 4,257 acquired in 1866-70, 50 of 7,020 acquired in 1871-75, and 12 of 8,552 acquired in 1876-84 (neglecting the negative differences in 1882 and 1884, which presumably reflect the acquisition of second-hand vehicles from a minor line).

A comparison of the vehicles acquired year by year in the 1885 retrospective used here (*Relazione ferroviaria 1900*, part I, vol. 2, p. 149) and the corresponding description of the major operators' fleets shortly thereafter (e.g., *Locomotive Mediterranea 1888*, *Locomotive Adriatica 1887*, *Locomotive Sicula c.1902*) suggests that these sources are quite consistent, and drawn from the same set of company records. A much reduced level of agreement is instead found between the data used here and the annual numbers placed in service by each of the major companies (and at times the Sarde) reported, for 1880-84 and 1889-90, by the *Relazione S.F.I.* (e.g., *1880*, p. 382, *1884*, p. 506, *1888-90*, parte III, pp. 311-312, 317); the discrepancies are troubling, not easily explained, and here merely acknowledged.

A further difficulty is that the later list used here (*Atti ferroviari 1905*, vol. 5, parte 3, pp. 406-407) appears to miss 1 or 2% of the major companies' current stock of vehicles: it counts a total of 2,543 locomotives, 7,254 passenger cars, and 47,894 freight, baggage, and service cars, against 2,597, 7,385, and 48,277, respectively, listed for the end of 1898 by the company reports (*Statistica Adriatica 1899*, pp. 68-69, *Statistica Mediterranea 1899*, pp. 82-83, *Statistica Sicula 1899*, pp. 16-17); the *Relazione S.F.I. 1898*, pp. 70 ff., quotes still different, intermediate figures closer to those in the company reports. The coverage of the data used here for 1861-98 thus seems to be quite good, and their minor omissions are amply compensated by their relative convenience and freedom from ambiguity; but somewhat different numbers can at times be obtained in equally authoritative sources.

The numbers of vehicles acquired by the major railway lines in 1899-1914 are here obtained from the annual reports of the major operating companies; the data are combined into the present categories, and the passenger-car figures are corrected to exclude (otherwise double-counted) rail-cars. The company-specific estimates that underlie the aggregates in Table F.28, cols. 1, 5, and 9 are transcribed, through 1906, in Table F.29. In 1899-1905, the *Statistica Adriatica* (e.g., *1904*, pp. 70-71), *Statistica Mediterranea* (e.g., *1904*, pp. 84-85), and *Statistica Sicula* (e.g., *1904*, pp. 16-17) report the gross numbers of each type added to their fleets, with further information in the corresponding footnotes. In the *Statistica Mediterranea* and *Statistica Sicula*, these footnotes refer only to transfers and conversions; the present estimates in Table F.29 are the residuals that presumably correspond to new acquisitions. In the *Statistica Adriatica*, exhaustive footnotes typically document new acquisitions as well as transfers and conversions, so the corresponding figures in Table F.29 are quite reliable; however, vehicles purchased under the *legge 25 febbraio 1900, n. 56* were reported separately, and only as end-of-year totals. The present figures for this company thus include a second component, estimated simply as the annual increment in the corresponding stock.

The *Statistica F.S. 1905* to *1914* (e.g., *1906*, pp. 237-243) includes a main table on the fleet of the State railways, and a separate table on the fleet of some minor lines: those operated for, or by, the State railways by, or for, private concessionaires (1905-07), and narrow-gauge Sicilian lines (1910-14). The minor lines whose rolling stock was provided by the State railways can be ignored, since they are already included in the estimated acquisitions by the State railways (e.g., *Statistica F.S. 1907*, pp. 389, 399; note also the figures for State-railway vehicles leased out, pp. 390-396). The vehicles of the Roma-Nettuno, Iseo-Brescia, and narrow-gauge Sicilian lines are instead considered below, along with those of other minor lines. The Ofantino-Margherita di Savoia line is also ignored, even though it had its own locomotives and passenger cars (*Statistica F.S. 1907*, p. 399). The disposal of this fleet when operations were taken over by the State railways is not known (*Statistica F.S. 1908*, p. 1); no acquisitions by transfer are recorded by the State railways in that year, so the vehicles may have been scrapped. The size of the relevant fleet is also unknown, but appears to have been very small: the length of the line and vehicle mileage in 1908 suggest 1 or 2 locomotives and 2 or 3 passenger cars (*Statistica F.S. 1908*, pp. 256-257).

The main tables in the *Statistica F.S. 1907* to *1914* report new acquisitions as such; those in the *Statistica F.S. 1905* and *1906* are instead similar to the less informative reports of the private companies. The present estimates for 1905 and 1906 in Table F.29 are accordingly residuals, obtained by deducting the indicated transfers and conversions from the indicated gross acquisitions; exceptionally, the 1906 residual is here reduced by a further 15 locomotives, 31 passenger cars, 7 baggage cars, 62 freight cars, and 1 service car transferred from minor lines. The latter are the 46 locomotives, 152 passenger cars, 20 baggage cars, 341 freight cars, and 1 service car reported by the *Relazione S.F.C. 1906*, p. XVII, less the 14 locomotives, 31 passenger cars, 2 baggage cars, and 97 freight cars attributed to the Roma-Nettuno line and the 17 locomotives, 90 passenger cars, 11 baggage cars, and 182 freight cars attributed to the Schio-Vicenza, Vicenza-Treviso and Padova-Bassano lines in the *Relazione S.F.C. 1905*, pp. 60-87; the former were apparently not included in the State railways' fleet in 1906 (*Statistica F.S. 1906*, pp. 237, 243), while those of the latter that were not scrapped were already listed in the main table as transfers from the Venete. In 1907-14, finally, the figures in Table F.28, cols. 1, 5, and 9 are taken directly, as reported, from the *Statistica F.S.*

F03.03 Acquisitions by minor lines: units

Italy's minor railway lines were a few dozen independent systems, of various gauges, operating about one fifth of the total rail network in 1900. The estimated numbers of locomotives and rail-cars, passenger cars, and freight, baggage, and service cars acquired by these railway lines are presented in Table F.28, cols. 2, 6, and 10.

The information in the sources is much less abundant than in the case of the major lines. The most useful data appear to be the annual year-end stock figures reported in the *Relazione S.F.I. 1868*, *1871* to *1903* (e.g., *1903*, pp. 90 ff.) and the *Relazione S.F.C. 1904* to *1910* (e.g., *1910*, pp. 68 ff.), here transcribed in Table F.30 (1861-1910). The present estimates of acquisitions (Table F.28, cols. 2, 6, and 10) for 1872-1910 are the non-negative first differences in these reported stock figures, with the following exceptions (for simplicity, all corrections to the locomotives' figures are taken to refer to steam engines only). First, the reported passenger and freight car figures are corrected to exclude rail-cars (Table F.30, notes *c* and *d*). Second, the data for 1872 are adjusted to include 5 locomotives, 30 passenger cars, and 34 freight cars (as in 1871 and 1873) on the Torino-Cirié line. Third, the data for 1876-79 are adjusted to include the narrow-gauge Torino-Rivoli line (4 locomotives, 30 passenger cars, and 5 freight cars in 1876; 4 locomotives, 32 passenger cars, and 5 freight cars in 1877; 4 locomotives, 33 passenger cars, and 6 freight cars in 1878-79), separately counted in the sources (e.g., *Relazione S.F.I. 1877*, pp.

224-225, 375). Fourth, the vehicles of the Sassi-Superga line reported for 1888 (3 locomotives, 11 passenger cars, and 2 freight cars) are here assumed to have been acquired in 1884, when the line opened (*Relazione S.F.I. 1888-90*, vol. 1, part 1, pp. 62-63, 140-143). Fifth, the data for 1891 are adjusted to include an estimated 46 locomotives, 143 passenger cars, and 249 freight cars (the average of the data for 1890 and 1892) in service on the Sardinian, Lugano, and Neapolitan lines whose rolling stock was neglected by the current report. Sixth, the estimated freight car acquisitions in 1905 are the first difference in the stock figures plus 72 vehicles on the Bergamo-Ponte della Selva line that appear to have been transferred out of the line's endowment, but retained in use (*Relazione S.F.C. 1904*, pp. 72-73, *1905*, pp. 76-77). Seventh, the estimated acquisitions in 1906 are the first differences in the stock figures plus 46 locomotives, 152 passenger cars, and 362 freight, baggage, and service cars transferred from various minor lines to the State railways (*Relazione S.F.C. 1906*, p. XVII), plus another 6 locomotives and 30 passenger cars acquired by the Roma-Nettuno line covered by the *Statistica F.S.* (*1906*, pp. 242-43). Eighth, the estimated acquisitions in 1907 are the first differences in the stock figures plus 29 locomotives, 73 passenger cars, and 292 freight, baggage, and service cars transferred from the Sicula occidentale to the State railways (*Relazione S.F.C. 1907*, p. XIII), less the 5 locomotives, 15 passenger cars, and 74 freight and baggage cars of the Iseo-Brescia line reported in the *Statistica F.S. 1907*, pp. 400-401, and taken to be the line's fleet when it joined the group covered by the *Relazione S.F.C.* (*1907*, pp. 64 ff.; compare *1906*, pp. 64 ff.). Ninth, the estimated acquisitions in 1908 are the first differences in the stock figures less the 20 locomotives, 56 passenger cars, and 99 freight and baggage cars of the Roma-Nettuno line reported in the *Relazione S.F.C. 1908*, pp. 66 ff., and taken to be the line's fleet when it joined the group covered by that report (compare *Relazione S.F.C. 1907*, pp. 64 ff.; the comparable figures for this line in the *Statistica F.S. 1907*, pp. 400-401, are equal to or marginally greater than the above). Tenth and last, the estimated acquisitions in 1910 are the first differences in the stock figures plus the 18 locomotives, 24 passenger cars, and 105 freight cars built for the narrow-gauge Sicilian State railways (*Statistica F.S. 1910*, pp. 120-122, noting that only 6 of those locomotives entered service in that year).

The corresponding estimates for 1911-14 are obtained as follows. Excluding the narrow-gauge Sicilian State railways, the year-end operated route mileages and fleets are reported as 3,162 kilometers in 1907, with 465 locomotives and, excluding rail-cars, 1,371 passenger cars and 4,813 freight cars, and 3,624 kilometers in 1910, with 588 locomotives and (again excluding rail-cars) 1,687 passenger cars and 6,077 freight cars (e.g., *Relazione S.F.C. 1907*, pp. IX, XIII, and Table F.30). The resulting type-specific ratios of vehicles to mileage are calculated for 1907 and 1910, geometrically extrapolated to 1911-14, and applied to the reported year-end operated mileage (successively 3,696 in 1911, 3,694 in 1912, 3,925 in 1913, and 4,168 in 1914, *Annuario 1915*, p. 221); the resulting type-specific year-end stock estimates are transcribed in Table F.30. The estimated numbers acquired in 1911-14, transcribed in Table F.28, cols. 2, 6, and 10, are in turn the sum of two sets of elements. One is simply the first differences in the stock figures in Table F.30 (excluding passenger and freight rail-cars in 1910); the other refers to the gross acquisitions of the narrow-gauge Sicilian State railways. The latter are here attributed no (new) rolling stock in 1911; 5 locomotives (estimated as the 22 in service at year-end, plus another built, less the 18 assigned to 1910), plus 10 passenger and 77 freight cars in 1912, as reported, and, again as reported, 7 locomotives, 9 passenger cars, and 40 freight cars in 1913, and a further 8 locomotives in 1914.

Before 1872, finally, the numbers acquired by the minor lines are estimated directly from the available line-specific stock figures in 1871 and the opening dates of those lines, as follows: Torino-Cirié, 3 locomotives, 21 passenger cars, and 34 freight cars in 1868, and 2 locomotives and 9 passenger cars in 1869; Torino-Rivoli, 3 locomotives, 15 passenger cars, and

7 freight cars in 1871; Sardinian lines, 4 locomotives, 13 passenger cars, and 20 freight cars in 1871 (*Relazione S.F.I. 1867*, pp. 124 ff., *1868*, p. 48, *1872*, pp. 282 ff., 341; the Moncenisio line counted in the *Relazione S.F.I. 1868*, pp. 128-129, is excluded from the present estimates, as it was absorbed soon after by the *Alta Italia* company, and is therefore already included with the major lines).

F03.04 Acquisitions by tramway lines: units

Italy's tramways included urban (horse-drawn and then electric) lines, and suburban (horse, steam and then also electric) lines that were essentially light railways (running on public roads and not on the separate right-of-way that characterized railways proper). The estimated numbers of locomotives and rail-cars, passenger cars, and freight, baggage, and service cars acquired by the machine-tramway lines are presented in Table F.28, cols. 3, 7, and 11; col. 13 presents the corresponding estimates for horse-drawn cars.

Data on the tramways are scarce. There is no (national) periodical report dealing with horse-drawn tramways; and the relatively detailed annual *Relazione tramvie*, on machine-powered tramways, was published only for 1900-1909 (earlier information, in the *Relazione S.F.I. 1878-84*, e.g., *1884*, pp. 345 ff., appears limited to track length). The numbers of vehicles annually acquired are therefore obtained from the available data through a relatively extensive set of intermediate estimates; the more complex of these, dealing with machine-powered tramways, are presented in Table F.31. The *Relazione tramvie 1900* to *1909* (e.g., *1900*, pp. 158-159) and the *Relazione S.F.C. 1910* (p. XII) contain the following information on the end-of-year stock of tramway vehicles: in 1900-1907, separate data for steam tramways' locomotives, passenger cars, and freight cars, and electric tramways' locomotives, powered passenger cars (rail-cars), and unpowered passenger and freight cars (trailers); in 1908-10, separate data for steam locomotives, electric locomotives, electric passenger cars, unpowered passenger cars, and freight cars. A comparison of the data for unpowered vehicles in 1907 and 1908 indicates that most of the increment in the vehicles identified as passenger (or mixed) cars and freight cars (Table F.31, cols. 4 – 5) stems from the distribution of the 1,116 trailers of electric tramways, and suggests that some 69% of these were passenger cars and 31% freight cars. The reported electric-tramway trailer figures are here accordingly distributed between passenger and freight cars in these proportions (cols. 10 – 11); the other data for 1900-10 are instead transcribed without modification (cols. 3 – 5, 8 – 9).

These end-of-year stock figures for steam (cols. 3 – 5) and electric (cols. 8 – 11) tramways are then separately extrapolated back from 1900 to 1861, simply in proportion to the reported end-of-year track length (cols. 1 and 6, respectively, from the *Annuario 1905-1907*, vol. 2, p. 689, and the *Relazione tramvie 1909*, p. XXXII).

The extrapolation forward from 1910 to 1914 is based instead on end-of-year route length (Table F.31, cols. 2 and 7). The latter figures, disaggregated by type of power, are available for year-end 1900-08 and 1912, as transcribed in Table F.31, col. 2, and mid-1914 (3,227 kilometers of steam lines and 2,300 of electric lines) in the *Relazione tramvie* (e.g., *1907*, p. XII) and the *Annuario* (*1912*, p. 201, *1914*, p. 281); aggregate figures for 1909 (4,473 kilometers) and 1910 (4,606 kilometers) are also available in the *Relazione tramvie 1909*, p. XXV, and *Relazione S.F.C. 1910*, p. XII. The present route-length estimates for other years are obtained as follows. First, the year-end route length in 1914 is estimated by adding one third of the reported increment from end-1912 to mid-1914 to the reported mid-year route length. Second, the steam-tramway figures for 1909-11 and 1913 are obtained by linear interpolation. Third, the electric-tramway route mileage is estimated in 1909 and 1910 as the reported total less the estimated steam-tramway mileage, and in 1911 and 1913 by linear interpolation. The year-end stock of steam locomotives (col. 3) is then extrapolated from 1910 to 1914 on the basis

of steam route length (col. 2); that of electric locomotives and rail-cars, on the basis of electric-route length (col. 7); and that of unpowered passenger and freight cars, on the basis of aggregate route-length.

The estimated numbers of locomotives and rail-cars acquired by (machine-) tramway companies (Table F.28, col. 3) are simply the sum of the non-negative first differences in Table F.31, cols. 3, 8, and 9 (between 1910 and 1911, cols. 8 plus 9). On the assumption that horse-drawn cars were lightly built and adaptable to machine towing only with a reconstruction equivalent in practice to new construction, the increases in passenger cars on electric tramways are here treated uniformly as new cars. On the further assumption that unpowered vehicles could instead be transferred between steam and electric lines, the estimated numbers of (new) passenger and freight cars acquired by machine-powered tramway companies (Table F.28, cols. 7 and 11) are obtained as the non-negative first differences in the sum of Table F.31, cols. 4 and 10 (passenger cars) and cols. 5 and 11 (freight cars), respectively.

The corresponding estimates for horse-tramway cars (Table F.28, col. 13) are very tentative. In the apparent absence of time-series evidence on the growth of the horse-tramways fleets, the present estimates rely on the extensive but incomplete lists in the *Atti tranviari, Sunto* pp. 157 ff., and the *Notizie città 1891*, p. XXXVI (also *1888*, pp. 22, 74). These suggest a fleet of cars (passenger cars, with a negligible proportion of freight cars) numbering perhaps 800 to 850 in 1885 (685, as reported, less 50-odd for the Firenze steam tramways, plus 200-odd for Genova, Napoli, and Roma), and perhaps 1,100 to 1,200 in 1891 (854, as reported, less 100-odd for the Firenze steam tramways, plus 400-odd for Ancona, Bologna, Livorno, Verona, and what appear to be omitted lines in Milano, Roma, and Torino).

The year-end length of the horse-tramway net is in turn estimated from the railway-construction estimates derived below. The sum of the estimated mileage of the network-extensions completed (Table K.10, cols. 5 and 6), less the estimated mileage converted to machine power (Table K.10, cols. 7 and 8) is the present estimate of the net mileage added; the cumulation of the latter is the present estimate of the total year-end mileage of the horse-tramway net. This last estimate equals 274 kilometers in 1885 and 424 in 1891 (and 513 at its estimated peak in 1896), suggesting a norm of approximately three cars per kilometer of line. The estimated fleet of horse-tramway lines is obtained simply by applying that coefficient to the estimated length of the net; the positive first differences in the resulting series are transcribed in Table F.28, col. 13.

F03.05 Acquisitions by other concerns: units

The estimated numbers of (railway) locomotives and rail-cars, passenger cars, and freight, baggage, and service cars acquired by other concerns (e.g., the Post Office) are presented in Table F.28, cols. 4, 8, and 12.

Information on the rolling stock of these concerns is naturally sketchy. From 1891, the railway company and government reports include statistics on annual average rolling stock in use that distinguish between vehicles in the companies' endowments and leased or privately owned vehicles (e.g., *Relazione S.F.I. 1899*, pp. 147-173; *Statistica Adriatica 1900*, pp. 68-69, *Statistica Mediterranea 1899*, pp. 82-83; *Statistica Sicula 1899*, pp. 16-17; *Statistica F.S. 1910*, pp. 111-119; *Relazione S.F.C. 1910*, pp. 67-97). These statistics on leased and privately owned vehicles are the basis of the present estimates; selected excerpts are presented in Table F.32. For present purposes, the essential weakness of these statistics is that they are not strictly additional to the company endowment data that underlie the other acquisitions estimates described above, but rather tend to be swollen by inter-company leasing, second-hand acquisitions, and the like. The resulting margin of error is here simply accepted, in preference to that which would result from deriving aggregate estimates from the numbers of vehicles in

use, for the latter approach would make no use of the relatively more valuable information on gross, rather than net, acquisitions by the major lines.

Accounting changes create further difficulties, and in fact appear to dominate the series in Table F.32. No information at all was provided in 1892; in 1891 and 1893-98, the *Relazione S.F.I.* data simply reproduce those of the *Statistica Adriatica*, as the other companies provided no information; in 1899, all three major companies report figures high enough to suggest the inclusion of previously neglected vehicles even by the *Statistica Adriatica* (note also the apparent transfer of 560 freight cars from the company's endowment into its private ownership, *Statistica Adriatica 1899*, pp. 68-69); the 1904 figures, taken from the company reports, are swollen by the *Statistica Adriatica* vehicles purchased by virtue of the *legge 25 febbraio 1900, n. 56* (*Statistica Adriatica 1904*, pp. 70-71); and the *Statistica F.S.* figures for 1905 do not appear comparable to those for 1906 ff. In all this, the leased and privately-owned vehicles in use that appear most likely to be net additions to the estimates already compiled are those for rail-cars (probably belonging to the manufacturer), sleeping cars (probably belonging to the Wagons-lits company), mail and cell cars (belonging to the Ministero delle poste e telegrafi and the Ministero dell'interno, respectively: *Statistica F.S. 1907*, pp. 393, 398), and tank cars (belonging to private firms); one notes that the mail and cell cars were all of the passenger cars, and the tank cars most of the freight cars, listed as leased or privately owned by the *Statistica F.S.* (Table F.32). All of these vehicles (except perhaps for some rail-cars) appear to have been used exclusively by the major lines (e.g., *Relazione S.F.I. 1903*, pp. 89-119); the present estimates in Table F.28 are accordingly derived from the major-line statistics in Table F.32 (cols. 2 – 4, 7), with tentative corrections for accounting changes, as follows.

The estimated acquisitions of locomotives and rail-cars (Table F.28, col. 4) are simply the positive first differences in Table F.32, col. 2.

The estimated acquisitions of passenger cars (Table F.28, col. 8) cover sleeping, mail, and cell cars. The stock recorded in 1899 is simply assumed to have been built up over a decade, at 26 cars p. a. (1890-99); estimated acquisitions in 1900-1904 are the sum of the positive first differences in Table F.32, cols. 3 and 4; and estimated acquisitions in 1905-14 are the sum of the positive first differences in Table F.32, col. 4 (interpolating between 1904 and 1906), plus an allowance of 1 sleeping car p. a. (note that the *Statistica F.S.* neglected the Wagons-lits company's cars: e.g., *1907*, p. 389).

The estimated acquisitions of freight cars (Table F.28, col. 12) cover tank cars only. Tank cars are assumed to represent 90% of the tank and other cars recorded in 1891-1900 (Table F.32, col. 7), by analogy to their proportions in 1901 (270/309). The estimated initial stock of 50 tank cars in 1891 is assumed to have been built up over a decade, at 5 cars p. a. (over 1882-91); the increment between 1891 and 1893 is distributed over 1892 and 1893, at 29 cars p. a.; the recorded increment in 1898 is taken to include only 2 new cars; the recorded increment in 1899 is taken to include a stock of 76 cars built up over six years, at 13 cars p. a. (1894-99); and estimated acquisitions in 1900 and 1901 are 90% of the recorded increments. Estimated acquisitions in 1902-14 are the first differences in Table F.32, col. 7 (excluding the 39 other cars in 1901), save that the calculated increment in 1904 is reduced by the 100 Rete Adriatica vehicles purchased by virtue of the *legge 25 febbraio 1900, n. 56* (*Statistica Adriatica 1904*, p. 70). All of these estimates are obviously crude; in particular, they make no attempt to allow for the sensitivity of an annual average in use to acquisitions over the course of the year.

F03.06 Acquisitions: weight

The estimated vehicle-numbers acquired (Table F.28) are transformed into estimated tonnages acquired (Table F.33) on the basis of type- and year-specific unit weights estimated as follows.

The unit weights of the locomotives (excluding tenders) of major lines and other concerns (Table F.28, cols. 1 and 4) are estimated from Damen, Naglieri, and Pirani (1971), pp. 172-177, where one finds data on the construction period, aggregate number, and weights of all the locomotives that served on the Ferrovie dello Stato. Assuming that construction was evenly spaced over the reported years, and that the survival rates of different locomotive types were sufficiently close that the surviving sample remained representative even for early types, these data are used to calculate an average gross weight (in running order, excluding the coal and water capacity of tank engines) of currently built locomotives for a set of benchmarks 5 years apart (from 1866 to 1911; the 1861 figure is estimated directly at 33 tons, against 34 tons in 1862). These benchmark values are then reduced by 9% to approximate actual empty weights (as suggested by the detailed information on a variety of locomotive types in *Locomotive F.S. 1911*, pp. 54-55). These figures suggest an average unit empty weight equal to some 30 tons in 1861, 34 tons in 1866, 35 tons in 1871, 38 tons in 1876 and 1881, 40 tons in 1886, 41 tons in 1891, 44 tons in 1896, 46 tons in 1901 and 1906, and 51 tons in 1911; these benchmarks are then linearly interpolated and extrapolated (to 54 tons in 1914). Table F.33, cols. 1 and 4 are the product of these unit weights and the estimated numbers acquired in Table F.28, cols. 1 and 4.

The major lines' acquisitions of tenders (Table F.33, col. 14, to be included with freight cars, as in the *Movimento commerciale 1878* to *1906*) are estimated as the product of locomotives acquired excluding electric locomotives and rail-cars (Table F.28, col. 1; note that col. 4 includes only rail-cars) and a unit weight per locomotive. The latter weight is again estimated for a set of benchmarks, and then linearly interpolated; the benchmarks are 13 tons in 1861, 11 tons in 1866, 12 tons in 1871, 1876, and 1881, 11 tons in 1886, 13 tons in 1891, 14 tons in 1896, 11 tons in 1901, and 10 tons in 1906 and 1911. Like the locomotive estimates, these benchmarks are obtained from a frequency-weighted sum of the unit weights (net of coal and water) in Damen, Naglieri, and Pirani (1971), pp. 172-177; tank engines are attributed a zero-ton tender (the relatively low average tender weights in 1886 and 1901 ff. are due to increased acquisitions of such engines). Table F.33, col. 14 is the product of these unit weights and the estimated numbers of locomotives acquired in Table F.28, col. 1, net of electric locomotives and rail-cars.

Table F.33, col. 2 refers to the locomotives of the minor lines. It is obtained by multiplying the numbers acquired in Table F.28, col. 2 by the same unit weights as their major-line counterparts, with a 20% discount to allow for lighter equipment on secondary and narrow-gauge lines (the figures in Oppizzi, 1913, p. 591, suggest that narrow-gauge locomotives may have weighed about 70% of their standard-gauge counterparts; the *Relazione S.F.C. 1910*, pp. 64-65, indicates that 40% of the minor lines' route length was narrow-gauge).

The estimated weight of the tenders acquired by the minor lines is transcribed in Table F.33, col. 15. The average unit weight of these tenders is estimated at a constant 10 tons (applied to the locomotive-acquisitions figures in Table F.28, col. 2, net of electric locomotives and rail-cars), as there is no reason to expect the variations of that weight on the major lines to be representative of its fluctuations, if any, on the minor ones.

Table F.33, col. 3 refers to the locomotives and rail-cars of the tramway lines. Again in the presence of very little evidence, the numbers acquired (Table F.28, col. 3) are allowed a unit weight of 8 tons through 1885 and 10 tons from 1905, with a linear interpolation in 1886-1904 (Bianchi, 1883, p. 102 ff.; Oppizzi, 1913, pp. 591, 875, 885). The tramways' acquisitions of tenders are assumed negligible.

Table F.33, cols. 5 and 8 refer to the weight of the passenger cars acquired by the major railways and other concerns (Table F.28, cols. 5 and 8). The average unit weight of these passenger cars is assumed to have grown linearly between (and beyond) benchmark estimates of 7 tons in 1861 and 1866, 8 tons in 1871, 9 tons in 1876, and so on (growing at .2 tons p. a.) to

13 tons in 1896, 17 tons in 1901, 21 tons in 1906, and (again at .2 tons p. a.) to 22 tons in 1911. The early benchmarks are drawn by inspection from *Carrozze Mediterranea 1888* and *Materiale Mediterranea 1898*; the later ones, from the descriptions of car types in *Materiale F.S. 1911* (separately estimating the weight of third-class and other cars, and then weighting these two groups equally).

Table F.33, col. 6 refers to the weight of the passenger cars acquired by the minor railway lines (Table F.28, col. 6). The unit weights of these passenger cars are also estimated as 80% of the corresponding vehicles on the major railway lines.

Table F.33, col. 7 refers to the weight of passenger trailers acquired by the machine tramway lines (Table F.28, col. 7). These are are attributed a unit weight of 3 tons through 1885 (when the figures are dominated by suburban steam lines), rising linearly to 4 tons in 1895, 5 tons in 1905, and finally to (and beyond) 6 tons in 1910; these figures are compatible with the limited evidence in Bianchi, 1883, pp. 113 ff., and Oppizzi, 1913, pp. 869, 875, 885.

Table F.33, cols. 9 – 12 refer to the weight of the (machine-drawn) freight cars acquired by the various operators. The average unit weight of the freight cars (including baggage and service cars) of major lines and other concerns (Table F.28, cols. 9 and 12) is assumed to have grown linearly between (and beyond) benchmark estimates of 5.4 tons in 1860, 6.3 tons in 1870, 6.8 tons in 1880, 8.5 tons in 1890, 9.5 tons in 1900, and 10.0 tons in 1910 (*Centenario ferroviario*, vol. 2, p. 192). The average unit weights of the comparable vehicles for minor rail lines (Table F.28, col. 10) are again estimated as 80% of those on the major lines. On the basis of the usual scanty evidence (Bianchi, 1883, p. 118; Oppizzi, 1913, p. 875), the average unit weight of machine-tramway freight cars (Table F.28, col. 11) is instead assumed to have equaled 2.0 tons through 1880, and then to have grown linearly to (and beyond) 4.0 tons in 1910.

Table F.33 col. 13, finally, refers to the weight of the horse-tramways' (passenger) trailers (Table F.28, col. 13); these are here allowed a constant 2.5 tons per unit.

F03.07 Acquisitions, by weight: domestic and foreign

The disaggregated weights-acquired series in Table F.33 are combined into the corresponding aggregate series in Table F.34. The aggregate for locomotives and rail-cars in Table F.34, col. 1, is the sum of Table F.33, cols. 1 – 4; that for passenger cars in Table F.34, col. 4, is the sum of Table F.33, cols. 5 – 8 and 13; and that for freight cars, baggage cars, and tenders in Table F.34, col. 7 is the sum of Table F.33, cols. 9 – 12 and 14 – 15.

From 1878, the *Movimento commerciale* separately reports rail-guided passenger cars and freight cars (including tenders, separately recorded only from 1907); before that, they were included with other vehicles (the quinquennial summary in the *Movimento commerciale 1878* includes separate tonnage figures for railway passenger and freight cars from 1874, but these are not utilized here as the lack of a parallel reconstruction of the time series for ordinary road vehicles casts doubt on the actual significance of those figures). From 1886, locomotives (excluding tenders) are also separately reported; before that, they were included with other non-stationary steam engines. The corresponding net imports are reported in Table F.34, respectively cols. 2 (from 1886), 5 (from 1878), and 8 (from 1878). These series allow for exports from temporary (duty-free) imports of metal even when these were not included in the *commercio speciale*. In 1890 and 1891 these "reexport" data cover steam engines (of all types) and railway vehicles together, with 95.9 tons exported to Germany in 1890, and 894.3 tons exported to non-industrial countries in 1891; the 1890 reexports are here considered freight cars, while the 1891 reexports are broken down into 128.4 tons of locomotives and 765.9 tons of freight cars, by analogy to the mix in 1892, when reexports equaled 77.9 tons of locomotives (and no other steam engines) and 459.1 tons of freight cars, exported to Japan and the Balkans

(*Movimento commerciale 1890*, p. 632, *1891*, p. 634, *1892*, p. 468).

The aggregate tonnages of domestic railway vehicles delivered are estimated simply as the total acquired (Table F.34, cols. 1, 4, and 7) less the corresponding net imports (Table F.34, cols. 2, 5, and 8) in 1886-1914 in the case of locomotives (Table F.34, col. 3), and in 1878-1914 in that of passenger and freight cars (Table F.34, cols. 6 and 9). In the case of locomotives, a small negative number is obtained in 1887; it is assumed to be due to an inexact correspondence between recorded imports and recorded acquisitions, and here taken in stride.

Table F.34 is completed using the data transcribed in Tables F.35 – F.37, as follows. The individual sources are cited below; all are essentially technical descriptions of the various vehicles in service, typically in the late 1880s, on the various major railway systems, with an indication, for each type, of their number, year of construction, and source. The source is on occasion listed only as a foreign country; normally, the reference is to a firm, the location of which is often to be inferred. The firms considered Italian in the compilation of Tables F.35 – F.37 are all those with an Italian place-name in the firm name ("Officine di Savigliano"), or appended to it (as when the source was the Italian subsidiary of a foreign firm, e.g., "Frossard-Verona"), and, with varying degrees of confidence, the following: Ansaldo, Bauer, Cerimedo, Colano, Grondona, Macry & Henry, Mancardi, Miani (and Miani & Grondona, Miani & Venturi), Moncalvo, Montefiori, Orlando, Pickering, and Wilmor & Grimaldi (Maffei, a major provider of locomotives, was of course German).

Table F.35 refers to locomotives. These are all individually dated in the *Locomotive Mediterranea 1888* and the *Locomotive Adriatica 1887*. In the *Locomotive Sicula c.1902* a few groups are attributed to spans of years; these are here distributed evenly over those years, by whole units, with the eventual residual added to the last year. The old Stephenson engines that were attributed to the year of reconstruction in the *Locomotive Mediterranea 1888* (plate 62) are here excluded; and the two (foreign) railcars that the *Locomotive Adriatica 1887* (plate 92) does not date are here attributed to 1881 (*Locomotive S.F.A.I. 1884*, plate LXXIII). A comparison of the company-specific totals in Table F.35 and the corresponding series in the *Relazione ferroviaria 1900*, parte I, vol. 2, p. 149 (through 1884) which underlie Table F.28, col. 1, reveals only the few discrepancies also reported in Table F.35 (cols. 4, 8, and 12). There should be none (the present arbitrary allocation of some Sicilian locomotives apart), as the two published sources were presumably derived from the same set of company records; and since most cancel out over time, company by company, they appear to result simply from misdatings, which in turn would appear to have been more likely in the more complex source. On the further assumption that these few errors reflect the misdating of some of the (far more numerous) foreign vehicles, the aggregate data reported for the Italian locomotives (Table F.35, col. 13) are accepted as they are, with a single exception: 3 (Italian) locomotives of the Sicule are moved back from 1879 to 1878. Table F.35, col. 13, thus amended, is then multiplied by the same unit weights used to convert Table F.28, col. 1 into Table F.33, col. 1; the resulting figures are transcribed directly in Table F.34, col. 3, for the years 1861-85, and net imports (col. 2) are estimated as a residual (col. 1 minus col. 3). The neglect of the Italian locomotives acquired by the minor lines and the early (steam) tramways is based on very limited but fairly univocal evidence: on the one hand, even the Ferrovie Nord Milano, the largest of the minor railway lines, appear to have acquired only foreign locomotives in their early years (Cornolò, 1979, pp. 37-45), and almost all the tramways' locomotives appear to have been imported (*Atti tranviari*, vol. 2, pp. 170 ff.).

Table F.36 similarly refers to passenger, mail, and cell cars. These are all individually dated in the sources (*Carrozze Mediterranea 1888*, *Carrozze Adriatica 1887*, and again *Locomotive Sicula c.1902*); 4 cars of unknown builder acquired in 1861 (*Carrozze Adriatica 1887*, plate 59) are considered foreign. The comparison of the company-specific totals in Table

F.36 and the corresponding series in the *Relazione ferroviaria 1900*, parte I, vol. 2, p. 149 (through 1884) which underlie Table F.28, col. 5, reveals the discrepancies also reported in Table F.36 (cols. 4, 8, and 12): none in the case of the Mediterranea, few and small in that of the Sicule, and more numerous, and significant, in that of the Adriatica, especially in the 1860s. The net balance of these is positive, and may reflect the marginal incompleteness of the later source noted in section F03.02 above; here too, this discrepancy is taken in stride. Proceeding much as before, the weight of the major lines' acquisitions of Italian vehicles is estimated simply as the total units in Table F.36, col. 13, times the average unit weights used to convert Table F.28, col. 5 into Table F.33, col. 5. The passenger cars of the early minor lines and tramways appear to have been a mix of domestic and foreign vehicles, like those of the major lines (*Atti tranviari*, vol. 2, pp. 170 ff.; also Cornolò, 1979, pp. 100-104). Among the major lines, the share of domestic vehicles over the relevant years (1868-77) varied from just 17% for the Mediterranea to 76-79% for the Adriatica and Sicule, with a weighted average of 46%. Here, the weight of the domestic vehicles acquired by the minor lines and tramways is estimated simply as half the estimated totals reported in Table F.33, cols. 6 – 7 and 13. The resulting aggregate weight for all rail- and tramways is transcribed in Table F.34, col. 6, for the years 1861-77, and net imports (col. 5) are estimated as a residual (col. 4 minus col. 6).

Table F.37 in turn refers to freight, baggage, and service cars. These are all individually dated in the sources (*Carrozze Mediterranea 1888*, *Carri Mediterranea 1888*, *Carri gru Mediterranea 1898*, *Carri Adriatica 1887*, *Locomotive Sicula c.1902*, and *Carri Sicula c.1902*), save for 10 (*Carri Adriatica 1887*, page following plate 173), which are here simply ignored, and a number of freight cars (in *Carri Sicula c. 1902*), which are dated by a pair of years and here distributed evenly over those years, by whole units, with the eventual residual added to the second year. The comparison of the company-specific totals in Table F.37 and the corresponding series in the *Relazione ferroviaria 1900*, parte I, vol. 2, p. 149 (through 1884) which underlie Table F.28, col. 5, reveals the discrepancies also reported in Table F.37 (cols. 4, 8, and 12). In the case of the Mediterranea, the discrepancies are mostly positive, and largely disappear if the crane cars are excluded (as if they had been omitted altogether by the cited retrospective); in that of the Adriatica, instead, the discrepancies largely cancel, and point to misdatings. In the case of the Sicula, finally, there are numerous small discrepancies, which tend to cancel to a small positive residual (which may again reflect the exclusion of service cars in the cited retrospective). The estimates of the aggregate weight of the Italian vehicles acquired in 1861-77 are obtained again as the sum of various components. The first refers to the major lines' acquisitions of Italian freight, baggage, and service cars; it is estimated simply as the total units in Table F.37, col. 13, times the average unit weights used to convert Table F.28, col. 9 into Table F.33, col. 9. The second refers to the (major lines') acquisitions of tenders; it is estimated as the number of Italian locomotives delivered (Table F.35, col. 13) times a constant 12.5 tons (per tender) per locomotive. The third refers to the freight and other cars of the early minor lines and (the very first) tramways. Here too, over the period 1868-77 there were sharp differences within the major lines, with the share of domestic cars equal to just 16% for the Mediterranea, 69% for the Adriatica, and 67% for the Sicula, with a weighted average of 42%. Here, the weight of the domestic vehicles acquired by the minor lines and tramways is again estimated simply as half the estimated totals reported in Table F.33, cols. 10 – 11. The resulting aggregate weight for all rail- and tramways is transcribed in Table F.34, col. 9, for the years 1861-77, and net imports (col. 8) are then estimated as a residual (col. 7 minus col. 9).

F03.08 New production

Table F.38 presents in cols. 1 – 3 the final estimates of the domestic production of rail- and tramway vehicles. To approximate the desired accrual basis, these production estimates are

the corresponding domestic-vehicle weight-acquired estimates in Table F.34, cols. 3, 6, and 9, shifted half a year backward.

Table F.38, cols. 4 – 5 present the estimates of the corresponding consumption of metal and wood, estimated here for later use. Locomotives (and, for simplicity, rail-cars) are assumed to be all-metal; allowing 15% for waste, the corresponding consumption is estimated as 1.15 tons of metal, and zero tons of wood, per ton produced (col. 1).

The estimates for unpowered vehicles are more complex. The *Centenario ferroviario*, vol. 2, Tables X, XI (following p. 192) provide brief technical descriptions of domestic vehicles at decadal intervals from the mid-nineteenth century; these appear to refer to (typical) vehicles then in production rather than in use. Passenger cars are described as being ever wood-bodied, with a wood chassis in 1860, a mixed wood/iron chassis in 1870, and an iron (or steel) chassis from 1880; "enclosed" freight cars are described as having an iron chassis and a wood body from 1860 to 1910, while "open" cars were all-wood in 1860 and with an iron chassis and a mixed wood/iron body from 1870.

In the case of passenger cars, the "all wood" vehicles of 1861 are allowed a 10% metal content (the wheels, axles, couplers, etc.); allowing 15% for waste in metal, and 18% for waste in (natural and therefore less homogeneous) wood, materials consumption in 1861 is estimated at .115 tons of metal and 1.062 tons of wood per ton of output. In 1871, by weight, the chassis is taken to consist of equal parts of wood and metal, with the entire chassis equal by weight to one third of the all-wood body; these correspond to 1 part of metal to 7 parts of wood. Scaling these to total .900 tons and adding the .100 tons of metal reserved for the undercarriage and the like, these yield vehicle-content estimates equal to .2125 tons of metal and .7875 tons of wood; allowing for waste, as above, these translate into some .244 tons of metal and .929 tons of wood per ton of output. In 1881, on the same logic, the (all-metal) chassis and (all-wood) body work out to 1 part of metal to 3 parts of wood, which scale to .225 tons of metal and .675 tons of wood; adding the .100 tons reserved for metal and allowing, as above, for waste, the consumption estimates per ton of output work out to some .374 tons of metal and .797 tons of wood. The consumption of metal and of wood is estimated from the production series in col. 2 on the basis of these coefficients, linearly interpolated from 1861 to 1871 and again from 1871 to 1881, and kept constant after 1881.

In the case of "enclosed" freight cars, 10% of the weight is here attributed to the metal undercarriage and the like; the (metal) chassis and the (wood) body are taken to have accounted for one third, and two thirds, of the residual 90%. Allowing as above for waste, these vehicles are attributed .460 tons of metal, and .708 tons of wood, per ton of output throughout the period at hand. In the case of "open" freight cars, in 1861 these are taken to be "all wood": as above, this translates into .115 tons of metal (for the undercarriage and the like) and 1.062 tons of wood per ton of output. In 1871, the (metal) chassis and the (mixed wood/iron) body are allowed equal weights, and the body is allowed equal shares of the two materials; again assigning 10% of the weight to the metal undercarriage and the like, and allowing for waste as above, consumption is estimated at .891 tons of metal and .266 tons of wood per ton of output. Assuming, finally, that "open" cars represented 60% of production, average consumption is estimated at .253 tons of metal and .920 tons of wood in 1861, and .719 tons of metal and .443 tons of wood in 1871. The consumption of metal and of wood is estimated from the production series in col. 3 on the basis of these coefficients, linearly interpolated from 1861 to 1871 and kept constant after 1871.

Value added in 1911 is estimated from output and input prices (import prices plus tariff, from the *Movimento commerciale*) and technical coefficients, as follows. Locomotives were worth some 1,640 lire per ton. The corresponding materials are estimated to have cost 390 lire, or some 43 lire for .18 tons of (semi-finished) castings at 240 lire per ton, 180 lire for .80 tons of

iron and steel beams and plate at 225 lire per ton, 92 lire for .17 tons of steel tubing at 540 lire per ton, and 75 lire for fuel and other neglected items; the technical coefficients are adapted from Giordano, 1864, p. 349, with the substitution of steel tubing for the far more expensive copper tubing used in the 1860s. The corresponding value added estimate equals 1,250 lire per ton, or 19.05 million lire for 15,240 tons of locomotives.

Third-class passenger cars were worth 1,260 lire per ton. The corresponding materials are estimated to have cost some 85 lire for .374 tons of metal (iron and steel beams and plate, with an admixture of castings), as estimated above, 76 lire for .797 tons of wood (worth 95 lire per ton), again as estimated above, and perhaps 64 lire for fuel, toilet fixtures, and other neglected items, for a total of 225 lire, and a value added of 1,035 lire per ton of output. First-class cars were worth an additional 380 lire per ton, but perhaps 90% of that was presumably absorbed by the cost of superior furnishings (notably overstuffed seats rather than wooden benches, given that overstuffed furniture was valued at over 4,000 lire per ton), so the corresponding value added per ton was plausibly near 1,075 lire per ton. The (weighted, by .625 and .375, respectively) average value added selected here equals 1,050 lire per ton of output, or 10.86 million lire for 10,340 tons of passenger cars.

Freight cars were worth 650 lire per ton if "open," and 750 lire per ton if "enclosed" (and a uniform 850 if all-metal); the weighted average consistent with the present estimates of materials consumption equals 690 lire per ton. Allowing 162 lire for .719 tons of metal, as estimated above, 42 lire for .443 tons of wood, again as estimated above, and 36 lire for fuel and other neglected items, value added is estimated at 450 lire per ton, or 28.25 million lire for 62,770 tons.

These estimates of value added in the construction of rail-guided vehicles in 1911 sum to 58.2 million lire.

F03.09 Maintenance: railway rolling stock

The engineering industry includes the maintenance of rail-guided vehicles performed by repair-shop personnel (and, as usual, the manufacture of replacement parts); the petty maintenance performed by station or traveling personnel is considered part of the transportation sector (*Censimento demografico*, category 8.32). The sources contain a variety of statistics on the maintenance of railway rolling stock; but these do not appear to provide satisfactory indices of the activity relevant here, and are accordingly eschewed in favor of a simple indirect index.

Railway rolling stock maintenance expenditure data are available in the *Relazione S.F.I.*, *Relazione S.F.C.*, and *Statistica F.S.*, as well as in the individual companies' reports. From 1876 to 1912, the data separate major maintenance, which might be expected to correspond closely to the activity of interest here, from minor maintenance, cleaning, and lubricating (e.g., *Relazione S.F.I. 1876*, pp. 248, 268, 284, 300, 316, 330, 344, 358, *1903*, pp. 410-16; *Statistica F.S. 1912*, p. 372). In fact, however, these major-maintenance expenditure figures appear to be very poor indices of real maintenance, in part because of the general problem of deflating current expenditure, but most severely because they are the expression of essentially arbitrary, and inconstant, accounting conventions. In particular, the most dramatic departure from relatively steady growth displayed by these statistics -- the jump in the State railways' expenditure on passenger and freight cars from 13 million lire in 1906 to 36 million lire in 1911 -- may be almost entirely a matter of accounting. The retrospective figures in the *Statistica F.S. 1909*, p. 306, suggest a virtual stasis from 1906; later issues increase the later figures but simply reproduce earlier ones, suggesting a 50% increase over those same years -- but then attribute the revisions to a more rational system of accounts (*Statistica F.S. 1911*, pp. 367, 370). The subsequent near-doubling to 1911, in turn, is contradicted by the ancillary data described below, and most directly by the verbal accounts of maintenance activity in those years (which report no

more than a slight increase, and do not comment on the increase in the budget figure: *Relazione F.S. 1909-10*, p. 82, *1910-11*, p. 81).

Statistics on the number of vehicles actually repaired are also available, in two versions. The more systematic series, available continuously from 1891 (e.g., *Relazione S.F.I. 1891*, pp. 266-297), refers to the average number of vehicles in the repair shops. From 1906, the figures in the *Statistica F.S.* (e.g., *1906*, p. 237) include, and are in fact dominated by, the much larger numbers of vehicles that are idle awaiting repair, or being repaired by station personnel (*squadre di rialzo*); for present purposes, in any event, the value of these figures is largely nullified by the lack of complementary time-series evidence on the intensity of the repair shops' activity. The less systematic information concerns the number of vehicles actually processed by the repair shops. Evidence on the intensity of work is presented in the form of a rough breakdown by extent of repair (e.g., *Relazione S.F.I. 1880*, p. 388, *Relazione F.S. 1905-06*, p. 106), but only rarely; without it, unknown changes in the extent of repair may easily dominate the changes in the number of vehicles repaired (e.g., the *Relazione F.S. 1913-14*, pp. 80-81, notes a decrease in expense despite an increase of about a third, on average, in the number of vehicles repaired, because the better condition of the vehicles reduced the average repair).

Finally, repair-shop employment figures are also available, but only rarely (e.g., *Relazione S.F.I. 1891*, pp. 414-417, *1900*, pp. 440-443; *Statistica F.S. 1905*, pp. 217-219); the most nearly relevant employment data available on a regular basis refer to the much broader totals for the entire rolling stock and traction division (e.g., *Statistica F.S. 1905*, pp. 214-215), while figures on the employment of private maintenance contractors do not appear to be available at all.

On balance, then, these ostensibly direct measures of maintenance activity appear to be very weak time series indicators; a simple indirect index would appear to perform as well or better. There is of course a choice of such indices; the stock of vehicles maintained is the most obvious, but probably not the best. The basic index selected here is the total vehicle ton-mileage actually performed, which corrects the simple stock figures for intensity of use and also -- as heavier vehicles typically require more maintenance (*Relazione F.S. 1913-14*, p. 72) -- for changing vehicle size.

The relevant mileage data are presented in Tables F.39 and F.40, along with the estimates that directly or indirectly complete the mileage series selected here (Table F.39, cols. 1, 3 – 4; also Table F.40, cols. 3 – 4, 7 – 8). The comprehensive vehicle-mileage figures for 1867-68 and 1872-1903 and axle-mileage figures for 1881-90 in Table F.39 are transcribed directly and unambiguously from the current *Relazione S.F.I.*, with only the following exceptions. First, the *Relazione S.F.I. 1867*, p. 145, reports only on aggregate vehicle mileage for passenger and freight cars together; the present breakdown is based on their ratio in 1868. Second, the 1872-75 vehicle mileage figures are all from the *Relazione S.F.I. 1875*, p. 329. Third, the breakdown in the sources is relatively complex from 1891 on; the present vehicle-mileage figures are those presented for each line's own vehicles on any line's track, but include the mileage of mail and cell cars listed as belonging to other concerns from 1893 (e.g., *Relazione S.F.I. 1895*, pp. 75-87, cols. 175, 186, 194, 208, 219, 239). Fourth, the present estimate of freight-car mileage in 1898 includes 71.2 million vehicle-kilometers for Rete Adriatica vehicles on other lines (the average of the figures reported in 1897 and 1899; the corresponding figure for 1898 was omitted from the current report, p. 109, line 2, col. 218). Other corrections appear to be unnecessary; in particular, the 1891 vehicle-mileage figures cover the minor Sardinian lines (omitted by the current vehicle-stock data), and the remaining omissions appear insignificant. One notes, however, that the varying ratios of passenger-car vehicle mileage to axle mileage can be traced at least in part to the occasional computation of vehicle mileage on an axle-weighted basis that in effect reduces it to half the axle mileage

(*Relazione S.F.I. 1883*, p. 402, *1884*, p. 414, *1885-87*, vol. 3, pp. 78-80, 270-272, 522-524, *1890*, p. 144).

The figures for major lines in Table F.40, cols. 1 – 5, excluding only col. 3 in 1904-09 and col. 4 in 1910-13, are obtained directly from the major operators' reports. In particular, the present figures for 1904 in cols. 1, 2, and 4 are the sums of those that correspond to the 1891-1903 figures in Table F.39, cols. 1, 2, and 4, as reported in the *Statistica Adriatica 1904*, p. 73, *Statistica Mediterranea 1904*, pp. 89-91, and *Statistica Sicula 1904*, p. 18 (cols. 113, 114, and 120, in all three reports); the *Statistica Adriatica* figures are adjusted to include the mileage of mail and cell cars listed as belonging to other concerns, and to distribute the aggregate passenger and baggage car mileage on other lines' track (col. 120) between passenger cars (attributed 80% of the reported sum, as in 1903) and freight cars. The present figures for 1905 in Table F.40, cols. 1, 2, and 4 are obtained as the sum of the corresponding statistics for the first semester reported by the three major private operators, plus those for the second semester reported by the Rete Adriatica and the State railways. The second-semester Rete Adriatica figures omit the mileage performed on other lines' track; it is here estimated from the mileage on its own track, on the basis of the ratios prevailing in the first semester (the corresponding percentage increases are very small, except for a 40% increase in freight car mileage). The second-semester State railways' figures include the mileage of mail and cell cars belonging to other concerns, as well as the mileage separately reported for the Roma-Nettuno line in *Statistica F.S. 1905 (2° Semestre)*, p. 155. The present figures for 1906 in cols. 1, 2, and 4 are those reported for the State railways, plus those separately reported for the Roma-Nettuno line and for the Meridionali and Venete lines (*Statistica F.S. 1906*, pp. 254-255, 262, 264). The relevant data do not appear to have been included in the *Statistica F.S. 1907*; that year's figure for locomotive mileage (col. 6) is taken from the *Statistica F.S. 1908*, pp. 140-141, while those for passenger and freight cars (cols. 7 and 9) are obtained by allocating their sum, also reported in the 1908 issue, as reported in the *Annuario 1911*, p. 188. Finally, the figures in cols. 1, 2, and 4 for 1910-13 include those separately reported for the narrow-gauge Sicilian lines (e.g., *Statistica F.S. 1910*, p. 150).

The minor-line figures for 1904-10 in Table F.40, cols. 6 – 8 (again referring to the mileage of each line's own vehicles on any line's track) are similarly obtained directly from the *Relazione S.F.C.* (e.g., *1910*, pp. 112-127).

The estimates that complement these data, in turn, are obtained as follows. First, the minor-line vehicle-mileage figures in Table F.40, cols. 6 – 8 are extrapolated from 1910 to 1913 simply in proportion to the growth of the estimated year-end fleets; excluding the narrow-gauge Sicilian State railways, these are taken to have equaled 588 locomotives, 1,687 passenger cars, and 6,077 freight cars in 1910 (above, F03.03), and thereafter as indicated in Table F.30.

Second, the relevant major-lines mileage series are extrapolated as necessary to complete the 1904-13 series. In the case of passenger-cars, in 1904-09 axle mileage (col. 3) is estimated from vehicle mileage (col. 2), and in 1910-13 vehicle mileage (col. 2) is estimated from axle mileage (col. 3), using the (three-digit) average number of axles per passenger car in the fleet at the end of the year, calculated from the figures reported in the *Statistica F.S.* (e.g., *1909*, pp. 112-113, *1913*, pp. 120-121; the 1904 average is a direct estimate that interpolates the 1903 major-line figure of 2.11 calculated from the *Relazione S.F.I. 1903*, pp. 90-91, and the 1905 State railways' figure of 2.15). Freight-car vehicle mileage in 1910-13 (col. 4) is instead the reported axle mileage (col. 5) divided by 2.02; the corresponding average number of axles per freight, baggage, and service car was 2.022 in 1910 and 2.024 in 1913.

Third, the aggregate series for 1904-13 (Table F.39, cols. 1, 3 – 4) are obtained from the corresponding partial series (Table F.40, cols. 1, 3 – 4, 6 – 8), as follows. Aggregate locomotive mileage (Table F.39, col. 1) and freight-car mileage (Table F.39, col. 4) are the direct sums of

the corresponding components (Table F.40, cols. 1 and 6, cols. 4 and 8); aggregate passenger-car axle-mileage (Table F.39, col. 3) is the sum of the major-lines' axle-mileage (Table F.40, col. 3) on the one hand, and the minor-lines' vehicle mileage (Table F.40, col. 7) times 2.1 (against an average number of axles per vehicle equal to 2.10 in 1903 and 2.12 in 1910, *Relazione S.F.I. 1903*, pp. 90-93, *Relazione S.F.C. 1910*, pp. 70-71) on the other.

Fourth, the aggregate passenger-car axle mileage figures for 1891-1903 (Table F.39, col. 3) are interpolated, as follows. In 1890, the ratio of axle mileage to vehicle mileage is just 2.02 (less than the 2.07 of 1881), suggesting that most vehicle-mileages were calculated on an axle-weighted basis (as described above) that in effect inflates the reported vehicle mileage. The latest vehicle mileage figures transcribed here were not weighted, as is obvious from the relative (reported) vehicle and axle mileage figures in 1909 and 1910; the basic switch from weighted (inflated) to true vehicle mileage figures is here judged to have taken place between 1900 and 1901, when the passenger-car mileage data show a drop that contrasts with the increase in locomotive and freight car mileage. The present passenger-car axle mileage estimates are accordingly the reported vehicle-mileage figures times 2.02 in 1891-1900 (as in 1890), and times the actual average number of axles per vehicle (as calculated from the *Relazione S.F.I.*, e.g., *1901*, p. 87) in 1901-1903 (successively 2.08, 2.10, and 2.11). This results in a 3% increase in passenger-car axle mileage from 1900 to 1901, comparable to 3% and 2% increases in locomotive and freight car vehicle mileages, respectively.

Fifth, the aggregate passenger-car axle mileage figures for 1861-80 (Table F.39, col. 3) are estimated, as follows. In 1867-68 and 1872-80, axle mileage is estimated on the basis of vehicle mileage. In 1881, the ratio of axle mileage to vehicle mileage is 2.07; in view of the rapid increase in vehicle weights in the later 1870s (above, F03.06), the ratio of axle mileage to vehicle mileage is set equal to 2.00 from the early years through 1874, then increased by .01 p. a. to 2.06 in 1880. The estimates for 1861-66 and 1869-71 are based instead on the length of the railway net at the end of each year, as reported in the *Annuario 1881*, p. 402. The present figures for 1861-66 allow a constant 27,300 axle-kilometers per kilometer, as in 1867; those for 1869-71 are based on axle-kilometer per kilometer figures that (geometrically) interpolate the 28,400 obtained for 1868 and the 35,200 obtained in 1872.

Sixth and last, the locomotive and freight-car mileage figures for 1861-66 and 1869-71 (Table F.39, cols. 1 and 4) are estimated, again on the basis of the railway-net figures cited above. The locomotive mileage figures for 1861-66 allow a constant 4,030 vehicle-kilometers per kilometer of line; those for 1869-71 allow vehicle-kilometers per kilometer that (geometrically) interpolate the 3,860 obtained for 1868 and the 4,590 obtained for 1872. The freight-car mileage figures for 1861-66 similarly allow a constant 24,400 vehicle-kilometers per kilometer of line, while those for 1869-71 allow vehicle-kilometers per kilometer that (geometrically) interpolate the 25,200 obtained for 1868 and the 37,500 obtained for 1872.

The estimates of vehicle-ton-kilometers that serve here as the real indices of railway-vehicle maintenance are obtained from the mileage figures in Table F.39, and unit weights. Benchmark estimates of the average weight of the vehicles actually in use are estimated by comparing the numbers of vehicles in service and their total weight, calculated by assuming an initial stock and average weight, and cumulating the numbers and weights of the vehicles acquired, allowing for retirement after a fixed span of years (whether the vehicle was actually written off or merely idled).

In the case of locomotives, the present calculation allows 300 vehicles at 25 tons each at the end of 1860, and cumulates the railways' acquisitions in units (Table F.28, cols. 1, 2, and 4) and weight (Table F.33, cols. 1, 2, and 4), allowing for retirement after thirty years; the figures so obtained suggest that the average weight of the locomotives actually in use can be approximated by a linear interpolation of benchmarks equal to 26 tons in 1861, 31 in 1871, 33

in 1881, 37 in 1891, 39 in 1901, 44 in 1911, and 45 in 1913. These unit weights are here multiplied by the locomotive vehicle-kilometers in Table F.39, col. 1; the resulting vehicle-ton-mileage series is presented in Table F.41, col. 1.

In the case of passenger cars, the present calculation allows 1,200 vehicles at 6.5 tons each in 1860, and cumulates the railways' acquisitions in units (Table F.28, cols. 5, 6 and 8) and weight (Table F.33, cols. 5, 6, and 8), again allowing for retirement after thirty years; the figures so obtained suggest that the average weight of the cars actually in use can be approximated by a linear interpolation of benchmarks equal to 6.6 tons in 1861, 6.9 in 1871, 7.5 in 1881, 9.3 in 1891, 11.0 in 1901, 16.0 in 1911, and 16.8 in 1913. The corresponding benchmark estimates of axles per vehicle are derived from Tables F.39 and F.40, save of course when vehicle-mileage was itself calculated, in the sources, on an axle-weighted basis. Average axles per vehicle are thus set at 2.00 in 1861 and 1871, 2.07 in 1881, 2.08 in 1901, and (as the ratio of Table F.39, col. 3, to Table F.40, cols. 2 plus 7) 2.55 in 1911 and 2.62 in 1913; the 1891 benchmark is simply interpolated (2.075). The resulting benchmark weights per axle equal 3.300 tons in 1861, 3.450 in 1871, 3.623 in 1881, 4.482 in 1891, 5.288 in 1901, 6.275 in 1911, and 6.412 in 1913. These benchmark unit weights per axle are here linearly interpolated, and multiplied by the passenger-car axle-kilometers in Table F.39, col. 3; the resulting vehicle-ton-mileage series is presented in Table F.41, col. 2.

In the case of freight cars, finally, the present calculation allows 6,000 vehicles at 5.3 tons each at the end of 1860, and cumulates the railways' acquisitions in units (Table F.28, cols. 9, 10, and 12) and weight (Table F.33, cols. 9, 10, and 12), again allowing for retirement after thirty years; the figures so obtained suggest that the average weight of the cars actually in use can be approximated by a linear interpolation of benchmarks equal to 5.3 tons in 1861, 5.7 in 1871, 6.1 in 1881, 7.0 in 1891, 7.9 in 1901, 9.2 in 1911, and 9.4 in 1913. These unit weights are here multiplied by the freight-car vehicle-kilometers in Table F.39, col. 4; the resulting vehicle-ton-mileage series is presented in Table F.41, col. 3.

The estimates of 1911-price value added in the maintenance of railway rolling stock are obtained as the product of these vehicle-ton-mileage series and the corresponding estimates of 1911-price value added in maintenance (including the manufacture of replacement parts) per locomotive ton-kilometer, passenger-car ton-kilometer, and freight-car ton-kilometer.

The *Relazione F.S. 1911-12*, p. 253, reports maintenance expenditure, by vehicle type and more, in 1910-11 and 1911-12; the figures across the two years are reasonably similar, and appear to obey common accounting rules. Summing over the figures reported for in-house and subcontracted work, considering baggage cars and freight cars together, and averaging over the two years one obtains calendar-year expenditure estimates for 1911 equal to 30.22 million lire for locomotives (and, presumably, their tenders), 16.07 million for passenger cars, and 24.38 million for freight cars. The new-construction value added estimates described above allow materials some 24% of the cost of locomotives, 25% of the cost of passenger cars (allowing third- and first-class cars weights equal to .625 and .375 respectively, as above), and 35% of the cost of freight cars. Assuming that the share of materials in the cost of maintenance was two thirds that in new construction, the above expenditure figures for 1911 yield major-railway value added estimates equal to 25.38 million lire in the maintenance of locomotives, 13.39 million in that of passenger cars, and 18.69 in that of freight cars.

Assuming that the average unit weights of the minor lines' vehicles were 20% below those of their major-line counterparts, further assuming that maintenance charges were in proportion to vehicle weights, and allowing for relative mileages in 1911, the corresponding minor-railway estimates of value added in maintenance work out to .8(18)(25.38/151) = 2.42 million lire for locomotives, .8(51 X 2.1)(13.39/1,125) = 1.02 million lire for passenger cars (allowing 2.1 axles per vehicle, as above), and .8(56)(18.69/1,108) = .76 for freight cars. Total

value added in railway-vehicle maintenance in 1911 is accordingly estimated as 27.80 million lire for locomotives, or 3,739 lire per million vehicle ton-kilometers; 14.41 million lire for passenger cars, or 1,864 lire per million vehicle ton-kilometers; and 19.45 million lire for freight cars, or 1,816 lire per million vehicle ton-kilometers. Summing the series in Table F.41, cols. 1 – 3, with these unit weights one obtains the aggregate estimate of 1911-price value added in railway-vehicle maintenance transcribed in Table F.41, col. 4.

The estimates of the corresponding consumption of semi-finished metal and wood, calculated here for later use, are presented in Table F.41, cols. 5 and 6. In the new construction of locomotives, in 1911, the consumption of materials is allowed 24% of value. In their maintenance, materials are attributed two-thirds the new-construction share of value, equivalent to a $(.24(2/3))/(1 - (.24(2/3))) = .190$ share of value added. Retaining the new-construction ratio of metal consumption to materials costs, or 1.15 tons of metal per 390 lire, metal consumption per million lire of value added in the maintenance of locomotives works out works out to $.190(1.15/390)10^6 = 560$ tons. The corresponding aggregate estimate, given a value added of 27.80 million lire, works out to 15,568 tons; this figure is here simply extrapolated to other years in proportion to the locomotive ton-kilometers in Table F.41, col. 1.

In the new construction of passenger cars, in 1911, the consumption of materials is allowed 25% of value. In their maintenance, materials are attributed two-thirds the new-construction share of value, equivalent to a $(.25(2/3))/(1 - (.25(2/3))) = .200$ share of value added. In new construction, metal and wood consumption are allowed, in 1911, 85 lire for .374 tons of metal and 76 lire for .797 tons of wood, against a (weighted) average materials cost of 352.5 lire, per ton of output. Retaining the new-construction ratio of metal and wood consumption to materials costs, their consumption per million lire of value added in maintenance works out to $.200(.374/352.5)10^6 = 212$ tons of metal and $.200(.797/352.5)10^6 = 452$ tons of wood. With the materials-content of new passenger cars apparently unchanged for thirty years, and an equivalent effective vehicle life, the average materials-content of the fleet was then plausibly very near that of the new vehicles themselves; but wood was presumably less durable than metal. To allow for that, keeping the combined expenditure on wood and metal constant, the above initial estimates are here adjusted to 150 tons of metal, and 600 tons of wood, per million lire of value added in maintenance, again in 1911. The corresponding aggregate estimates, given a value added of 14.41 million lire, work out to 2,162 tons of metal and 8,646 tons of wood.

The production estimates developed above allow passenger cars a materials content, per ton of vehicle, varying linearly from .1000 tons of metal and .9000 of wood in 1861 to .2125 and .7875, respectively, in 1871, and .3250 and .6750, respectively, from 1881. Again proceeding much as above, the average fleet-wide materials content is here estimated by assuming 1,200 vehicles at 6.5 tons each, or 7,800 tons in all, in 1860, with a tenth of that metal and the rest wood; multiplying the railways' acquisitions in units of weight (Table F.33, cols. 5, 6, and 8) by the above metal- and wood-content estimates, linearly interpolated; and cumulating the results, again allowing for retirement after thirty years. The figures so obtained suggest that the average metal content per ton of vehicle in service can be approximated by a linear interpolation of benchmarks equal to .100 tons in 1861, .140 in 1871, .181 in 1881, .276 in 1891, .319 in 1901, and .325 in 1911 and again in 1913; the residual is attributed to wood. These year-specific estimated average metal- and wood- shares are here multiplied by total vehicle-ton kilometers in Table F.42, col. 2 to obtain the corresponding estimates of metal- and wood-ton-kilometers (for example, approximately 2,513 and 5,218 million, respectively, in 1911); and these are in turn used to extrapolate the point estimates of materials consumption in 1911 (respectively 2,162 tons of metal and 8,646 tons of wood).

In the new construction of freight cars, in 1911, the consumption of materials is allowed

35% of value. In their maintenance, materials are attributed two-thirds the new-construction share of value, equivalent to a (.35(2/3))/(1 − (.35(2/3))) = .304 share of value added. In new construction, metal and wood consumption are allowed, in 1911, 162 lire for .719 tons of metal and 42 lire for .443 tons of wood, against a materials cost of 240 lire, per ton of output. Retaining the new-construction ratio of metal and wood consumption to materials costs, their consumption per million lire of value added in maintenance works out to $.304(.719/240)10^6$ = 911 tons of metal and $.304(.443/240)10^6$ = 561 tons of wood. With the materials-content of new freight cars apparently unchanged for forty years, or more than the effective vehicle life, the average materials-content of the fleet was then plausibly very near that of the new vehicles themselves; but to allow for the lower durability of wood, keeping the combined expenditure on wood and metal constant, the above initial estimates are here adjusted to 770 tons of metal, and 900 tons of wood, per million lire of value added in maintenance, again in 1911. The corresponding aggregate estimates, given a value added of 19.45 million lire, work out to 14,977 tons of metal and 17,505 tons of wood.

The production estimates developed above allow freight cars a materials content per ton of vehicle, excluding waste, varying linearly from .220 tons of metal and .780 of wood in 1861 to .625 and .7875, respectively, from 1871. Proceeding as in the case of passenger cars, the average fleet-wide materials content is here estimated by assuming 6,000 vehicles at 5.3 tons each, or 31,800 tons in all, in 1860, with 22% of that metal and the rest wood; multiplying the railways' acquisitions in units of weight (Table F.33, cols. 9, 10, and 12) by the above metal- and wood-content estimates, linearly interpolated; and cumulating the results, again allowing for retirement after thirty years. The figures so obtained suggest that the average metal content per ton of vehicle in service can be approximated by a linear interpolation of benchmarks equal to .220 tons in 1861, .370 in 1871, .490 in 1881, .586 in 1891, and .625 from 1901; the residual is attributed to wood. These year-specific estimated average metal- and wood- shares are here multiplied by total vehicle-ton kilometers in Table F.42, col. 3 to obtain the corresponding estimates of metal- and wood-ton-kilometers (for example, approximately 6,693 and 4,016 million, respectively, in 1911); and these are in turn used to extrapolate the point estimates of materials consumption in 1911 (respectively 14,977 tons of metal and 17,505 tons of wood).

These estimates of metal consumption and wood consumption in the maintenance of locomotives, passenger cars, and freight cars are summed across vehicles; the resulting estimates of aggregate metal and wood consumption are presented in Table F.41, cols. 5 – 6.

F03.10 Maintenance: tramway rolling stock

Data on the maintenance of tramway rolling stock do not appear to have been published; even (machine-tramway) mileage figures are available only in 1908 and 1909. For lack of a better indicator, the real maintenance of tramway rolling stock is here assumed to vary with the aggregate weight of the vehicles in service on machine-powered lines, with no further allowance for horse-drawn cars. The latter may have reached a total of approximately 1,500 units in service around the turn of the century (Table F.28, col. 13), but the relatively stress-less handling which they enjoyed suggests that the corresponding maintenance burden was insignificant.

Table F.42, cols. 1 and 4 present the estimated total weight of the steam and electric locomotives and rail-cars in service over the year. These estimates are obtained from the year-end stock figures in Table F.31, col. 3, on the one hand, and cols. 8 plus 9, on the other. The positive differences in each of these are attributed the (common) unit weights used to transform Table F.28, col. 3, into Table F.33, col. 3, and the negative first differences in col. 3 a standard weight of 8 tons per unit; these weighted differences are then cumulated, and finally shifted half a year forward.

Table F.42, cols. 2 and 5 present the analogous estimates for passenger cars. Here, Table F.31 is first amended: in 1908-13, col. 10 is extrapolated on the basis of the 1907 ratio of trailers to electric rail-cars and locomotives together (770/2,053), and rounding to whole units; the resulting annual estimates equal, successively, 847, 874, 896, 1,066, 1,237, 1,396, and 1,555. These numbers are then deducted from col. 4, which than accordingly equals, successively, 1,824, 2,273 (in effect leaving most of the increase in the combined fleet, in 1909, to the steam lines), 2,344, 2,365, 2,386, 2,404, and 2,421. The first differences in these (amended) series are attributed the (common) unit weights used to transform Table F.28, col. 7, into Table F.33, col. 7 (whether those differences are positive or negative, as the latter are here presumed to be transfers from one group to the other), cumulated, and finally shifted half a year forward.

Table F.42, cols. 3 and 6 present the analogous estimates for freight cars. Again, Table F.31 is first amended: in 1908-13, col. 11 is extrapolated on the basis of the 1907 ratio of trailers to electric rail-cars and locomotives together (346/2,053), rounding to whole units, and the result (successively 381, 393, 403, 479, 556, 627, and 699) is deducted from col. 5 (which then equals, successively, 4,041, 4,498, 4,550, 4,766, 4,982, 5,182, and 5,379). The first differences in these (amended) series are attributed the (common) unit weights used to transform Table F.28, col. 11, into Table F.33, col. 11 (again without regard to sign), cumulated, and finally shifted half a year forward.

Table F.42, col. 7 presents the estimates of value added in the maintenance of (machine) tramway vehicles. These are obtained as a weighted sum of the series in cols. 1 – 6; the weights themselves are extrapolated from the estimates of value added in the maintenance of railway vehicles, as follows.

In 1911, as documented above, the estimates of value added in the maintenance of the State railways' vehicles equal 25.38 million lire in the maintenance of locomotives, 13.39 million in that of passenger cars, and 18.69 in that of freight cars; allocating the locomotive total in proportion to expenditure (*Relazione F.S. 1911-12*, p. 253), some 24.971 million lire are here attributed to steam engines, and just .409 million to electric locomotives.

Again in 1911, the State railways owned and presumably maintained the following numbers of vehicles, calculated as the average of those at the start, and at the end, of the year (and including the handful on the Sicilian lines): 4,945 steam locomotives and rail-cars, against 101 electric ones; 10,035 passenger (and mail) cars; and 94,409 freight (and baggage and service) cars (*Statistica F.S. 1911*, pp. 114-124).

Repeating the cumulations (with a thirty-year life) used to estimate the mean weights of railway vehicles entering Table F.41 above (F03.09), excluding the minor railway lines, the corresponding average weights for the major railway lines appear to have been, in 1911, close to 45 tons for locomotives (and perhaps 50 tons for the electric ones, which were very recent), 16.5 tons for passenger cars, and 9.9 tons for freight cars.

Together, these figures yield the State railways' estimated value added per ton of vehicle. In the case of steam locomotives, for example, 24.971 million lire divided by 4,945 units and again by 45 tons per unit equals 112.22 lire/ton; the corresponding figures for the other vehicles are 80.99 lire/ton for electric locomotives, 80.87 lire/ton for passenger cars, and 20.00 lire/ton per freight car. These estimates are applied to the machine-tramways' vehicles, adjusting for relative mileages, and again, in the case of passenger cars, for the relative luxury, and complexity, of the furnishings.

In 1909, the machine-powered tramways reported an aggregate 129.3 million train-kilometers (*Relazione tramvie 1909*, p. 451); the estimated average number of locomotives and rail-cars in service over that year was 2,901 (Table F.31, cols. 3, 8 – 9, averaging over the year-end figures), for an average 44,600 kilometers per powered vehicle (assuming one to a

train, and neglecting deadheading). The corresponding figure for State-railway locomotives was then just 31,200 kilometers (145 million locomotive-kilometers for 4,650 locomotives, *Statistica F.S. 1909*, pp. 110-111, 134-135).

On the State railways, average mileages for steam and electric locomotives appear to have been much the same (*Statistica F.S. 1909*, pp. 110-111, 130-131, *1911*, pp. 114-115, 136-137). The tramways' higher utilization thus seems associated with the greater frequency of service on shorter routes, with the urban tram-cars, in particular, operating almost continuously through the day; and the urban machine-tramways were powered by electricity, while the suburban ones were overwhelmingly powered by steam. It thus seems reasonable to allow (suburban) steam tramways some 1.15 times the mileage of the State railways' vehicles, for a total of (607)(1.15)(31,200) = 21.8 million train-kilometers, leaving 107.5 million for the 2,294 electric locomotives and rail-cars, or 46,900 per unit, or, again, almost exactly 1.50 times the State-railway average.

Adjusting the above State-railway estimates for these relative mileages, one obtains tramway-maintenance value added estimates per ton equal to 129 and 121 lire for steam and electric locomotives and rail-cars, respectively, and 23 and 30 lire per ton for freight cars on steam and electric lines, again respectively.

The corresponding figures for tramway passenger cars equal 93.0 lire per ton on steam lines, and 121.3 lire per ton on electric lines. Since the furnishings of the urban tramways passenger trailers (and rail-cars) were, and remain, extremely spartan, the electric-line figure is here reduced by 20%, to 97 lire per ton. The suburban lines were closer to light railways; the steam-line figure is accordingly reduced by 10% only, to 84 lire.

The maintenance value added estimates are thus the tonnages in cols. 1 – 6, with weights equal to 129, 84, 23, 121, 97, and 30 lire per ton, respectively. Their sum is transcribed in Table F.42, col. 7; in 1911, this aggregate equals 5.35 million lire.

In the absence of more direct evidence, materials consumption in tramway-vehicle maintenance is estimated by multiplying these six value added series by the estimates of metal and wood consumption, per million lire of value added in maintenance in 1911, obtained in the preceding section for (all) railways. In the latter context, locomotives were considered all-metal; the composition of new passenger and freight cars was considered constant from 1881 and 1871, respectively, so that with thirty-year lives by 1911 the average composition of both fleets equaled that of new vehicles. Metal consumption in tramway maintenance is accordingly estimated, per million lire of value added (calculated as indicated just above), as 560 tons for locomotives, 150 tons for passenger cars, and 770 tons for freight cars; wood consumption, as 600 tons for passenger cars, and 900 for freight cars. The resulting annual aggregates are transcribed in Table F.42, cols. 8 and 9.

F03.11 Aggregate value added and employment

The above estimates of value added in 1911 sum to 58.2 million lire in the construction of rail-guided vehicles, and 67.0 million lire in their maintenance, for a total of 125.2 million lire for the rail-guided vehicles industry as a whole. The corresponding employment estimates are derived above (section F01.02 and Table F.02).

F04. Fabricated metal and equipment

F04.01 Introduction

The set of industries at hand is essentially a residual: it covers all the activities that process non-precious semi-finished metal, excluding the shipbuilding and railway-vehicles industries considered above. Those two industries, it will be recalled, worked wood as well as metal; those considered here are by definition (almost) exclusively metal-working, and their wood-processing counterparts (such as the construction of wooden hydraulic engines) are attributed to the wood-working industry considered below. The more fundamental difference, for present purposes, is that the shipbuilding and railway-vehicles industries are abundantly documented; the residual at hand is not.

The indirect evidence of this residual production includes of course the present group's apparent consumption of semi-finished metal, calculated here by adding net imports to estimated output, and deducting estimated direct consumption by other sectors (including construction and the utilities, as well as the shipbuilding and railway-vehicles industries). Metal consumption of course constrains the industry's total product; but it is a poor index of its movements, for average value added per unit of metal is sensitive to the composition of new production, and perhaps even more to the balance between (cyclical, materials-intensive) new production and (trend-dominated, labor-intensive) maintenance. To capture the evolution of the industry's total product one must track its composition, which cannot be presumed to have varied uniformly, much less to have remained constant, over time; the path of the industry's various components must be reconstructed allowing for variations in their relative shares of the total consumption of metal. Clearly, too, the overall metal-consumption constraint is more directly binding for the component industries that consumed more metal, as even a small relative change by a large consumer may imply an impossibly large relative change by a small one, and even a large relative change by a small consumer is without practical consequence for the large one: the practical upshot is that the path of the minor consumers of metal must be estimated from independent evidence, leaving the major consumers alone constrained by the (residual) consumption of metal.

To capture the evolving structure of its product the set of industries at hand is here represented by thirteen separate series, only jointly (and, for the reasons noted, differentially) constrained by the total consumption of metal. These make use of the industry-level census data at the corresponding four benchmark years (and the resulting employment and value added estimates for 1911 presented in Tables F.02 and F.03 above), the data on international trade in the relevant products, and of course a grab-bag of specific data on technical coefficients, prices, and the like. In general, the present estimates distinguish three activities: maintenance, new production from metal, and also, where relevant, new production by assembling imported parts. This last is of course tracked directly by the corresponding imports; it is their strongly cyclical path that suggests they were used as components of new machines rather than, as is common today, for replacement during maintenance. In an age before cheap air freight, it would seem, firms simply did not have the now low-cost option of obtaining parts from the manufacturer as they happened to be needed. Had replacement parts been ordered as needed from the original manufacturer the machines' down-time would have been long and costly, had original spare parts been held in stock inventories would have been large and costly; the least-cost solution, it would appear, was simply to mend or remanufacture parts as needed, incurring high direct production costs but saving the even greater costs of waiting, or of keeping large inventories.

These activities are here distinguished within four industries. One is the fabricated metal ("hardware") industry, which corresponds in Tables F.02 and F.03 above to rows 1 – 3

and 8 (this last on the above-noted presumption that it produced traditional steelyards and weights, "precision hardware" that is for present purposes simply hardware). Its new production (from metal) is here tracked by a single aggregate series, its maintenance activity instead by three series, distinguishing that by blacksmiths, that by other smiths, and the residual. Another is the "precision instruments" industry, which corresponds in Tables F.02 and F.03 above simply to row 9; again simply, it is represented by a single series for new production (from metal), and a single series for maintenance. A third is the "clocks and watches" industry, which corresponds in Tables F.02 and F.03 above simply to row 10; it is represented by two new-production series (from metal, and by assembling imported parts), and a single series for maintenance. The fourth is the (residual) "general equipment" industry, which produced structural components and (ordinary) machinery, and corresponds in Tables F.02 and F.03 above to rows 6 and 7 together. Its maintenance activity is again represented by a single series; its new production, by three series, of which one again refers to the assembly of imported parts, and two to production from metal; for reasons that will be noted in due course, the production of truss-structure components is here separated from that of everything else (general machinery, other structural components).

In general, of course, value added per ton of metal will be higher in the new production of complex and especially precision equipment than in that of hardware, much higher still in maintenance, infinite in the mere assembly of imported parts. But it also varies significantly even within the present new-production categories, for example within hardware as between nails and needles, within residual general equipment as between pressure pipelines and handguns, even within time-pieces as between tower clocks and fine watches. The present estimates remain very crude; but they are what can be obtained with the sources so far recovered.

In outline, these series are generated as follows. After reviewing the evidence in the sources (whence Table F.43), and reconstructing the group's metal consumption (Table F.44) and the relevant net import series (Table F.45), production is estimated initially at the four census-year benchmarks (Tables F.46 – F.49), which are here taken to refer to 1871 and 1881 (when the census was taken at the end of the year, to 1900 (marked by a peak in metal consumption, suggesting that the census taken early in 1901 reflects the results of that prosperity better than it does those of the subsequent crisis), and to 1911 (when the census was taken near the middle of the year). These benchmarks are obtained in essence as solutions to a system of equations, summarized by four formally identical 23 X 8 matrices. Thirteen rows correspond to the thirteen time series to be estimated; the further ten are subtotals and totals that are, by definition, simple sums of the others. Of the eight columns, in turn, four correspond to the variables that are to be obtained as final or intermediate estimates (respectively value added at 1911 prices, and physical product, on the one hand, and metal consumption and the work force, on the other), the other four to the coefficients that link the preceding (value added per ton of output and per worker, and metal consumption per ton of output and per worker). Some cells are by definition empty (for example, only the seven rows that correspond to the elementary new-production series include estimates of physical output, and of the corresponding value added and metal consumption per unit), some obviously null (metal consumption in mere assembly); others are filled by specific direct estimates (for example, the industry-total work force figures, the input/output ratios, the quantities of assembled parts), or by extrapolation (about which more below). When enough cells are filled, the equations that link the cells can of course be solved for the remaining unknowns.

The algorithm that provides the solution is dictated by the nature of the evidence that can be brought to bear; the latter is more abundant in 1911 than in the other benchmark years,

and the estimates for 1911 are accordingly obtained first. In 1911, the aggregate work-force and value added estimates for the four industries at hand are taken from Tables F.02 and F.03. Logically, the metal consumption these imply will be higher, the higher the share of employment and value added attributed to (metal-intensive) new production rather than to maintenance, and again, given total value added in new production, the lower value added per ton of metal (value added per unit of output, divided by the input/output ratio); *ceteris paribus*, therefore, the metal-consumption constraint means that a lower maintenance share will be consistent with a higher mean value added per unit in new production, and vice versa. As noted, the unit value added estimates are perforce imprecise; but once they are in place the essential constraint is that the metal consumption attributed to new production be low enough to leave to maintenance an adequate, non-negative residual. The 1911 data thus provide a lower bound, but only a lower bound, to the maintenance share of employment and value added.

At the three earlier benchmarks the industry-level work force figures are again provided by the censuses, and aggregate metal consumption is again known. In those years, the estimates of the work force, metal consumption, and value added in maintenance (and the minor bits of new production, which were similarly relatively insignificant users of metal) are extrapolated back from 1911, using activity-specific indices. The work force and aggregate metal consumption in (the rest of) new production are then obtained as residuals; the work-force estimates are used to allocate that metal consumption to the new production of the various (remaining) industries, and thus to calculate their output and 1911-price value added. In those years, the maintenance (and minor new-production) estimates are derived from those for 1911, and the work force data and residual-metal-consumption estimates are then used to back out the residual disaggregated estimates of new production and industry-level value added. Given the algorithm, the higher the metal consumption attributed to maintenance in 1911, the higher at these earlier benchmarks that attributed to maintenance, in total and per man, and the lower therefore that attributed to new production, again in total and per man. But as one goes back in time overall average metal consumption per worker falls off sharply; and since the calculated average in maintenance is essentially constant over time, the low overall average at the earliest benchmark translates into an even lower average, relative to 1911, within new production alone. Even in 1871, however, a worker in new production surely consumed many times more metal than his counterpart in maintenance; to obtain a reasonable ratio between these two averages metal consumption in maintenance must then be sufficiently low, and therefore it must be sufficiently low in 1911 as well. In summary, for the purposes of the 1911 benchmark alone maintenance must then be allowed a share of the industry large enough to imply a metal consumption in maintenance that is not unreasonably low in its own right; for the purposes of the earlier benchmarks maintenance must at the same time be allowed a share of the industry in 1911 small enough to imply in 1871 a metal consumption in maintenance that is not unreasonably high next to that in new production. The upper bound to the maintenance share of employment and value added in 1911 thus provided by the data for 1871 complements the lower bound provided directly by the data for 1911. Between these constraints, as it turns out, there is not much room: the present benchmark estimates are reasonably firmly pinned down.

The 1911 benchmark estimates that are extrapolated directly with the use of ancillary evidence (Tables F.50 – F.51) include all the series for maintenance, indexed by estimates of the stocks maintained, the two series for assembly from imported parts, indexed by the corresponding net import data, and the three for the minor branches of new production from metal. Two of the latter refer to precision engineering (precision instruments, clocks and watches); since these consumed only trivial quantities of metal, they are estimated directly (in

conjunction with the corresponding stocks), maintaining reasonable relationships to the corresponding imports on the one hand and to the benchmark-year work force figures on the other. The third refers to the manufacture of truss-structure components, obtained by extrapolating rare data points with a (weighted) construction index.

These extrapolations yield the corresponding benchmark-year estimates in Tables F.47 – F.49; and these in turn yield as residuals the new-production labor force of the fabricated-metal industry and that of the general-equipment industry (net of truss-structure components), and the new-production metal consumption of these two industries together. Since the general-equipment industry appears to have experienced rapid growth from benchmark to benchmark (and in particular boom conditions even in 1900), its metal consumption is estimated directly from its estimated new-production work force, allowing for productivity growth, and metal consumption in the production of fabricated metal is obtained as a residual; the benchmark output and (1911-price) value added estimates for these two industries are then derived from estimated metal consumption, thus completing the matrices in Tables F.47 – F.49.

The time-series estimates for the fabricated-metal industry and the general-equipment industry (net of truss-structure components) are then obtained by interpolating and extrapolating the four benchmark estimates with an eye to import flows, so as to imply a reasonable relationship between the latter and domestic production; the underlying presumption is that imports were prone to greater short-run volatility, and erosion by tariff increases.

F04.02 Some evidence in the sources

The industry at hand is, as noted, poorly documented (*Rilevazioni statistiche*, vol. 7, pp. 361 ff), essentially because the State was little involved as regulator or grantor of concessions. It monitored boilers (*Statistica caldaie*), and taxed bicycles and later cars (about which more below); the main public interest in the broader engineering industry was that of the Navy, concerned with the domestic capacity to produce (a concern not visibly shared by the Army, apparently content either with its own arsenals, or to let the sister service carry the ball).

The available sources are thus less than systematic, and do not readily furnish time series; but they do provide aggregate estimates by the experts of the day, sample data, and many a useful *aperçu*. These sources are reviewed below, in broadly chronological order; in general, and naturally enough, they tend to ignore the traditional fabrication of metal by blacksmiths and the like, and to focus on the more advanced, and interesting, components of the industry. In the data and commentary they provide, four themes seem to recur. First, many Italian firms traced their foundation to foreign engineers or foreign engineering firms, suggesting that technology moved readily across national boundaries. Surely thanks in part to that, second, Italian firms seem to have been able, or to have become able in relatively short order, to produce the machines required to equip agriculture and industry, with the natural exception of particular niche products. Third, the tariff structure penalized the industry on the domestic market: at times more, at times less, the duties paid on machines were said to fall short of those paid on the metal from which they were obtained. Fourth, the tariff structure penalized the industry on the international market: Italian engineering firms lobbied strenuously, and finally successfully, for the right to import duty-free the metal embodied in exported products.

Much of the detailed evidence on the engineering industry is to be found in the reports of the commissions repeatedly appointed by the Ministero della Marina to study the entire metalworking sector. The first such is of course Giordano (1864). It naturally focuses on ferrous metalmaking; it is divided into two main parts, the first discussing the expected requirements of the military and the railways, the second the current state of the industry. The

latter part contains a section on the engineering industry, broadly defined to include foundries, with a text that describes the composition and raw material consumption, and the related cost, of various types of machines (pp. 347-353), and a long table describing the location, owner, employment, technical equipment, production (in quantity, or value, or most often simply as a list of products), and raw material consumption of each (significant) individual engineering shop in greater Italy, including Venetia, the Papal states, and Malta (pp. 354-373; interestingly, many of the employment figures are accompanied by comments such as "could be twice as many," pointing to relatively flat or even downward-sloping cost curves). Metal-consumption data are provided, typically, for foundries, and rarely for other shops; the latter include (in the province of Biella, pp. 368-369) the Canepa machine works (60 tons of metal, 30 workers), the Ricca machine works (3 tons of metal, 5 workers), and the Serramoglia sword works (22 tons of metal, 50 workers). The only summary data refer to employment: in round figures some 20,000 workers, including 7,000 in private works, 1,500 in the (public) railways' shops, close to 8,500 in public arsenals, and another 2,000 outside the Kingdom (p. 347). The conclusions and recommendations devote a section to machinery (pp. 418-422), essentially to underscore the negative protection generated by the current tariffs on metals and machines.

The almost contemporary *Statistica mineraria* was concerned more generally with mining and the processing of mineral products, including metalmaking; and under the latter heading it also considers the fabrication of metal. It describes in some detail the production of ferrous hardware (and firearms, pp. XIX-XXI), and provides tables documenting the technical equipment, labor force, costs and sales, raw material consumption and production of the various components of the industry, and international trade (pp. XXI-XXV); the reported products include nearly 4,000 tons of tools, nails, and other hardware, 3,000 tons of processed steel, and near 10 million lire of "machinery and sundry devices." These figures are based on, but amend, the detailed data in the underlying tables (pp. 14-41); curiously, the text commenting production (p. XXIV) seems consistent not with the accompanying table but with the original figures, which report only some 7 million lire for machinery and such (p. 41), and imply a correspondingly lower aggregate. These data suggest that forges consumed annually some 5.3, and naileries some 1.9, tons of wrought iron per worker, and foundries 8.7 tons of pig iron. "Foundries and engineering shops" are attributed some 4,400 workers consuming 16,000 tons of pig iron and 3,600 tons of wrought iron and steel, or about 4.5 tons of metal per worker; allowing some 1,800 workers to the foundries leaves 2,600 workers processing the wrought iron and steel, at some 1.4 tons per worker. Other metals are treated much like the ferrous metals; the reported production of copperware equals some 490 tons, apparently from 126 workers consuming some 510 tons of metal, or some 4.0 tons per worker (pp. XXVIII, 43, data for Lombardy, Emilia, Campania, and Basilicata). Total employment in the covered metalmaking and processing works totals some 8,200, of whom under 30% skilled *artefici*, the rest mere *manuali* (p. XXIV, using the figures in the text, which correspond to the sums of the individual entries in the accompanying table, and not the very different "totals" of the table itself). This employment total is of the order of 5% of the labor force reported by the 1871 census (below, section F04.05); the latter was dominated by smiths, which the *Statistica mineraria* clearly ignored.

Ellena (1880, pp. 138-139) devotes to the engineering industry only three short paragraphs, noting important recent progress in the production both of industrial machinery, and of structural components (thanks especially to Cottrau's Neapolitan firm); from 1872 to the time of writing the industry is said to have increased its annual sales from some 27 million lire to 36, with a rise in employment from some 12 thousand blue-collar workers to 15, excluding those in State arsenals.

The *Notizie minerarie* contains a chapter devoted to ferrous metals, with sections on

mining, metalmaking, and "engineering shops and shipyards". This last begins by noting that the engineering industry is in practice a metalworking industry, as only railway cars and some farm machinery contain significant amounts of wood (p. 137). Turning to the data, it cites the figures for 1864 in Giordano's report recalled above, and those for 1872 in an apparently unpublished report by mining engineer Axerio (and apparently used by Ellena): some 12,000 workers in private shops, with sales of 27 million lire, and another 7,000 workers in military establishments; imports then amounted to some 24,000 tons, worth 33 million lire (pp. 139-140). Axerio subsequently updated his figures (and passed them on to Ellena): at the time of writing the industry employed 6,400 workers in the railway companies' shops and 8,600 workers in other private shops, with a total private-sector product of 36 million lire; adding military establishments, the industry totals rise to 28,000 workers and 66 million lire (against imports of 14,000 tons, worth 21 million lire). In addition, it is said, the total horsepower installed in Italy include 41,000 steam horsepower and over 100,000 hydraulic horsepower (p. 140). The subsequent text distinguishes the production of ordinary machines for agriculture and industry, in which Italy is said to have been largely self-sufficient (with the exception of power looms, not produced at all), and large-scale works for the railways and the military. The latter include structural components, produced in three plants; Cottrau's alone produced "in the last ten years" (presumably to 1880) some 1,000 bridges totaling 20 kilometers, and 30,000 square meters of canopies (p. 141; allowing 1-3 tons per m of bridge and 40-60 tons per thousand square meters of canopy, Giordano, 1864, pp. 103-104, this output is equivalent to something over 40,000 tons). The balance of the section discusses the production of railway vehicles and ships (pp. 142-147). A final section is devoted to tariff reform; it provides data that point to a perduring (if much reduced) negative protection of machinery in the wake of the 1878 tariff increases (p. 151), but nonetheless describes the current tariff as "satisfactory" (p. 152).

Summary estimates similar to Ellena's are provided in later years by the Direzione della statistica, directly in the *Annuario*; these refer back to one-off studies, confirming the lack of annual reports. The *Annuario 1886*, p. CXV reports that the production of "machines" by private firms grew in value terms from some 12 million lire in 1860 to 40 million in 1880. Adding to the latter the *Notizie minerarie* figure of 30 million lire attributed to State arsenals, the total for 1880 reaches 70 million lire; and that figure can grow to exceed 100 million, it is said, given current imports of 45 million. Later editions (*1887-88*, p. 745, *1889-90*, p. 669) raise the current total to 100 million lire, against imports of 50 million in 1887, 40 in 1888, 43 in 1889, and 39 in 1890. The *Annuario 1895*, p. 398, recalls the growth of the engineering industry's aggregate product from 70 million lire ("as estimated by Giordano") to 100 million lire in 1887-90, "thanks to the growth of public works and residential construction"; it also notes the subsequent decline to no more than 80 million in 1894 (against imports of 28 million). The *Annuario 1900*, p. 436, repeats this text almost verbatim, adding only that the downswing seems to have bottomed out. Subsequent issues were more narrowly statistical, and such comments on the engineering industry do not appear to recur. Nor are data provided, with very limited exceptions; the *Annuario 1904*, p. 304, provides time-series data on the verification of weights and balances (produced in Italy) and of gas meters (including imports, but most were made in Milan), and on the assaying of precious-metal objects.

Curiously, the *Annuario* seems to ignore the harvest of information provided by the two further reports commissioned for the Navy in the 1880s, respectively Bozzoni (1885) and Bozzoni (1889). The first of these was based on visits to all the metalmaking, engineering, and shipbuilding works "of a certain importance," noting that many of these had grown significantly in recent years (pp. 4, 5). The text proceeds to describe the products and capabilities of the various firms, emphasizing that domestic needs can be met from internal sources (e.g., pp. 52-

53); it is followed by three appendices devoted to the metalmaking, shipbuilding, and "engineering" industries, respectively. The tables on the engineering industry (pp. II – XXIX) refer to 60 different establishments (those that returned the questionnaire: Cottrau's are described in the text, pp. 71, 105, but do not appear in the appendix tables). For each of these they report (if possible) the horsepower, blue-collar labor force (on average in 1880-82 and "at present"), the nature of the available equipment, and metal and fuel consumption (again on average in 1880-82); the equipment data are separately reported for the machine shop, the blacksmithing shop, the coppersmithing shop, and the foundry, but the employment figures are only establishment aggregates. The consumption of (semi-finished) metal per blue-collar worker can be calculated from the data for 1880-82; here, the pig iron, scrap iron, ingot iron, and non-ferrous metal consumption figures are divided by 1.2, and "current" blue-collar employment is used if the three-year average was not reported. Of the 60 firms in Bozzoni's table, 14 must be omitted for lack of the requisite data (Ansaldo, Wilson, Cravero, and Tardy in Liguria, Carrera, Poccardi, and Polla in Piedmont, Tesini and the Tecnomasio in Lombardy, Veneta/S. Elena in Venetia, de Morsier and Calzoni in Emilia, Cattro in the Marches, Cerutti in Tuscany), and four (Savigliano in Piedmont, Orlando in Tuscany, and Pietrarsa and Granili in Campania, with over 2,800 workers together) are here excluded as they were heavily involved in ships or railway vehicles. The Galilei works in Tuscany, with 153 workers, produced precision instruments, and consumed about half a ton of metal per worker. Six works seem to have produced mainly hardware: Trombotto, Laurenti, and Mongenet in Piedmont, and Macchi, Dupont, and Glisenti (pp. 120-121) in Lombardy. Together, they employed 790 workers, and averaged some ten tons of metal per worker (or nearer seven, if the bar-iron consumption figure for the Laurenti works is taken to have omitted a comma), with firm-specific figures ranging from 1.2 to 27. The remaining 35 firms appear to have produced heavy equipment (including some railway vehicles, p. 72); together, they employed near 7,900 workers and (taking the Pattison figures as three-year totals, as suggested, p. XXVIII) averaged something under five tons of metal per worker, with firm-specific figures typically between two and ten (with an outlier under one, and another over 22).

Bozzoni (1889) updates the preceding, thanks to a repeat visit "limited to those few establishments that were known to have greatly expanded" (p. 7). Again, a descriptive text is followed by a set of detailed tables devoted to metalmaking, "engineering," and shipbuilding, respectively. Those devoted to "engineering" establishments (pp. 90-119) are organized very much like those of the preceding report (save for the fact that the firms are no longer grouped by region); usefully, the data for each firm are reported for 1883 as well as for 1888. The work concludes with a summary table for each of the three major sectors. That for the "engineering" sector (p. 134) lists 24 firms, six of them new; excluding the figures for the Orlando works, which include the shipyard, from 1883 to 1888 they increased their horsepower from 989 to 4,517, and their blue-collar employment from 6,337 to 10,811. Of these 24 firms, only 12 (Barbieri, De Luca, De Marco, Hawthorn Guppy, Larini, Layet, Mongenet, Neville, Pattison, Veneta/Treviso, and Franco Tosi) allow the calculation of metal consumption, in both years, as above; correcting the apparent typographical errors (to 1.5 tons of steel for De Luca and 2.5 tons of bar iron for Laurenti, both in 1883), one obtains 17,979 tons with 3,654 blue-collar workers in 1883 and 21,751 tons with 4,655 blue-collar workers in 1888, for a small decline, from 4.9 to 4.7 tons per worker. Firm-specific ratios range from 1.5 to 17 tons per worker, but tend to vary relatively little over time; the outlier is the Layet firm, where workers doubled, metal consumption fell by half (but with a notable redistribution from crude metal to finished pieces), and fuel consumption fell by three-fourths, suggesting a shift from production from metal to assembly. Omitting these works, the aggregates fall to 16,906 tons and 3,589 workers in 1883, and to 21,189 tons and 4,519 workers in 1888, for an average of 4.7 tons per worker in both

years. Five further works report metal-consumption data for 1888; these yield a broad range of firm-specific figures, from 1.1 tons per worker (Criste) through 6 (Migliardi) and 11 (Cravero) to 35 (Ansaldo) and 38 (Miani).

In general, it must be said, the metal-consumption-per-worker averages derived from Bozzoni's data appear surprisingly high in the light of the figures in Grioni (1914), discussed below: the more so since about half the metal consumed was simple pig or ingot iron, suggesting that these firms were essentially integrated metalmaking/engineering firms, and that part of the reported work force was engaged in the metalmaking side. Perhaps, like the figures in the earlier *Statistica mineraria*, the overall averages are swollen by the high weight-productivity specific to foundry production; as noted above that earlier source yields a crude average (4.5 tons) close to Bozzoni's, and an estimate excluding castings of less than a third of that. Perhaps too, by the same token, Bozzoni's intermingling of metalmaking and engineering proper explains the apparent failure of the *Annuario* (and later the *Riassunto industriale*) to make use of his evidence.

The *Rivista mineraria* also provided statistics and commentary, neither of them systematic. The metalmaking production data include indications of the actual products of the metalmaking firms; these were often vertically integrated, and the reported products include various kinds of hardware (e.g., *Rivista mineraria 1886*, pp. XXXII-XXXIII, *1913*, pp. LXX-LXXII). The district reports at times commented directly or indirectly on the engineering industry: the Milano district reports in the *Rivista mineraria 1889*, p. 263, *1891*, p. 231, thus include brief paragraphs on the business conditions of various major engineering firms, documenting *inter alia* the transition from boom to bust; the Genova district report in the *Rivista mineraria 1891*, p. 145, describes a new rolling mill, noting that the machinery with which it was equipped was entirely Italian-made.

The *Riassunto industriale* paid attention to the engineering industry as it did to other industries; but to minimize data-collection costs it relied in so far as possible on ready-made statistics (as did the *Annuario*), and the (geographically detailed) horsepower and labor data in vol. 3 are frustratingly combined into four tables that refer respectively to "private engineering works and shipyards," to "State-owned establishments" (including arsenals and shipyards), to "transportation-company shops and yards," and to "shops producing metal objects," while precious-metal work is lumped in with the processing of other precious materials (pp. 14-20). Vol. 2 is in turn organized by geographic unit, and here of no use; but vol. 1 provides useful descriptions and statistics. The section on metalmaking (pp. 38-43) divides that industry into two classes of works, those monitored by the Corpo delle miniere, producing basic metals, and the others, essentially smithies and foundries working metals into useful objects. For the former group the data are taken from the *Rivista mineraria* (and again include the finished hardware produced in integrated works); in 1903 these shops employed 20,609 workers with 43,853 horsepower. For the latter the *Riassunto* reports 10,106 workers with 2,615 horsepower producing (ferrous) hardware, 1,575 workers with 883 horsepower producing copperware, 1,655 workers with 361 horsepower producing brass- and bronzeware, 460 workers with 36 horsepower in type foundries and a further 425 workers with 287 horsepower producing (other) lead goods, and 290 workers with 40 horsepower casting bells, for a total of 14,511 workers with 4,222 horsepower; the text suggests that these include smiths, farriers, and the like, but the numbers given fall far short of the corresponding figures in the 1901 census (about which more below). The section on "engineering" proper (pp. 43-52) assigns 38,104 workers with 14,588 horsepower to private firms in heavy engineering (including railway rolling stock), and refers back to Ellena (for 1872) and Giordano (for 1880) as the most recent prior estimates (again, tellingly, ignoring Bozzoni's report); a descriptive section mentions the strengths of the major firms, all of them apparently "specialized" in a broad menu of different products. Public firms

are assigned 4,906 workers with 3,307 horsepower (against 6,367 workers with 1,065 horsepower in 1878); 4,590 workers with 3,045 horsepower were in arsenals, and most of the rest in precision engineering. The railway companies and (public and private) shipyards, finally, are assigned 13,451 workers with 15,009 horsepower, and 25,936 workers with 10,788 horsepower, respectively; a separate table shows that from 1891 to 1904 Italian-built steam-ships were powered very largely by Italian-built engines. The further section on the production of "metal objects" (pp. 53-60) reports figures (updated from vol. 3) that total 19,560 workers with 3,814 horsepower, with a table that allocates them to 28 different industries, including bicycles and automobiles, metal furniture, precision instruments, watches, tin cans, and so on, and again a set of comments that refer to the more important firms; precision instruments (other than weights and measures) and pocket watches are said to have been mostly imported, or, in the case of the latter, merely assembled from imported parts (pp. 56-59). Finally, the section on the working of precious materials (pp. 60-65) separates out precious-metalworking; the latter is assigned 5,347 workers, many of them working at home, with 104 horsepower.

Much can also be learned from the record of the engineering industry's efforts to obtain duty-free temporary imports of metal to be worked to export order, to be found in the minutes of the meetings of the Consiglio dell'industria e del commercio. The structural components industry appears to have been a leader in raising the issue (*Atti C.I.C. 1873, adunanza del 14 giugno 1873*, pp. 101-103; the petitioner was Cottrau's firm), in later lobbying efforts (with the above-mentioned Cottrau as its premier spokesman: *Atti C.I.C. 1885, sessione ordinaria del 1884*, pp. 74-94, Cottrau, 1891), and in obtaining satisfaction (*regio decreto 2 febbraio 1890, n. 6622*). Machine builders appear to have started their parallel lobbying rather later, and at first only for selected types of heavy equipment (*Atti C.I.C. 1885, sessione ordinaria del 1884*, pp. 68-73, *1902, sessione ordinaria del 1901*, pp. 25-26, *1902, sessione ordinaria del 1902*, pp. 22-27); a blanket ruling covering all types of machinery was pursued, and obtained, only in 1903 (*Atti C.I.C. 1904, sessione ordinaria del 1903*, pp. 30 ff., 100 ff., *regio decreto 24 dicembre 1903, n. 522*). The case for specific types of hardware was still being argued in succeeding years (*Atti C.I.C. 1905, sessione ordinaria del 1904*, pp. 148 ff., *1905, sessione ordinaria del 1905*, pp. 181 ff.). These discussions appear devoid of quantitative information, with one signal exception: at a meeting late in 1884, Cottrau indicated that the Italian structural components (iron bridges, metal canopies) industry consumed 14-16,000 tons of rolled products p. a., or approximately 10% of all rolled products excluding rails (*Atti C.I.C. 1885, sessione ordinaria del 1884*, p. 81).

Evidence on the state of the industry at the end of the period at hand is provided in two further publications. Grioni (1914) is a two-volume directory of the firms in the metal-processing industries, including mining, metalmaking, and engineering. Volume 1, in two parts, is the directory proper. Part I is organized geographically, region by region, within region by province, within provinces by localities, in alphabetical order following the provincial capital. The firms in each locality are listed alphabetically by name, and for each there is at least a brief indication of its sector of activity (for example, the first page lists the forty-odd firms in the province of Aquila, in the Abruzzi; most of them are identified simply as machine shops, a few as foundries, one as a bauxite mine). The total number of firms listed in the 300-odd pages of Part I appears near 8,000, including everything from mines and steel mills to bicycle repair shops; by way of comparison, the *Censimento industriale* counted over 41,000 firms in categories 2.11-2.12 (metal mining, with under 200 firms) and 4 (metalmaking and metalworking, with 41,100 firms), and some 18,000 even excluding smithing firms (categories 4.31-4.32, with 23,200 firms; vol. 4, pp. 508, 512, 522). Part II, approximately half as long as Part I, is a re-listing of those same firms, by sector of activity. The sectors are numerous and relatively detailed; a final index provides cross-references, and lists, for example, 16 different

headings related to automobiles. Firms are identified only by name and location, and may appear under multiple headings. The individual entries here number some 100 per page, for a total in the neighborhood of 15,000, with, obviously, very many duplications (which reflect the nature of the classification as well as a widespread lack of specialization: the F.I.A.T. works thus appear four times on pp. 425-426 alone, as producers of both generic and Diesel-type heavy oil engines, again as producers of internal-combustion/gasoline engines, and yet again as producers of airplane engines). Volume 2, of over 500 pages, contains part III, a set of some 80 company hagiographies apparently supplied by the firms themselves. These contain occasional data, numerous photographs, and much trumpeting of success, especially on world markets.

For a small minority of firms, Part I of the directory also provides a capsule description that may specify the number of workers and horsepower, the types of products, perhaps their quantity or value. The more useful of these micro-data are summarized in Table F.43. Col. 1 notes the source page; col. 2 identifies the firm by a short name (or acronym), and col. 3 its activity or product. Col. 4 transcribes the reported number of blue-collar workers (with a few exceptions, estimated as noted below). Col. 5 transcribes the weight of output, as reported (where col. 6 is blank), or as estimated from the reported sales transcribed in col. 6; the ratio of col. 6 to col. 5 is of course the estimated value per ton of output (normally a round 1,000 lire per ton of hardware and 1,300 lire per ton of heavy machinery, with higher figures for light equipment; these refer in principle to 1912, allowing for reporting and publication lags, but correspond in fact to those estimated below for 1911, noting the comparatively small price changes suggested by the *Movimento commerciale 1911* and *1912*). Col. 7, the estimate of physical product per (blue-collar) worker, is of course the ratio of col. 5 to col. 4; and col. 8 is the ratio of the reported horsepower (not transcribed here) to the reported workers in col. 4. The better to highlight the here relevant information, the individual observations are grouped as in the 1911 census (Table F.01), with "fabricated metal" corresponding to category 4.3, "heavy engineering" to categories 4.41, 4.43, and 4.45, and "light engineering" to categories 4.51 – 4.5<u>10</u>. The heavy engineering sector is itself subdivided to separate road vehicles, machinery, and (components of) structures; and within each group the observations are arranged in ascending order of product weight per worker (col. 7).

Foundries are excluded from the sample, unless the firm produced machinery, and so of course are firms producing ships or rail-guided vehicles. A few more are excluded because reported production appears far too low to cover even the likely wage bill of the reported workers (the Russo, Lancini, Galdabini, Tessarotto, Mangelli, and Cerasi works listed on pp. 43, 113, 130, 135, 225, and 281, respectively). The internal evidence suggests an order-of-magnitude misprint, typically in the sales figures; symmetric errors are of course also possible, but there are none so obvious as clearly to exclude genuine cases of high productivity. Finally, some firms straddled the present groups, and are here assigned to one of these with considerable uncertainty.

Some detailed notes may assist in the reconstruction of Table F.43. Some figures are simply the mid-point of the reported range. Bicycles, motorcycles, and motor-cars are allowed .02, .05, and 1.00 tons per unit, respectively (assuming motorcycles were then little more than heavy, powered bicycles, as suggested by the photograph in Part III, p. 518); alarm clocks and watches, .30 and .10 kilograms per unit, respectively; rifles, 4 kilograms per unit. The output estimated for the Rusconi works (p. 146) includes 1,900 tons reported as such, with the residual calculated from its sales value. The actual number of workers at the Frera works (p. 161) is taken from Part III (p. 514). The Savigliano works (p. 195) appear thrice. It had four shops; two are attributed the reported output and, at a guess, one fourth the total labor force, while the entire firm is attributed an output that includes allowances of 10,000 tons for railway vehicles and, again at a guess, 2,500 tons of electrical equipment.

The sample entering Table F.43 is relatively small, as it finally includes just 146 firms. Not surprisingly, these are, on average, relatively large, with a mean of some 160 blue-collar workers per firm; by way of comparison, the firms with more than 10 subordinate workers counted by the *Censimento industriale*, vol. 3 in the relevant categories (4.3; 4.4, excluding 4.42 and 4.44; 4.5, excluding 4.59 and 4.5$\underline{10}$; 4.ω) totaled 2,260, with 137,168 blue-collar workers, for an average nearer 60. The sample firms (that reported horsepower) were also relatively power-intensive, with, overall, some .6 horsepower per worker; the census large firms in the relevant categories averaged as much or more (over .5 in use, and obviously more installed), but that was well above the estimated overall average of about .4 including small firms (Table F.02). Finally, and not surprisingly, given that Grioni himself appears to have been based in Milan, the sample is geographically biased even with respect to Grioni's own listing: the latter devoted a quarter of its pages to Lombardy and another ninth to Piedmont, but of the firms that responded to his request for information with enough data to be included in the present sample almost half were Lombard, another sixth Piedmontese.

Table F.43, col. 7 suggests that product weight per (blue-collar) worker varied widely, both within and across the present groups; the differences in product per worker seem due primarily not to differences in size or power-intensity, but to differences in the products themselves. Within the fabricated-metal group, those near one ton per worker were producing brass- and copperware, swords, and hand-forged nails; at the other extreme, the 33 tons per man of the Tocco works may have been achieved in the main by simply stamping out corrugated sheet. Within heavy engineering, product per worker in the production of structures ranges from some three tons of relatively complex goods (gates, spiral staircases, and the like) to ten times that of relatively simple large elements (pressure pipelines and the like; the even higher figure obtained for part of the Savigliano works is only indicative, as the actual labor force is unknown). Product per worker in the production of general machinery ranged from in the main from two to ten tons; the even higher figures at the top of the scale appear to consist largely of castings, while the total product of the Savigliano works includes 18,000 tons of structures. Product per worker in the production of road vehicles was instead much lower, ranging from one third of a ton to ten times that for complete vehicles, with higher figures for those who merely produced parts. The lowest products per worker were naturally registered in light engineering, with well under a tenth of a ton for watches and precision instruments, a tenth to a quarter of a ton for firearms, one or two tons for electrical equipment (the Greco works appear also to have cast columns), and some two to four tons for sanitary equipment, cheap stoves, and the like. The inverse of col. 7 illustrates the variation in the labor input, and derivatively in the likely wage bill and value added, per ton of metal: over the full set of sample observations the number of blue-collar workers per ton of product varies up from .025 through approximately .150, .300, and .500 at the quartiles to a peak of 50.000.

Finally, the engineering industry too was considered by the wartime committee pressing for a revision of the tariffs. The general report (Falco, 1916) was signed by the Director of the national engineering-industry association; that same association is named (after the *Comitato nazionale*) in the headings of the otherwise anonymous individual pamphlets devoted to specific branches of the industry (e.g., *Notizie meccaniche: caldaie*). Falco (1916) argues first of all (pp. 5-9) that the engineering industry is a "natural" industry for Italy (because transport costs are lower for the raw materials than for the bulkier, more delicate final products; because metal costs represent only 11-12% of product value, and the critical component is labor; because capital is mobile, and hydroelectricity promises favorable power costs). Next (pp. 10-15) he argues that it is an indispensable industry (both for national defence, and for the progress of other industries), and reviews the industry's past progress; he quotes here extensively from an 1881 report by Colombo (which details the industry's weakness in 1861, and its subsequent

progress) and then from Ellena (1880), noting the rise in private employment from 7,000 in 1862 (from Colombo) to 11,750 in 1872 and 15,000 in 1880 (from Ellena), and in total employment from 35,600 in 1880 (also from Ellena) to 200,000 in 1911 (from the census, deducting smiths and the like). His third section (pp. 16-24) reviews the obstacles to the industry's "regular" development, complaining about high metal and fuel costs, unfair international freight rates, a lack of capital, German dumping, low sales, consumer preferences for foreign goods, and tax pressure; interestingly, there is even here a complaint of administrative difficulties that limit temporary imports of metal (p. 18). That said, he puts forward his recommendations to address those issues (pp. 25-31), which include excluding foreign firms from public contracts, and, unsurprisingly, tariffs high enough to cover domestic firms' greater costs (and offset any discounts due to dumping); and he argues that higher tariffs would not damage agriculture and other industries, as greater protection would result in a higher volume of production, therefore lower costs, and a negligible effect on the costs of other products.

The individual pamphlets devoted to specific trade categories typically contain little more than trade figures, and complaints about the current tariffs. *Notizie meccaniche: caldaie*, p. 5, reproduces data on the distribution of boilers (by years of construction, to 1904, and country of origin) that suggest that the share of the market captured by domestic firms rose from some 40% through the 1870s to 50% in the 1880s and near 65% by the turn of the century. *Notizie meccaniche: locomobili*, p. 16-17, presents a table that would document negative protection on farm machinery (save mobile steam engines, subject to relatively high duties, and threshing machines, made mainly of wood). *Notizie meccaniche: per confezioni*, p. 15, echoing Falco, argues that higher duties on sewing machines would not hurt consumers: the initial price increase would cut the high profits of the dealers, and the rise of domestic competitors would soon force a reduction in the price of imported machines.

Thus this literature.

F04.03 The apparent consumption of semi-finished ordinary metal

In the prevailing absence of output data, production movements are typically inferred from those of the corresponding raw materials (e.g., Gerschenkron, 1962; *Reddito nazionale*, pp. 89, 98). Here, the apparent consumption of semi-finished ordinary metal by the (residual) fabricated metal and general equipment industry is estimated from the aggregate implied by metal production and net imports through a series of corrections that allow both for the new metal not processed, and for the old metal actually processed, by the industry at hand. These estimates are collected in Table F.44; cols. 1 – 8 refer to ferrous metals, cols. 9 – 13 to non-ferrous metals, and col. 14 to all metal, suitably shifted to allow for production lags.

Table F.44, cols. 1 – 2 transcribe the initial estimates of the aggregate consumption of the ferrous metals industry's products, respectively of cast iron and of wrought iron and steel, excluding only railway chairs and rails. Col. 1 refers to cast iron, and is simply the sum of Table E.03, cols. 3, 4, and 13, less imported railway chairs (successively, 7, 13, 1, 1, 2, 0, 0, 0, and 2 thousand tons from 1861 to 1869). Col. 2 refers to wrought iron and steel: it sums Table E.03, cols. 7 and 12, an allowance of 3,000 tons p. a. in 1861-70 for the net imports of Latium and Venetia (above, section E02.03), and a further allowance for the temporary imports of semi-finished metal not already included in col. 7 (ibid.). These last figures, which include small quantities of non-ferrous metals, are culled from the current issues of the *Movimento commerciale*. They sum over the quantities of metal imported to be reexported as barrel hoops, as structural components (for bridges and roofing), as undersea cables, and as boilers, steam engines, railway cars, etc.; the totals appear negligible through 1889, and then to equal, successively, 1, 4, 7, 2, 4, 3, 4, 5, 8, 9, 5, 4, 2, 3, 2, 3, and 2 thousand tons from 1890 to 1906.

The estimated net consumption of ferrous metals in col. 8 is obtained from the sum of cols. 1 and 2 by deducting cols. 3 – 6 and adding col. 7. Col. 3 refers to the metal consumed by the shipbuilding and railway rolling stock industries separately considered above; it equals the sum of Table F.20, col. 5 (shipbuilding), Table F.38, col. 4 (new rolling stock), Table F.41, col. 5 (railway rolling stock maintenance), and Table F.42, col. 8 (tramway rolling stock maintenance). For simplicity, all that metal is here considered ferrous.

The gross consumption estimates in Table F.44, cols. 1 – 2 already exclude rails and railway chairs; cols. 4 – 6 report estimates for the other final products of the ferrous metals industry, that is, the goods consumed without further processing of the metal itself. Col. 4 reports the consumption of wrought iron and steel bars in reinforced concrete, estimated here from the apparent consumption of cement. The latter is obtained simply as the sum of estimated production, transcribed in Table C.05, col. 10, and net imports, transcribed in Table F.45, col. 1. These last are calculated directly from the cement import and export data in the *Movimento commerciale* (categories 903 and 904 in 1913) from 1899 to 1913. In 1883-1898, they are estimated as the net imports of cement and hydraulic lime together, times the ratio of the net imports of cement alone to those of cement and hydraulic lime together in 1899 (9,222/8,929, greater than one because hydraulic lime was, on balance, exported); they are not estimated in earlier years, as cement was then included in a broad residual group of non-metallic minerals and their derivatives.

The aggregate rod/cement ratio is less readily pinned down. A range of figures can be obtained from the technical literature on the one hand, and from American census data for 1929-30 (the earliest that permit this calculation) on the other. The technical literature suggests a steel/cement ratio in reinforced members of approximately .3: a steel/concrete ratio of .03 to .05 is implied by the typical weights per cubic foot of steel (490 lbs), concrete (145 to 147 lbs), and reinforced concrete (150 lbs) quoted in Sutherland and Reece (1943), pp. 9, 11, and Turneaure and Maurer (1913), p. 29; and a concrete/cement ratio of 7.5 is implied for a standard mixture of cement, sand, and gravel by the loose-volume proportions (1 : 2 : 4), strict volume/loose volume ratios (.49, .70, and .50, respectively), strict/volume specific gravities (3.10, 2.65, and 2.65), and water-cement ratio (.6 by weight) quoted in Taylor (1965), p. 122, and Turneaure and Maurer (1913), p. 10. The actual steel/cement ratio appears to vary significantly across types of reinforced members (e.g., Dunham, 1944, p. 28; Sutherland and Reece, 1943, pp. 505, 507, 513; Urquhart and O'Rourke, 1923, pp. 63, 115, 260); in any event, the steel/cement ratio in reinforced members is only a crude upper bound to the average reinforcing steel/cement ratio, since not all concrete elements are (fully) reinforced.

The American census does provide evidence on the average reinforcing steel-cement ratio, since it includes expenditure data for cement on the one hand and reinforcing steel on the other for various types of construction, as well as for construction as a whole (*U.S. 15th Census Construction*, pp. 27-30). The desired steel-cement ratio can be obtained as the ratio of reinforcing steel costs to cement costs, times the ratio of the price of cement to the price of reinforcing steel. Cement appears to have been worth $8.15 per short ton, from the cement industry's sales and output figures ($260.4 million for 170 million barrels of Portland cement, allowing 376 lbs per barrel; *U.S. 15th Census Manufactures*, p. 836, *U.S. 1947 Census Manufactures*, vol. 2, p. 504); reinforcing steel appears to have been worth $43.62 per short ton, from the rolling mills' sales and output figures ($42.4 million for 972,000 tons of reinforcing bars; *U.S. 15th Census Manufactures*, p. 954). The construction industry as a whole reported aggregate expenditures of $47.1 million for reinforcing steel and $140.7 million for cement, yielding a ratio of .063 (suggesting that only one fifth of the cement it used was for reinforced-concrete elements); the corresponding figures reported by firms specialized in different types of construction yield ratios equal to .106 in commercial building, .031 in

residential building, .040 in highway construction, .018 in street paving, and .160 in bridge and culvert construction. In Italy, it would seem, the types of construction that lowered the American average reinforcing steel/cement ratio (streets and highways, foundations for frame houses) were relatively unimportant; the major residential use appears to have been for multi-story apartment buildings technically similar to American commercial construction, so that the Italian average ratio appears better estimated from the American commercial-building ratio than from the American average ratio. Since this technology appears to have matured towards the end of the nineteenth century (Derry and Williams, 1961, p. 417), the estimates in Table F.44, col. 4 are obtained on the assumption that the ratio of reinforcing rods to cement consumption grew by .0106 p. a. from zero in 1890 to .106 in 1900, and then remained constant; the complication created by the cement-products industry is here simply ignored, not least because cement products are normally also reinforced.

Table F.44, col. 5 reports the estimated consumption of wrought iron and steel I-beams used to support floors in inhabitable structures. These were not of course traditional materials, but were certainly in use early in the twentieth century, and are often visible when buildings from that period happen to be demolished. In the apparent absence of any direct documentation, these are simply assumed to have represented, in 1911, 2.5% of buildings' costs (corresponding for example to a 5% share where they were used, if they were used in half the buildings), against a 34% share for value added (below, section K05.04). Given that iron bars cost some 267 lire per ton (Table K.05, col. 6), these coefficients imply a consumption, in 1911, of approximately 275 tons per million lire of value added. On the presumption that this use of metal beams appeared relatively late, and spread only slowly, the time-series estimates of beam consumption in col. 5 are obtained as the product of 1911-price value added in the construction of public and private buildings (Table K.05, col. 6, plus Table K.58, col. 5), times a tonnage per million lire of that value added that is assumed negligible from 1861 through 1878, and to have then grown by (25/3) tons per year to (and through) 275 tons in 1911.

Table F.44, col. 6 covers, together, the other products of the ferrous metals industry that were not subject to further fabrication. These are estimated initially for 1862 and 1913, and then interpolated and extrapolated as a share of residual consumption. Giordano (1864), pp. 354-373, provides typically descriptive evidence on a number of engineering shops. Detailed production figures for 1862 are provided for the Calzoni works in Bologna; loosely generalizing from these figures, which amount to something short of one percent of the estimated 24,000 tons of castings then consumed in Italy, the latter are here estimated to have included 12,000 tons of final goods, including some 2,500 tons of pipes, 4,500 of ornamental castings, and a residual 5,000 tons of pillars and similar objects. Allowing another 1,000 tons for iron wire consumed as such, the total in col. 6 is here set at 13 thousand tons in 1862.

The corresponding estimate for 1913 allows for castings, pipes, and wire. In 1913, assuming growth in proportion to 1911-price value added on the construction of public and private buildings, ornamental castings, pillars, and the like may have accounted for some 36,000 tons of castings.

In 1913, the production of non-fabricated pipes appears in turn to have been near 69,000 tons, including 55,000 tons of cast iron pipes and 14,000 of seamless steel pipes, while another 35,000 tons were fabricated by welding or riveting sheet metal (*Notizie metallurgiche*, pp. 145-149); net imports of pipes include some 11,000 tons of iron and steel pipes (fabricated and not: categories 685-687 in the *Movimento commerciale 1913*), and perhaps another 6,000 tons of cast iron pipes (estimated as twice the imports from Germany alone, in 1913, noted in the *Notizie metallurgiche*, p. 148). Here, the pipes consumed without further fabrication are estimated to include 61,000 tons of cast-iron pipes produced and imported, 7,000 tons of domestic seamless steel pipes (as suggested by the figures in the *Censimento i. e c.*, vol. 3, pp.

41, 71), and perhaps 9,000 tons of imported iron and steel pipes, for a total of 77,000 tons.

The *Rivista mineraria 1913*, pp. LXX-LXXI, reports a production of wire (and nails, presumably obtained from wire) of some 14,000 tons, pointing to an aggregate output of wire, including omitted fabricating firms, of perhaps 15,000 tons. Net imports of wire (categories 678 and 679 in the *Movimento commerciale 1913*) were near 3,000 tons, for a total wire consumption of perhaps 18,000 tons; perhaps a third of that was consumed directly as wire (judging from the American figures in *U.S. 13th Census VIII*, p. 410).

These estimates of ferrous metalmaking products not subject to further fabrication sum to a total of 119 thousand tons in 1913. The full time series in col. 6 is obtained from residual consumption (col. 1 plus col. 2 minus cols. 3 – 5), through a simple geometric interpolation and extrapolation of the benchmark shares of that residual in 1862 (13/108) and 1913 (119/842). The figures so obtained are not contradicted by the available data on international trade: in the later 1880s (when these specific figures first appear) and the 1890s, net imports of iron and steel pipes were near 4,000 tons p. a., those of wire under 1,000 tons p. a.

Table F.44, col. 7 is in a sense the mirror-image of cols. 4 – 6: it refers to the scrap metal processed directly by the engineering industry. The output from such scrap was discussed in section E02.03 above (as the eighth correction entering Table E.03, col. 11); it was considered negligible through 1895, and in the following years to 1901 equal successively to 1, 2, 5, 5, 9, and 8 thousand tons. The *Notizie metallurgiche*, pp. 40-42, provides roughly similar figures for the turn of the century, and suggests that such output rose to 10,000 tons over the ensuing decade and a half. Output is here assumed to have grown linearly from 8,000 tons in 1901 to 10,000 in 1915. The figures in col. 7 are these output estimates, multiplied by 1.35 to allow for weight losses in processing.

Table F.44, col. 8 is the present estimate of the tonnage of ferrous metals actually transformed by the engineering industry of concern here; it is the simple sum of cols. 1, 2, and 7, less cols. 3 – 6, with a single further adjustment. Tariffs on semi-finished metal were sharply raised between 1887 and 1888; to allow for the accumulation of inventories (of imported metal, Table E.03) in anticipation of that increase, 24,000 tons of metal are here transferred from 1887 to 1888.

Table F.44, cols. 9 – 13 refer to (non-precious) semi-finished non-ferrous metals, excluding those that were simply not, or rarely, subject to further, separate fabrication (antimony, lead, mercury: *Enciclopedia italiana*, vol. 27, p. 331). The gross apparent consumption figures of semi-finished aluminum, copper and its alloys, and zinc in cols. 9 – 10 and 12 are the simple sums of the output estimates obtained above (respectively Table E.04, col. 3, Table E.06, col. 5, and Table E.12, col. 6) and the corresponding net import figures transcribed in Table F.45, cols. 2 – 3 and 5. In the case of semi-finished nickel, domestic production appears to have been negligible (above, section E03.08), and the consumption estimates in Table F.44, col. 11 coincide with the net import figures in Table F.45, col. 4. The net import figures in Table F.45, cols. 2 – 5 correspond respectively to categories 775-777, 731-736, 751-754, and 770 in the *Movimento commerciale 1913*; semi-finished aluminum seems to have been separately identified only from 1905. These are not adjusted for border changes, in view of the substantial stability in the trade flows from 1870 to 1871, and of the apparently small scale of Venetian trade (as documented, for the last two months of the year, by the *Movimento commerciale 1866*); and net imports in 1861 are simply set equal to those calculated for 1862.

Table F.44, col. 13 reports the estimated net consumption of non-ferrous metals by the industry at hand; it is obtained as the sum of these estimates in cols. 9 – 12, with two adjustments. The first excludes from these the semi-finished metals consumed as final goods; these are here limited to copper and copper-alloy pipes (or tubing) and wire, neglecting bronze

castings for public monuments and the like as well as other metals. The data in the *Movimento commerciale 1913* (categories 733-735) yield net imports of 1,343 tons of wire and pipes (and but a few dozen tons of wire and pipes of other metals, categories 753-754, 776-777). The data in the *Rivista mineraria 1913*, p. LXXII, yield 8,571 ton of (ordinary) wire and pipes, out of a total product of 24,625 tons; inflating the former in proportion to the output estimate of 30,700 tons (Table E.06, col. 6), one obtains a total output of wire and pipes just shy of 10,700 tons, and a total consumption of some 12,000 tons, of which (judging from the underlying disaggregated data) perhaps 8,000 tons of wire, and 4,000 of pipes. The relative importance of wire at that date presumably reflected the recent growth of electric power distribution; twenty years earlier, if the trade figures can be taken as a guide, wire consumption was comparable to pipe consumption. To allow for the growing use of electric wiring, the share of Table F.44, col. 10 excluded from col. 13 to allow for wire and pipes is here set at 25% in 1861-93, and then allowed to grow by .004% p. a. to 33%, as calculated, in 1913.

The second adjustment allows for the processing of semi-finished tin. The corresponding net imports identified by the trade data refer only to wire and, apparently, foil (*Movimento commerciale 1913*, categories 763-765); and such final products surely accounted for a significant share of that produced domestically. In the absence of more detailed evidence Table F.44, col. 13 includes an allowance for the net consumption of semi-finished tin equal simply to half of estimated domestic output (Table E.11, col. 5).

Table F.44, col. 14 reports in turn the estimate of the metal actually processed by the engineering industry: it is obtained as the sum of cols. 8 and 13, shifted forward half a year to allow for production lags (and simply retaining the unshifted estimate for 1861).

Table F.44, col. 15 is a partial metal-consumption series, derived from col. 14, used below to estimate production movements. It is transcribed here for convenience; the details of its construction are documented below, as this series become relevant.

F04.04 International trade: parts and finished products

The further net import series included in Table F.45, cols. 6 – 21 refer to the various products of the engineering industry at hand. They are collected here for the light they can shed on the evolution of consumption, and, derivatively, of production, in the various segments of the market, not all of which need have participated in the overall cycle documented by the metal-consumption figures in Table F.44, col. 14. As such, they aim to correspond, singly or in groups, to the various components into which the engineering industry is here divided; but as will be seen forthwith that aim is only imperfectly achieved, for the trade categories which are so often inconveniently narrow are nonetheless, at times, frustratingly broad.

The present series are reconstructed by working backwards, starting from the category-specific quinquennial retrospectives in the *Movimento commerciale 1913* and *1909*. They are then normally extended with the quinquennial summaries in the *Movimento commerciale 1906*, *1904*, *1900*, *1896*, *1892*, *1888*, *1884*, *1880*, and *1878* (which provides figures from 1874, calculated for the new tariff categories), *1876* (with the overlap in 1874-76 assisting in chaining the appropriate series), *1872* (that goes back to 1868), and the current issues for the years 1862-67. It bears notice that these sources are not entirely in agreement where they overlap, and that the correspondence between the summary retrospectives and the current detailed data is at times uncertain; but for present purposes these defects can be accepted. In all cases the figures refer to the Kingdom at current borders, and trade in 1861 is simply assumed equal to that recorded in 1862.

Table F.45, cols. 6 – 9 refer to fabricated metal, ferrous (cols. 6 – 8) and non-ferrous (col. 9). Col. 6 refers specifically to ferrous sheet-metal products (*lamiere in lavori*, *latta lavorata*). Exceptionally, the figures for 1862-87 are taken as reported in the annual issues;

those for 1888-1906, from the quinquennial summaries in the *Movimento commerciale 1892*, *1896*, *1900*, *1904*, and *1906*, with the addition of the omitted reexports of temporary metal imports (full cans only in 1889-98, lithographed tin plate in 1901-06); and those for 1907-13, from the *Movimento commerciale 1909* and *1913*, summing over categories 701-708 and adding the imported and exported full cans again omitted by the figures for the *commercio speciale*. In 1906, the figure obtained from these last sources corresponds exactly to that obtained from the preceding. Col. 6 is clearly dominated by the tin cans made in Italy, mostly with imported plate, and exported full.

Table F.45, col. 7 refers in turn to other hardware identified as such. The present figures for 1862-87 sum over current annual data: to 1877 for bayonets, sword blades (at 1.25 kilograms per unit, where so recorded), swords (at 2.00 kilograms per unit), needles, metal pens, fishhooks, mesh, plated hardware, springs, knives, and ordinary tools; from 1878 for springs, other steel hardware, knives, sickles, ordinary tools, and mesh. The present figures for 1888-1904 are taken from the quinquennial summaries in the *Movimento commerciale 1892*, *1896*, *1900*, and *1904*, summing over the data for springs (taken from the current issues in 1889-91), ordinary tools, burnished goods (taken from the current issue in 1904), pins and needles, mesh, and pen nibs (also from the current issues). The present figures for 1905-13 sum over categories 697-698, 719-729, 748, and 1153: the corresponding detailed data in the *Movimento commerciale 1904* return the figure obtained from quinquennial summary, but the totals obtained from the data for 1905 and 1906 in the quinquennial summaries are, oddly, some 400 tons p.a. above those retained here. Col. 7 is dominated by ordinary tools, which average over 90% of the total in the years to 1877, and roughly 80% thereafter; the net imports of these goods long grow relatively steadily, then collapse in 1888, and finally bounce back to high levels in 1907-13.

Table F.45, col. 8 refers to fabricated ferrous metal identified simply as such (*ferro e acciaio di seconda fabbricazione*) in the summary quinquennial retrospectives to 1904, which chain back without ambiguity to the early data in the current issues. The figures for 1905-13 sum over categories 709-718 (including nails, identified as such), as suggested by the correspondence between the detailed data in the *Movimento commerciale 1904* and the corresponding figure for that year in the quinquennial summary, and also the new categories 699-700 (ropes, tableware), as suggested by the analogous data in the *Movimento commerciale 1906*. The present figures for 1889-1904 correct those in the quinquennial summaries to allow for reexports of temporary imports of metal; these refer to barrel hoops, which are indeed products of the fabricated-metal industry, and also to structural components (of iron bridges and canopies), which are here considered products of the general.equipment industry, as in the 1911 census. Col. 8 thus straddles the fabricated-metal and general.equipment industries, as here defined; it displays both a sharp upswing in the early 1880s and an absolute peak in 1908.

Table F.45, col. 9 refers to non-ferrous hardware. Excluding the metal products (ornamental bronzes, lead products, and the like) that were plausibly cast, these are here identified with the final products in categories 741-747 and 749 (of copper and copper alloys), 755-756 (of nickel), 766-768 (of tin), 771-773 (of zinc), 778 (of aluminum), and 785-786 (of unspecified non-precious metal) on the *Movimento commerciale 1913*. The corresponding data for 1905-13 are taken as usual from the category-specific retrospectives in the *Movimento commerciale 1909* and *1913*; all the earlier figures are taken from the current issues, as the summary retrospectives tend to aggregate over the finished and semi-finished products of the various metals. In 1861-77 likely bronze castings are not separately identified, but the data for 1876 and 1877 in the retrospective in the *Movimento commerciale 1878* suggest that the corresponding quantities were then under 20 tons a year. There is also a discrepancy between the present total for 1905 and that calculated from the current issue, but it is even smaller. The

movements of col. 9 are dominated by those of copper and copper-alloy products; in the 1880s, exceptionally, these share the limelight with zinc products. Net imports again display an apparently tariff-related decline, in 1878, and then the usual cycle, again with a strong final surge; but the quantities involved are ever relatively small.

Table F.45, cols. 10 – 13 refer in turn to general machinery, in parts (col. 10) and assembled (cols. 11 – 13), excluding firearms and precision equipment. The machine parts tallied in col. 10 are those identified as such (not elsewhere classified) in the *Movimento commerciale*, beginning in 1888. They correspond to categories 825-827 and 875 in the *Movimento commerciale 1913*; finished bicycle parts (category 875) are separated out only from 1906, when they amounted to some 130 tons of net imports. The time path of col. 10 is highly cyclical, suggesting that these imports were not replacement parts used for maintenance but components of new machines (including entire machines shipped in parts for assembly in Italy); as such, they represent new production by the heavy engineering industry in addition to that from semi-finished metal.

Table F.45, col. 11 refers to (metal) road vehicles, reported in the *Movimento commerciale 1913* as categories 861-863 (trucks), 870-872 (motor cars), 873 (motorcycles), and 874 (bicycles); in the 1906 retrospective and earlier, these are included, like other road vehicles, in the wood-products group. Bicycles and motorcycles are separately identified from 1896, and counted together through 1904; motor cars are separately identified from 1900, and appear to include trucks through 1905. In 1905-13, all but light trucks (861-862) are reported in numbers; the present estimates allow 4 tons per truck over 3 tons (863), .40, .75, and 1.25 tons, respectively, for cars respectively under half a ton, between half a ton and a ton, and over a ton (870-872), .05 tons per motorcycle (873), and .02 tons per bicycle (874). The earlier estimates are chained allowing cars and trucks together (from 1900) .704 tons each, and bicycles and motorcycles together (from 1896) .023 tons each. The net exports registered from 1907 were due entirely to cars and trucks, while bicycles and motorcycles continued to register one or two hundred tons of net imports annually.

Table F.45, col. 12 refers to prime movers, excluding rail-guided locomotives (and of course those incorporated in other automotive vehicles) but including steam-engine boilers traded as such; in the *Movimento commerciale 1913* these are the contents of categories 794-796, 800-802, and 804-805. The data are taken from usual retrospectives (ignoring however the garbled import data for stationary steam engines in 1874-77 in the *Movimento commerciale 1878*, and correcting the mobile-engine export figure for 1871 in the *Movimento commerciale 1872*), adding in 1893-1904 the separately recorded exports manufactured from temporary (duty-free) metal imports. Prime movers are separately identified from 1866 (on the import side, a year later on the export side), boilers from 1872; the latter normally account for near 1,000 tons of net imports annually, rising however in the early 1900s to a peak of some 7,000 tons a year in 1906-07, and then falling back to some 2,000 tons in 1913. From 1861 to 1885, when the trade data do not separate out railway locomotives, col. 16 amends the figures in the sources to exclude the present estimates of railway locomotive imports (Table F.34, col. 2; in 1862-65 col. 12 includes only these, with a negative sign); the present residual may display spurious short-run volatility, as the year of construction attributed to imported locomotives need not coincide with the year in which they were actually imported (above, section F03.07).

Table F.45, col. 13 refers to other (general) machinery; in the *Movimento commerciale 1913* it corresponds to categories 797-799 (machine tools), 806-807 (agricultural machinery), 808-809 (textile machinery), 810-813 (electric motors and powered machines), 814-815 (sewing machines), 816-821 (other machines), 823-824 (transformers and batteries), and 828 (heating and distilling equipment). Net imports are calculated from the data in the usual retrospectives (with the 1888 figure for sewing machines taken from the that year's edition). The overlap in

1905 and 1906 yields aggregate figures within 1% of each other; those taken from the *Movimento commerciale 1909* are oddly above those in the retrospective in the *Movimento commerciale 1906*, mostly, it would seem, because the latter neglect categories 798 and 799, while reexports from temporary imports of metal appear limited to some 20 tons in 1905. The earlier data link up exactly right back to 1874 (with the inclusion of gasholders, separately recorded in 1872-84, and of copper heating and refining equipment, and allowing for the machine parts separately counted from 1888). The pre-1878 tariffs generated rather different data. Initially all machinery paid duty on (and was recorded only as) its value, save for loom reeds, imported in trivial quantities. Agricultural and industrial machinery, like prime movers, are separately counted in units of weight from 1866 on the import side (with a figure so small as to seem partial) and 1867 on the export side; and from within this group, one presumes, gasholders, textile machinery, and heating and distilling apparatus are separately identified from 1872. In 1874 the current data yield net imports of 89,974 quintals plus 641,503 lire, against 95,146 quintals in the 1878 retrospective, suggesting that the 1874 value figure was converted at some 124 lire per quintal; the present estimates for 1862-73 simply add to the net imports reported in weight the net imports reported only as values, divided by 124 lire per quintal.

Table F.45, cols. 14 – 15 refer to firearms parts, and firearms, respectively. Col. 14 corresponds to categories 789-790 and 792-793 (rifle parts, pistol parts) in the *Movimento commerciale 1913*. The figures for 1874-1913 are obtained directly from the standard retrospectives listed above; those for 1862-73 are instead derived from the reported numbers of rifle and pistol barrels in the current issues through 1867, and then in the summary quinquennial retrospectives in the *Movimento commerciale 1876*, pp. 222, 241, *1872*, pp. 191, 210, allowing two kilograms per rifle barrel and one per pistol barrel, as suggested by the overlapping reports for 1874-77 (*Movimento commerciale 1877*, pp. 223, 242, *1878*, p. 179). Col. 15 corresponds in turn to categories 787-788 and 791 (rifles, pistols) in the *Movimento commerciale 1913*. These are ever reported simply as units, with data that readily match up over time; the current issue is used to correct the retrospective figures for 1868. The present figures allow 4.0 kilograms per rifle and 1.5 kilograms per pistol. Both these series display an idiosyncratic pattern, with net imports at their highest levels in the early years (with a peak in 1863, suggesting purchases by the military); imports of parts practically vanish after 1878, while those of complete firearm drop to near nothing after 1865 but then grow very slowly. Both series display occasional negative outliers, suggesting that orders were occasionally obtained from foreign governments; neither series displays the strong cycle observed in most of the series at hand.

Table F.45, cols. 16 – 17 cover gas meters and electrical apparatus on the one hand, and carding wire and precision instruments on the other; they correspond respectively to categories 833-837, and 829-832, in the *Movimento commerciale 1913*. The contents of col. 16 are separately identified only from 1905; in earlier years, as is clear from the retrospective in the *Movimento commerciale 1906* (p. 610), they were considered precision instruments, and are accordingly included in col. 17. The figures for optical and other instruments in 1887 are taken from the current issue, as those in the 1884-88 retrospective are very much in error. All goods are reported in units of weight, save light bulbs in 1906-13; these are here allowed 30 grams each, as suggested by the unit valuation of 15 lire per kilogram in 1905 and 45 lire per 100 in 1906. Specification increases over time, but the series link up without apparent inconsistencies (in 1862-77, in particular, the trade figures list only two relevant categories, with one labeled "carders and carding wire"; but the overlapping data with the old and new trade categories in 1874-77 coincide, at least in 1874-76). These net imports too are marked by a drop in 1878, and then the usual cycle, with a notable surge from 1905 (and a curious outlier in 1887).

Table F.45, cols. 18 – 19 refer to (metal) musical instrument parts, and musical

instruments, respectively. Col. 18 corresponds to category 1176 in the *Movimento commerciale 1913* (parts of musical instruments, here assumed to be metallic); these goods are separately reported only from 1888, but the quantities involved remained very small, and there is no reason to presume that they were significant in earlier years. Col. 19 is obtained as categories 1164 (music boxes and the like) plus 1166 (portable organs) in the *Movimento commerciale 1913*, plus half of categories 1172-1175 (wind instruments, including wooden ones, and instruments n.e.c.); categories 1165 and 1167-1171 (church organs, pianos, harmoniums, and string instruments, all mentioned as wood instruments in census category 3.18) are excluded altogether. Portable organs were ever separately counted, as units, and the full series is obtained directly from the usual sources. Music boxes were also ever separately counted as units; the values also recorded by the early retrospectives are ignored, as in the analogous case of clocks. Categories 1170-1175 were also reported as units, but as a single aggregate through 1887; the present figures include only 42% of that broader total, as suggested by its composition in 1888. These three components move very differently: portable organs typically registered net exports, but these never exceeded a few hundred a year; annual net imports of music boxes grew from 1,000 or fewer through the 1870s to a few thousand in the 1880s and '90s, and then surged to 10,000 in 1905 and, after a few years of stagnation, to near 18,000 in 1913; those of other instruments grew from 5,000 or so through the 1870s to a peak near 16,000 in 1887, and then declined steadily to over 9,000 units of net exports in 1913. The path of the aggregate in Table F.45, col. 19 is thus quite sensitive to the assumed unit weights, here tentatively set at 250 grams for music boxes, 4,000 grams for portable organs, and 2,500 grams for other musical instruments; these reduce a music box to a tenth of an unspecified instrument, and the estimated aggregate in units of weight is dominated by its third component. The calculated aggregate again points to a rapid rise from the level common in the early decades to a peak in 1887; in this case, however, the ensuing decline never reverses itself, and the early twentieth century is characterized by growing net exports.

Table F.45, col. 20 refers to parts of clocks and watches (category 859 in the *Movimento commerciale 1913*, with clarification provided by the analogy to artificial flowers parts in the *Movimento commerciale 1867*, p. 400); these chain back without difficulty. These flows display cyclical variation: they rise faster than before in the early and mid-1880s, suffer a sharp (and no doubt partly tariff-related) drop in 1888, then stagnate for a decade, and finally grow again from the turn of the century. Col. 21 refers instead to clocks and watches, including assembled mechanisms; it is built up by aggregating various components, again obtained from the usual retrospectives. The first refers to pocket watches (categories 850-851 in the *Movimento commerciale 1913*), ever reported as units; these are here allowed 100 grams each. The second refers to clocks, ranging from alarm to grandfather clocks (categories 852-855 in the *Movimento commerciale 1913*); these are also reported as units, and here allowed 2,000 grams each. The data for these link up well but not exactly over the mid-1870s; moreover, the early retrospectives (which illustrate tariff revenues as well as trade flows) report imported values as well as imported quantities. The former are here ignored, as they apparently refer back to the latter, and are only reported because these items paid a percentage of their value as well as a fixed duty per unit (*legge 14 luglio 1851, n. 1223*). The third refers to assembled mechanisms for ordinary clocks and watches (categories 856-857 in the *Movimento commerciale 1913*), plus those for bell towers and the like (category 858). These last alone are ever reported in units of weight. Watch mechanisms, reported as units, are here simply attributed the same 100-gram unit weight as the complete pieces. Table and grandfather clock mechanisms are reported in units of weight to 1887, and then as units; the latter are allowed 1,000 grams each, as suggested by the evidence that 72 quintals corresponded to (10,752 – 3,147) mechanisms (*Movimento commerciale 1888*, p. 272). Again, the quantities involved are small. Annual net imports of

watches surge from under 10 tons in the 1870s to near 48 in the late 1880s, stagnate, and then grow again, irregularly, to some 60 tons in 1913; those of clocks typically remain near 20 tons; those of mechanisms were also typically near 20 tons until 1887, very small for almost the next two decades, and finally between 9 and 11 tons in 1906-13. The path of the total is similar to that observed above for the corresponding parts (col. 16), but with a lower trend growth rate.

Table F.45, col. 22 is in turn the simple sum of cols. 6 – 21, as crude a measure of total net imports as the relevant metal consumption (Table F.44, col. 14) is of total domestic production. A comparison of these series, crude as they are, is instructive. In the main, they move very much together, sharing in particular the familiar long cycle from the late 1870s to 1913; their simple correlation equals .92. Significantly, too, metal consumption ("total output") varies less than total net imports: the coefficient of variation of the year-to-year growth rate of the former equals 2.0, that of the latter 3.0. Estimating "total output" as 80% of metal consumption (to allow for weight losses), one can calculate the "total consumption" of engineering-industry products as output plus net imports, and domestic industry's overall share of the domestic market as the ratio of "total output" to "total consumption." From 1861 to 1913 that share remained within a relatively narrow band (70 to 90%), dropping initially from a relatively high level (possibly as producers that had benefited from protection prior to Unification withdrew from the market), and then varying in apparent response to movements in demand. The simple correlation between "market share" and the year-to-year growth rate of consumption equals –.62: the overwhelming impression is that of a domestic industry with a supply curve that was ever elastic, but less so, in the short run, than the "world" supply curve. In general, it would appear, imports poured in when demand exploded, only to be eroded as production caught up; and so too when demand collapsed imports fell immediately, domestic production more slowly. The potential to produce was apparently always there: the crude aggregate statistics reviewed here and the contemporary evaluations reviewed above are in substantial agreement.

Table F.45, cols. 23 – 30 are further net import series, derived from col. 6 – 21, or related series, used below to estimate production movements. They are collected here for convenience; the details of their construction are documented below, as these series become relevant.

As indicators of production movements, the net import series are heir to multiple problems, and must correspondingly be used with considerable caution. The industries at hand produced durable goods, the demand for which was stock-adjusting and therefore inherently unstable; and as noted one can presume that domestic supply curves were less elastic than import ("world") supply curves, so that as demand fluctuated trade flows varied more than production flows. But if world supply curves were ever highly elastic, domestic supply curves were the more elastic, the longer the time period considered: the hypothesis that output movements were a damped version of import movements is reasonable enough if the latter were moderate, but a fall in imports after a large increase may indicate not a concurrent fall in demand, but a delayed supply response to the prior (and enduring) improvement in demand. Changes in net exports (as of tin cans, Table F.45, col. 20) are even more ambiguous: a decline may signal an output-reducing fall in foreign demand, or an output-augmenting increase in domestic demand so vigorous as to divert sales from foreign markets.

Further problems, specific to the context at hand, here need only be recalled. One is created by the partial mismatch between the categories of the 1911 censuses (and thus of the present production estimates) on the one hand, and the categories of the trade statistics on the other; specifically, as noted above, the "fabricated metal" trade data that yield Table F.45, col. 19 include components of structures, that is, general equipment other than machinery, as well as what can here be termed fabricated metal proper. Another is of course created by the

annexation of Venetia and Latium, included in the trade data only from 1867 and 1871, respectively. A third and more complex family of problems is created by tariff changes, which over the period at hand were numerous and complex. No attempt can be made here to calculate product-specific measures of net protection; but some patterns are suggested by sample rates. In the case of precision equipment, the tariff on precision instruments dropped from an initial 200 lire/ton to (a treaty rate of) 100 in 1864, rose to 300 in 1878, and there remained; that on watch parts remained unchanged at 500 lire/ton; and that on ordinary pocket watches fell from one lira each to 1883 to half that from 1884. In the case of general equipment, unspecified machinery paid 1% *ad valorem* to 1870, then 1.15% through 1877, then 60 lire per ton (about 3.5% *ad valorem*) through 1887, and then 100 lire per ton. Stationary steam engines and "industrial machinery" were separately identified from 1866; the former paid 30 lire per ton through 1870, then 60 through 1887, and then 120 lire per ton, the latter paid 20 lire per ton through 1870, then 40 through 1877, and then disappeared back into general machinery. Unspecified "fabricated metal" (which includes, as noted, components of metal structures) was subject to duties per ton initially of 100 lire, then 115.5 (introduced, oddly, by the 1864 treaty, but apparently applied across the board by 1877), then 118, and finally, from 1888, as the category was further broken down, from 105 to 165 and more; for ordinary tools duties per ton were set at 80 lire to 1870, then at 92.50 through 1877, then 100 through 1887, and finally 130 lire. Against these, per ton of thick plate duties were set initially at 50 lire, then from 1871 through 1887 at 46.20 lire, and finally at 70 lire, per ton of thin plate initially at 80 lire per ton, then from 1871 through 1877 at 92.50 lire, then again at 80 lire through 1887, and finally at 100 lire (and more, for the thinnest sheet metal). For what they may be worth, these sample rates point typically to varying rates of positive net protection of the industries at hand, with the possible exception of precision instruments from 1864 through 1877, and the near-certain exception of machinery: the latter appear to have been burdened by significant negative net protection before 1878, left with insignificant net protection from 1878 to 1887, and actually protected only from 1888. From 1885, too, the major railway operating companies were obliged to order from domestic suppliers so long as the price quoted by the latter was not over 5% greater than the competing foreign bid; a mirror-image change occurred in 1865, as the passing of the major railway network (the *Alta Italia*) from local to French control apparently diverted equipment orders (even apart from rolling stock) from domestic producers to foreign firms (Cornolò, 1998, p. 29).

F04.05 Census-year benchmark estimates: the labor force

The present production series are derived through an interplay of data-constrained cross-section and time-series estimates. The cross-section estimates, for four benchmark years, are collected in Tables F.46 – F.49; the intermediate and final time-series estimates, in Tables F.50 – F.53.

Tables F.46 – F.49 present four identically structured matrices, each with 23 rows and eight columns. The rows correspond to the identified components of the group at hand, and to various aggregates thereof. As indicated by the headings and subheadings, the entire group is divided in the first instance into eight elements, to distinguish at once the four basic industries into which it is here divided (the fabricated metal, general equipment, and precision equipment industries, distinguishing within this last instruments and the like on the one hand, and time-pieces on the other), and the two basic activities carried out by each of these (new production, maintenance); and three of these eight are further broken down, for reasons that will become apparent in due course. The elementary estimates of new production and maintenance, which correspond to the thirteen time series to be estimated here, are those in rows 1 – 4 (fabricated metal), 7 – 9 and 11 (general equipment), 13 – 14 (precision instruments), and 16 – 17 and 19 (clocks and watches); rows 5 – 6, 10, 12, 15, 18, and 20 – 23 are their subaggregates and

aggregates. The columns correspond in turn to the different measures that enter, or are obtained from, the present calculations. Cols. 1 and 2 refer to the desired estimates of value added (col. 1) and, in the relevant rows (1, 7 – 9, 13, and 16 – 17), physical (new) production (col. 2); cols. 3 and 4, to the corresponding aggregate metal consumption and total labor force; and cols. 5 – 8 to ratios that link these, respectively value added per ton of output (col. 5, again in the relevant rows) and per worker (col. 6), and metal consumption per ton of output (the physical input/output ratio, col. 7, again in the relevant rows) and per worker (col. 8). The desired estimates are obtained by using external evidence to fill a sufficient number of cells, and then using the equations that link the cells to calculate the rest. Needless to say, these initial values are themselves often rough and ready, and the resulting solution is itself an approximation; but there are enough strong constraints at work that the allowable ranges of variation are finally quite limited.

Tables F.46 – F.49 refer, in inverse chronological order, to the years 1911, 1900, 1881, and 1871. These tables exploit the censuses, taken at the end of 1871 and 1881, early in 1901, and in mid-1911; on the presumption that the events of the census year influence the structure of the labor force by the end of the year (and perhaps by the middle of it), but surely not at its inception, the census data for (early) 1901 are here assigned to (late) 1900.

The census labor-force data assign workers to numerous specific industries; but they do not distinguish some that are here separately identified, and obviously ignore the distinction between maintenance and new production. In practice, therefore, the census data serve directly to fill only four cells in Tables F.46 – F.49, col. 4, those for the broad aggregates in rows 6 (fabricated metal), 12 (general equipment), 15 (precision instruments), and 20 (clocks and watches); from these one derives their sum, in row 23.

These figures for 1911 are readily obtained, as the present classification is based directly on that of the 1911 census. They are practically ready-made, in fact, because the estimates of aggregate employment by industry derived in section F01.02 simply reproduce the labor-force figures, suitably grouped and barely rounded; Table F.46, col. 4 thus simply transcribes from Table F.02, col. 11 the sum of rows 1 – 3 and 8 (fabricated metal, into row 6), the sum of rows 6 – 7 (general equipment, into row 12), row 9 (precision instruments, into row 15), and row 10 (clocks and watches, into row 20), and of course the sum of these partial figures (into row 23).

In the 1901 census, the fabricated metal industry is taken to include categories IV.9 – IV.19, and XIV.4, less 5% of category IV.12 (which mentions the manufacturers of gun-barrels as well as of knives and of "arms," incidentally implying that these last were swordsmiths); the resulting labor force equals 217,911 individuals, including 150,422 blacksmiths (and key-smiths) and farriers (categories IV.10 – IV.11) and 45,212 coppersmiths, tinsmiths, and the like (category IV.16). The general equipment industry is taken to include categories IV.8, XIII.2, and XIV.3, plus 5% of IV.12, for a total labor force of 65,975 individuals. The precision-instruments industry is taken to include category XIV.2, plus 710 out of 2,551 workers in category XIV.1, musical instruments (using the proportion suggested by the 1911 census, which reports a labor force of 1,234 in category 4.56, metal musical instruments, and of 3,199 in category 3.18, wood musical instruments); the resulting labor force equals 1,581 individuals. The clock-and-watch industry, finally, corresponds to category XIV.5, which includes 8,787 individuals.

In the 1881 census, the fabricated metal industry is taken to include categories II.VI.6, II.IX.1 - II.IX.2, II.X.5 – II.X.10, II.XI.2, II.XI.4 - II.XI.5, II.XI.8, II.XII.3, XVI.6, and an estimated 3,700 of XVI.4; the resulting labor force equals 199,743 individuals, including 144,865 blacksmiths (and nail-makers) and farriers (categories II.X.5 – II.X.6) and 33,937 coppersmiths, tinsmiths, and the like (categories II.X.7 – II.X.8 and XVI.6). The general equipment industry is taken to include categories II.XI.1 and II.XI.3, for a total labor force of

15,729 individuals. The precision-instruments industry is taken to include categories II.XII.1 - II.XII.2, plus 400 out of 613 workers in category II.XII.5 (musical instruments other than pianos, organs, and the like; the latter are counted in category II.XII.4, with 827 workers, and the estimate allows metal musical instruments about the same proportion of the total as in the 1901 census); the resulting labor force equals 992 individuals. The clock-and-watch industry, finally, corresponds to category II.XII.6, which includes 5,959 individuals.

In the 1871 census, the fabricated metal industry is taken to include categories II.9.5, II.11.1, II.12.3 - II.12.6, II.13.3 - II.13.6, II.13.9, and II.14.2; the resulting labor force equals 172,962 individuals, including 121,738 blacksmiths and farriers (categories II.12.4 and II.9.5) and 29,660 coppersmiths, tinsmiths, and the like (categories II.12.3, II.12.5, and II.12.6). The general equipment industry is taken to include categories II.13.1 (reduced by 10%, to allow for the merchants it includes) and II.13.2, for a total labor force of 4,517 individuals. The precision-instruments industry is taken to include category II.14.1, plus 285 out of 482 workers in category II.14.3 (makers and merchants of string and wind musical instruments, allowing metal instruments the same proportion of 90% of II.14.3 as of II.XII.5 in 1881); the resulting labor force equals 686 individuals. The clock-and-watch industry, finally, corresponds to category II.14.5, which includes 4,277 individuals.

These census totals are subjected to a series of adjustments. The first is a crude adjustment for the different cutoffs to the census labor force, which included only persons over age 10 in 1911, over age 9 in 1901 and 1881, and of all ages in 1871. Allowing for likely age-specific participation rates, this first adjustment is simply the deduction of a 10% share of the reported labor force under age 15 in 1901; using the categories (and proportionate allowances) indicated above those under 15 equal 29,861 in fabricated metal, 6,092 in general equipment, 204 in precision instruments, including an estimated 110 in metal musical instruments, and 528 in clocks and watches, whence adjusted totals of 214,925 workers in fabricated metal, 65,366 in general equipment, 1,561 in precision instruments, and 8,734 in clocks and watches. A similar deduction of a 10% share of the reported workers under 15 is made in 1881; again using the categories indicated above those under 15 equal 18,248 in fabricated metal (including an estimated 300 in category XVI.4), 1,053 in general equipment, 50 in precision instruments, including an estimated 20 in metal musical instruments, and 286 in clocks and watches, whence adjusted totals of 197,918 workers in fabricated metal, 15,624 in general equipment, 987 in precision instruments, and 5,930 in clocks and watches. In 1871 the deduction is raised to 20% of the workers under 15; again using the categories indicated above those under 15 equal 18,214 in fabricated metal, 254 in general equipment (again excluding 10% of II.13.1 to allow for merchants), 29 in precision instruments, including an estimated 8 in metal musical instruments, and 213 in clocks and watches, whence adjusted totals of 169,319 workers in fabricated metal, 4,466 in general equipment, 680 in precision instruments, and 4,234 in clocks and watches.

The second, relatively complex adjustment is specific to 1871. That year's census counted 3.28 million agricultural day-laborers and the like in a specific category (I.1.5), and, uniquely, another .62 million day-laborers and unskilled workers, not assigned to any particular branch of the economy, in three further categories (XVI.1 – 2 and 10). These last were presumably engaged in mere hauling and the like in the sectors that handle commodities, that is, excluding agriculture, in industry, commerce, and transportation (sectors II, III, and IV). But the census allows industry 3.29 million workers, commerce and transportation just .47 million together: even if the latter were assisted by a disproportionate share of the unskilled day-laborers at hand, enough remain to increase the total in industry by a double-digit percentage. Within industry, moreover, construction does not appear to have a particular claim on them, as the census included (unskilled) manual laborers in construction, along with bricklayers, in a different category (II.6.2, with .23 million workers). From this particular point of view,

therefore, the engineering industry as a whole would appear to have been broadly average; but distinctions within it seem to be in order.

Here, the (age-adjusted) precision-equipment figures are left unchanged, on the presumption that there was little need in that sector, at that time, for mere brawn. The (age-adjusted) general-equipment figure seems instead to warrant significant inflation, for the heavy lifting now done by a skilled crane-operator was once done by teams of navvies; it is here increased by 80%, to 8,039 total workers, on the strength of two sets of considerations. The first stems from the early data on the metal-processing industries. The *Statistica mineraria*, p. XXIV, reports a (blue-collar) employment of 546 workers, no fewer than 492 of them unskilled, in "foundries," and 4,394 workers, 2,956 of them unskilled, in "foundries and engineering works." Assigning half the labor force of these integrated shops to their foundries, and dividing these by skills as in the pure foundries, the residuals for the engineering works proper yield a ratio of unskilled to skilled of 80%.

The second again uses evidence from the well-documented railway-vehicles sector, and specifically from the factory-like establishments that performed heavy maintenance. On the one hand, average productivity growth can be estimated from the aggregate railway maintenance-shop employment figures in the *Riassunto industriale*, vol. 1, pp. 49-50, equal to 6,403 (blue-collar) workers in 1878 and 13,451 in 1903; given the corresponding aggregate estimates of constant-price value added in maintenance, respectively 10.72 and 41.11 million lire (Table F.41, col. 4, plus Table F.42, col. 7), productivity growth (in a factory setting) is here estimated at 2.44% p. a. On the other, the State-railway repair shop employment data in *Personale F.S. 1911* (data for June 15, 1911), pp. 66-67, suggest that unskilled laborers (*manovali*) represented 10.3% of the labor force. The composition of the labor force 40 years earlier depends on the relative rate at which machines substituted for unskilled labor on the one hand, and for skilled labor on the other; and since (until very recently) machines have replaced brawn far more easily than brains, the former rate surely much exceeded the latter. Given the above share of the unskilled in 1911, given the above average productivity growth rate, a productivity growth rate for the unskilled equal to four to six times that of the skilled implies that in 1871 the unskilled numbered some 70% to 90% of the skilled. The 80% selected here is consistent with a mean annual productivity growth rates near 1.23% for skilled workers and just over five times that, or 6.25% for unskilled workers: from this perspective too, the present estimate seems reasonable.

The fabricated-metal industry total appears to warrant a more modest correction, not least because its products were singly far lighter, as a rule, than the machines and structural components produced by the general-equipment industry. The *Statistica mineraria*, p. XXIV, suggests that in nail-producing shops the ratio of unskilled to skilled was well below the overall (metal-processing) average, even if still comfortably above unity; but such shops were a very small part of an industry then utterly dominated by smiths and farriers, themselves indubitably brawny; and judging from the small smithing works documented forty years later by the *Censimento industriale* (Table F.01, categories 4.31 and 4.32, noting the still very limited use of mechanical power), these relied relatively little on hired workers of any kind, with but 6, skilled and not, for every 10 masters and members of the master's family. Here, very tentatively, the (age-adjusted) fabricated-metal total is increased by a round 10%, to 186,251 workers. The industry-group total thus rises to 199,205 individuals, from 178,700 obtained at the end of the previous iteration, or by a not unreasonable 11.5%.

The third and final adjustment is specific to the general-equipment industry, which here excludes the shipbuilding and railway (and tramway) vehicles industries separately considered above. Ship construction and maintenance are not a problem, as these appear as separate categories, here simply left aside, in the census of 1871 (II.10.1 – II.10.3), 1881 (II.VIII.1 – II.VIII.4), and 1901 (XIII.4, XIII.5); nor are unpowered rail-guided vehicles, apparently included

with similarly unpowered road vehicles in the censuses of 1871 (II.9.1, II.9.2) and 1881 (II.VII.1, II.VII.2), and separately identified in the census of 1901 (XIII.3). Locomotives, however, were at once clearly distinguished from "coaches and wagons," and not separately identified; the censuses, like the trade statistics, no doubt considered them "machines," and included their manufacture, at least, in the corresponding categories (II.13.1 in 1871, II.XI.1 in 1881, IV.8 in 1901), so far included in their entirety (with the above-noted adjustments). The appropriate deductions for the manufacture of locomotives are here calculated as follows. The production estimates obtained above equal 370 tons in 1871, 880 in 1881, 8,200 in 1900, and 15,240 in 1911 (Table F.38, col. 1); at 1,250 lire per ton, the corresponding value added in 1911 equals 19.05 million lire. The estimates for the industry (category 4.42) in Tables F.02 (48,150 total workers) and F.03 (125.16 million lire) yield a value added per worker of some 2,600 lire, and therefore an employment in locomotive production near 7,330, or .481 workers per ton. Using the productivity growth rate (in factory production) of 2.44% p. a. estimated above, workers per ton of locomotive output in new production are here estimated as ca. 1.262 in 1871, .991 in 1881, and .627 in 1900; the resulting workers here deducted from the adjusted totals for the general equipment industry equal 467 in 1871, 872 in 1881, and 5,142 in 1900.

The census figures for "machines" are not further adjusted to exclude an estimate of the workers engaged in the maintenance of locomotives. Logically, these could have been attributed either to the engineering industry (as they worked on "machines"), or to the transportation sector (as they worked for the rail- and tramway companies); the issue may or may not have been clarified at the time, in the supplementary instructions issued to the actual census-takers (local school-masters and the like), but these have not been recovered. The internal evidence provides no clear answer. The 1901 census is no help at all, as all land-transport workers were grouped together (XVII.7-8, actually a single category, white-collar workers; XVII.11, engineers and firemen; XVII.12, right-of-way maintenance workers). The 1881 census separates the various types of land transportation, but the railways appear to be attributed only their white-collar workers (V.1.1, with 26,902 persons) and their right-of-way maintenance workers (V.1.2, with 13,547 persons); by way of comparison, the *Relazione S.F.I. 1881*, pp. 408-409, lists a total of 66,000 employees at year end, including 25,400 workers in the central administration and the local agencies, again 25,400 maintaining the right-of-way, and 15,200 in vehicle operation and maintenance. The 1881 census categories appear to have been taken over unchanged from the 1871 census (IV.1.1, with 14,100 persons, and IV.1.2, with 4,100); the *Relazione S.F.I.* of the time seems not to include employment data. At the same time, the workers employed maintaining railway vehicles do not seem to have been included with those employed constructing them. The workers the censuses of 1871 and 1881 assign to the "machinery" and coach and wagon industries number only 6,600 (II.9.1 and II.9.2) and 11,100 (II.VII.1), respectively, against 30,100 in the wood road vehicles industry in 1911 (3.15), and, as noted above, 6,400 (blue-collar) workers in the railways' repair shops in 1878; but there is scarcely room for these last in the "machinery" industry either, with 15,600 workers in 1881 (II.XI.1) and but 4,400, as reported, in 1871. The present limited correction to the census figures assumes in fact that the workers repairing railway vehicles, and in particular locomotives, were not assigned to the "machinery" industry; and this assumption is supported by two extraneous bits of information. One is that article 26 of the *r. d. 6 novembre 1910, n. 776* on the implementation of the 1911 census explicitly specified that the railways' repair shops were to be considered part of the industrial sector, suggesting that they had not been, as a matter of course, up to that point. The other is the detailed, firm-specific evidence in Giordano (1864), pp. 354-373, reviewed in section F04.11 below, which points to some 5,700 (blue-collar) workers manufacturing heavy equipment, excluding the numbers reported (or roughly allowed) for those producing and repairing railway vehicles: a figure readily compatible with the present

net estimate (excluding maintenance) of some 7,600 (total) workers in 1871, but not with one much below that.

At the end of the day, therefore, and rounding throughout to the nearest 50, the estimated labor force in the industries producing and maintaining fabricated metal, general equipment, precision instruments, and clocks and watches equals 240,950, 113,600, 2,950, and 8,800 workers, respectively, in 1911; 214,950, 60,200, 1,550, and 8,750 workers, respectively, in 1900; 197,900, 14,750, 1,000, and 5,950 workers, respectively, in 1881; and 186,250, 7,550, 700, and 4,250, respectively, in 1871. These are the figures that appear in Tables F.46 – F.49, col. 4, rows 6, 12, 15, and 20 (and summed, in row 23).

In 1911, as noted in section F01.02 above, the industry was riding the crest of a long boom, and actual employment can be identified directly with the measured labor force. Judging from the path of metal consumption (Table F.44, col. 14), 1881 was also very much a boom year, with production far above formerly standard levels; 1871 was generally good, with metal consumption down a bit from 1870 but higher than in any earlier year, and so too was 1900, with metal consumption sharply higher than in the immediately preceding years even if not yet up to the peak levels of the late 1880s. In 1871 and 1900, therefore, the present labor-force figures may overestimate actual full-time equivalent employment, albeit not, one suspects, by very much. That said, the "per worker" figures in Tables F.46 – F.49, cols. 5 and 6 are to be understood in general as "per member of the labor force," and only as the occasion warrants as "per fully employed worker"; and the year- and industry-specific estimates of productivity must allow as needed for current cyclical deviations from trend.

F04.06 Production in 1911: aggregate value added and new-production coefficients

For the broad aggregates in rows 6 (fabricated metal), 12 (general equipment), 15 (precision instruments), and 20 (clocks and watches), the estimates of value added in 1911 are also practically ready-made, as they too were derived above (chapter F.01). Table F.46, col. 1 thus simply transcribes from Table F.03, col. 11 the sum of rows 1 – 3 and 8 (fabricated metal, into row 6), the sum of rows 6 – 7 (general equipment, into row 12), row 9 (precision instruments, into row 15), and row 10 (clocks and watches, into row 20); the sum of these partial figures is the industry-group total in row 23. The corresponding estimates of average value added per worker in 1911 (Table F.46, col. 6, rows 6, 12, 15, 20 and 23) are then obtained directly as the ratio of total value added (col. 1) to total workers (col. 4).

The estimates of 1911-price value added, and metal consumption, per ton of new production in the various industries separately identified here are transcribed in Table F.46, rows 1, 7 – 9, 13, and 16 – 17, cols. 5 and 7, respectively; but since even those industries are typically aggregates of heterogeneous activities, the estimates provided here can be no more than representative. The estimates of value added per ton of course incorporate the input/output ratios; the latter are here considered first.

New production by the fabricated metal industry is considered as a single aggregate, spanning the gamut from anchors and anvils to pins and needles (Table F.46, row 1). Input/output ratios in (traditional) fabrication are abundantly documented by Giordano (1864); its relative age does not appear to be a major handicap, as the subsequent technical progress appears to have been mostly labor- and perhaps fuel-saving rather than materials-saving. Giordano's figures suggest ratios varying from 1.1 for rural implements (including anvils) and heavy forgings (anchor chains) to 1.2 for horseshoes and wagon fittings, 1.3 for small marine fittings and armor plate, and 2.0 for military tools, harnesses, swords, and extensively forged pieces (pp. 40-41, 90, 340, 415; hardware for buildings is allowed a ratio of 1.2 on p. 40, and 1.7 on p. 41). The estimated average adopted here is 1.35 tons of metal per ton of output (Table F.46, row 1, col. 7).

New production by the general equipment industry is here divided into three very unequal parts. One is the assembly of machines from imported parts (Table F.46, row 7), separated out because value added per ton of output is obviously far less than in the production of the same machines from semi-finished metal, and net imports of parts are documented by the *Movimento commerciale*; as noted above, the cyclical variability of those imports suggests the present interpretation of their use. The relevant input/output ratio here is of course zero (Table F.46, row 7, col. 7, whence of course zero total metal consumption, col. 3, and metal consumption per worker, col. 8). Another is the production of truss-structure components (for bridges, canopies, and power-line towers, Table F.46, row 8); it is separated out because value added per ton is again relatively low, and to take direct advantage of the available data points (and thus to ensure that the time-series estimates remain consistent with them). The input/output ratio is here set at 1.2 (row 8, col. 7), as suggested by the ratio of total duty-free metal imports for bridges and canopies to the corresponding total exports from their inception in 1891 through 1907; later flows are ignored, as much imported metal appears never to have been reexported in fabricated form. The third component covers the rest of the industry (Table F.46, row 9), producing everything from storage tanks to hand-guns and sewing machines. Giordano's ratios for ordinary (heavy) equipment appear near 1.2 to 1.4, but up to 2.5 for individual parts (pp. 419-421), while Falco (1916), p. 36, uses a figure of 1.23 in the production of general machinery, most of it for metal to be cast; a ratio of 1.25 is tentatively adopted here (Table F.46, row 9, col. 7).

The two identified components of the precision-equipment industry are treated asymmetrically. The new production of precision instruments is treated as a single aggregate (Table F.46, row 13); trade in parts was recorded only for musical instruments, and even assuming they were all metallic the quantities involved appear to have been insignificant (Table F.45, col. 18). Giordano's figures recalled above suggest that the input/output ratio rose as pieces became smaller and more extensively worked; it is here tentatively set at 2.5 (Table F.46, row 13, col. 7). In the case of clocks and watches, on the other hand, part imports were relatively significant (Table F.45, col. 20), and again cyclically variable; that in Italy pocket watches were typically assembled from imported parts is explicitly noted by the *Riassunto industriale*, vol. 1, pp. 58-59. Here too, therefore, new production is disaggregated to distinguish the assembly of imported parts (Table F.46, row 16) from production from metal (row 17). The input/output ratio is of course zero in mere assembly (Table F.46, row 16, col. 7, whence again zero total metal consumption, col. 3, and metal consumption per worker, col. 8); in new production from metal (which includes a tail even of tower clocks), the input/output ratio is again tentatively set at 2.5 (Table F.46, row 17, col. 7). It may be noted that both branches of the precision equipment industry were relatively small, in value added terms, and characterized by a relatively low consumption of metal per unit of value added: their aggregate consumption of metal was correspondingly a very minor part of the engineering-industry total, and here at least the errors in the input/output ratios are of little consequence.

The estimates of value added per ton are derived in the main from the above input/output ratios, and the prices (plus tariffs) indicated by the *Movimento commerciale 1911*. Typical (ferrous) metal costs appear to have ranged from 220 lire per ton for large bar (import category 675) to 360 for thin plate (682a), and fuel costs may have added some 10% to that (Falco, 1916, p. 36). Fabricated metal values per ton range from 800 lire for common utensils (721) to over 1,000 lire for most unspecified small metal (716b), better utensils (sickles and the like: 723), and heavy files (725), over 3,000 lire for fine files (727), and 10,000 lire for pins and needles (729); on the other hand, in Grioni (1914), vol. 1, p. 194, the Turin Cooperativa works reported a production of 500 tons of files, and sales of 300,000 lire, for an average value of just 600 lire per ton. Materials costs per ton of output can be estimated at approximately 360 lire for

1.35 tons of metal (a mix of medium bars at 250 lire per ton, thick plate at 230 lire per ton, and medium plate at 310 lire per ton, categories 676, 680a and 681a), and 35 lire for fuel and other costs, or 395 lire in all. Value and value added are less readily pinned down, not least because the cited figures from Grioni (1914) sit poorly with the others; but as will be seen below the fabricated-metal industry was much the largest consumer of metal, and at the end of the day a reasonable estimate of that consumption requires that the corresponding value added per unit of output be kept within relatively narrow bounds. The figure selected here is 415 lire per ton (Table F.46, row 1, col. 5); the implied average unit value is 810 lire per ton, which seems reasonable enough next to the baseline 800 lire for common utensils derived from the *Movimento commerciale*.

The trade data for temporary imports and reexports from 1909 to 1913 (*Movimento commerciale 1913*, vol. 1, Tables XVI and XVII) suggest that (the components of) bridges and canopies belonged mostly to category 712, with a ca. one-third share spread over categories 711, 713, and 716, while the metal input belonged mostly to category 675, with a ca. one-third share in category 680. Including tariffs, which were presumably reflected even in the domestic-market output price, average prices per ton would appear to have been near 650 lire for the output, and 225 for the metal input. Allowing 1.2 tons of the latter per ton of the former and 30 lire for fuel and other costs, value added in the production of the components of bridges and canopies (and, by extension, of power-line towers) is here set at 350 lire per ton of output (Table F.46, row 8, col. 5).

Ordinary heavy equipment was valued at prices (including tariffs) ranging from 1,000 lire per ton for boilers with cast-iron pipes (794) to over 2,500 lire per ton (marine engines: 805), but typical prices seem to range from 1,200 to 1,400 lire per ton (medium machine tools, hydraulic motors, steam engines, agricultural machinery, general machinery: 798, 800-802, 804, 806-807, 821). Lighter equipment was of course worth much more: per ton, import prices plus tariffs ranged from ca. 2,700 lire for sewing machines and 2,800 lire for heating, refining, and distilling apparatus (category 828) and gas meters (833) to 4,500 lire for electric appliances (834) and 8,000 to 10,000 lire for firearms (788b, ordinary rifles, at 40 lire and an estimated 4 kilograms each; 791, pistols, at 12.5 lire each and an estimated 1.5 kilograms each); conversely, storage tanks and the like were plausibly worth no more, or even less, than the 650 lire per ton attributed to the components of bridges and canopies. Taking roughly modal values (for ordinary machinery), one can allow 1,300 lire per ton of output, 315 lire for 1.225 tons of ferrous metal (a mix of bars, thick and medium plate, and cast iron, with this last valued for consistency at 250 lire per ton, as in section E02.04 above), 50 lire for .025 tons of non-ferrous metal (copper bar, at near 2,000 lire per ton, category 731), and 35 lire for fuel and other costs, for a value added per ton of output from semi-finished metal at a round 900 lire per ton. This modal value plausibly doubles as the relevant mean. On the one hand, one notes that if one allows a value added per ton of 300 lire for low-fabrication goods ("storage tanks"), and 3,000 lire, on average, for high-fabrication goods (light equipment), the two tails together average 900 lire per ton if the total value added of the high-fabrication tail is just short of three times that of the low-fabrication tail (if per million lire of value added by the latter, corresponding to 3,333 tons of goods, the former generates 2.857 million lire of value added, with 953 tons of goods, together they account for 3.857 million lire of value added and 4,286 tons of goods, or 900 lire per ton). On the other, a ca. 3 to 1 ratio between these two tails seems entirely consistent with the census data and resulting value added estimates (Tables F.01 – F.03): considering only the large shops (which accounted for the larger part of total employment, and the bulk of that in new production), the low-fabrication tail may not unreasonably account for some 2,300 workers (in category 4.58) of the 25,300 workers in Table F.02, row 7, col. 2, leaving some 23,000 to the high-fabrication tail, and some 5,500 workers in category 4.41 (leaving to the middle of the

distribution the rest of the 53,500 in Table F.02, row 6, col. 2, net of the independently estimated 5,500 making truss-structure components, Table F.46, row 4, col. 4); allowing for relative value added per worker, equal in round figures to some 2,200 lire in row 6 and 2,100 lire in row 7 (from the estimates in Table F.03, rows 6 and 7, col. 7), the low-fabrication tail would account for some 17 million lire of value added, and the high-fabrication tail for 48 million lire, or just under three times as much. The above estimate of 900 lire per ton, derived for ordinary machinery, is accordingly applied unchanged to (all) residual new production of ordinary equipment from metal (Table F.46, row 9, col. 5).

Machine parts were valued at prices per ton, including tariffs, ranging from 810 lire for ordinary parts of ferrous metal (827a) and 2,760 for ordinary parts of non-ferrous metal (827d) through 3,850 for sewing-machine parts (826) and 5,500 for finished bicycle parts (875) to 23-25,000 for finished rifle and pistol parts (790, 793). Ordinary non-ferrous parts accounted for over 40% of (gross) imports, raising their average value to over 2,200 lire per ton, or well above that of typical machines; in the small, too, complete sewing machines were valued at 2,950 lire per ton (815), or less than their imported parts. In general, therefore, imported parts appear to have been either the components of peculiarly expensive machines, or the peculiarly expensive components of ordinary machines; either way, the import mix was clearly not representative of that in production. Here, value added in assembly is estimated directly at 300 lire per ton, or a third of the above estimate for machine production from metal, leaving twice that for the production of the component parts. This split in value added between the manufacture of parts and the process of assembly would seem reasonable for that time, when the former stage of production had been largely mechanized and the latter was still carried out very much by hand, without the gains that would come from assembly lines. Again, the implied average value of ordinary parts equals a round 1,000 lire per ton. The latter can be taken to include some 55 lire for non-ferrous parts, allowed a 2% share of the machine's weight, and therefore ca. 965 lire per ton of ferrous parts, again not unreasonable given average import values (near 900 lire per ton for sewing-machine parts and ordinary ferrous parts together, rising to an impossible ca. 1,700 including bicycle parts). Finally, the implied 60% ratio of value added to value in the production of machine parts sits comfortably next to the ca. 50% allowed fabricated metal, and the higher figures allowed, in what follows, to precision equipment.

In precision equipment the ratio of value added to value was relatively high (*Censimento i. e c.*, vol. 3, p. 67, Table 15). Standard non-optical precision instruments (of steel or copper alloys) were valued at import prices (plus tariffs) of 20,300 lire per ton (831a), musical instruments at even higher rates (1170-1173). Value added per ton is here tentatively set at 75% of 22,000 lire per ton of output, or 16,500 lire (Table F.46, row 13, col. 5); this estimate is consistent for example with the consumption of 2.5 tons of copper alloy in bars (731), costing some 5,000 lire, and 10% of that for fuel and other materials.

Value added in the production of clocks and watches from metal is particularly difficult to pin down. Including tariffs, imported parts were valued at 32,500 lire per ton (category 859a); assembled mechanisms for pocket watches at 4.75 lire each (category 856), for table and grandfather clocks at 9 lire each (category 857), and for tower clocks at 4,000 lire per ton; complete watches of ordinary metal, at just 4.0 lire each (category 851b), or less than the corresponding assembled mechanisms, and complete (non-electric) clocks not in cases at 20 lire each (category 853). Again allowing pocket watches 100 grams each, and clocks without cases 1,000 grams each, these last values correspond to some 40,000 lire per ton of watches, and 20,000 lire per ton of ordinary clocks, and proportionately less, obviously, with higher weights per piece (and as noted 4,000 lire per ton of tower clocks, where the assembled mechanism was in fact the finished product). On the other hand, Grioni (1914, vol. 1, p. 104, vol. 2, p. 329) reports data for the very significant Borletti works (and suggests that the only other significant

producers, the Junghans works, were less than half its size, vol. 1, p. 288 and Table F.43, panel E); and the easiest way to generate estimates consistent with those firm data is simply to incorporate them. Borletti employed 700 blue-collar workers in 1912, with an output of 643,030 (cheap) watches and 176,000 alarm clocks, for an estimated output weight of 117.1 tons (Table F.43, panel E, line 6); production in 1911 equaled 523,400 watches and 175,000 clocks, for an estimated output weight (again at 100 and 300 grams per piece, respectively) of 104.84 tons, near 90% of that of 1912. In 1911, neglecting productivity growth, Borletti would have employed some 630 blue-collar workers, or 70% of the estimated large-shop total in 1911 (Table F.02, row 10, col. 1); allowing the Borletti works 70% of the estimated large-shop value added (2.22 million lire, Table F.03, row 10, col. 7), or 1.554 million lire, one obtains a value added estimate of 14,800 lire per ton. Allowing for modest productivity growth, the present estimate of value added is set at a round 15,000 lire per ton (Table F.46, row 17, col. 5); since it is obtained in essence for simple watches and small clocks, more complex watches and larger clocks are implicitly assumed to offset each other. This estimate is low, next to the above-noted import values (and assumed weights per piece); but since it is clear from those values that the imported assembled watch-mechanisms were more complex than those in imported watches, it is also quite possible that the imported watches were finer, on average, than those produced in bulk within Italy. Again, the present estimate is obviously sensitive to the assumed average weight of individual time-pieces; but since it finally serves only to back out metal consumption, which is in any case trivially small, its uncertainty can be taken in stride.

A similar uncertainty surrounds the estimate of value added in assembling imported watch parts (to obtain watches apparently finer than those typically produced in Italy from metal). Using the above import values for parts and assembled mechanisms, value added per ton equals (47,500 – 32,500), or 15,000 lire with the assumed 100-gram weight per piece, declining with increasing weight to vanish altogether just short of 150 grams per piece. Here, value added per ton is set very simply at a round 8,000 lire per ton (Table F.46, row 16, col. 5), which allows assembly a not unreasonable 20% or so of the value of the assembled piece (and implies for example that a ratio of value added to value of 70% in the manufacture of those parts yields one near 75% for the assembled mechanisms). This particular estimate is without practical implications for metal consumption; as will be seen below it serves essentially to allocate the industry's small-shop employment between assembly work on the one hand and maintenance work on the other.

Since materials-saving technical progress world appear to have been negligible, the input-output coefficients in Table F.46, rows 1, 7 – 8, 13, and 17, col. 7 are simply repeated in the corresponding cells of Tables F.47 – F.49; and so of course are the corresponding estimates of value added at 1911 prices per unit of output in col. 5.

F04.07 Production in 1911: metal consumption, maintenance, and new production

The group's total metal consumption, year by year, was calculated above, and appears in Table F.44, col. 8; the estimates for 1911, 1900, 1881, and 1871 are transcribed row 23, col. 4, in Tables F.46 – F.49, respectively. Dividing these figures by the corresponding estimates of the total numbers of workers (row 23, col. 3) on obtains the per-worker averages in row 23, col. 8. These last rise over time, from .54 tons per worker in (indifferent) 1871 to .80 in (prosperous) 1881, 1.08 in (depressed?) 1900, and 2.19 in (prosperous) 1911.

This last figure is still far below the values in the middle of the distributions generated by Grioni (1914) and documented in Table F.43 above, at least for the larger of the industries at hand (fabricated metal, heavy engineering excluding road vehicles). To be sure, output weight per blue-collar worker is not input weight per total worker, but the differences in the numerator and the denominator tend to offset each other; as noted, moreover, while Grioni's sample firms

were above average in both size and power-intensity, within that sample neither variable is significantly correlated with product weight per worker. In the later 1930s, admittedly, the large engineering shops of the day consumed some 2 million tons of metal, or just over 3 tons for each of their 600,000-odd workers (*Censimento i. e c.*, vol. 3, p. 72, and above, Table F.03): a relatively low average apparently in line with the above pre-war figures and inconsistent with Grioni's, on reflection entirely consistent with the latter if one allows for the great increase in automobile and aircraft production. There is no reason to dismiss Grioni's micro-data, even if the metal consumption per worker they imply is high next to the overall average calculated for 1911; and if one accepts them the inescapable conclusion is the obvious one, to wit, that the discrepancy at hand is due first and foremost to the fact that the 1911 census includes, and Grioni's sample essentially excludes, large numbers of small-shop workers and artisans engaged in maintenance, with a relatively low per-capita consumption of metal.

The share of maintenance in total employment and value added can only be estimated; but as adumbrated above the logical problem is straightforward. Ignoring its internal subdivisions, the industry is divided into a new-production sector, and a maintenance sector; aggregate value added, metal consumption, and employment are given, in 1911, as are value added and metal consumption per unit of output. The lower the share of aggregate (employment and) value added attributed to maintenance in 1911, the higher value added, and therefore metal consumption, in new production, and the lower, therefore the residual metal consumption available for maintenance, overall and per maintenance worker, in 1911; since the latter consumption must be positive, the share of maintenance in aggregate value added in 1911 has a lower bound. The higher the share of aggregate value added (and employment) attributed to maintenance in 1911, conversely, the higher the residual metal consumption available for maintenance, overall and per maintenance worker, again in 1911. But as one goes back in time, aggregate maintenance is indexed directly by independent evidence, and 1911-price value added, employment, and metal consumption in maintenance at the earlier benchmarks are correspondingly determined by those attributed to 1911 itself. At the earlier benchmarks, these estimates yield as residuals the labor force and metal consumption in new production, and the corresponding metal consumption per worker (including unemployed workers, but as noted the share of the latter was plausibly small in 1871, and negligible, as in 1911, in 1881). At the early benchmarks, average metal consumption per worker is relatively low; the average in maintenance varies directly with that calculated for 1911 (changing only slightly, with composition effects), and the higher it is, the lower is the implied average in new production. But metal consumption per worker must always have been many times higher in new production than in maintenance: a reasonable ratio between the two at the 1871 benchmark requires that estimated metal consumption per worker be sufficiently low in 1911, that is, on the logic outlined above, that the share of (employment and) value added attributed to maintenance in 1911 also be sufficiently low. In short, the share of maintenance in 1911 is bounded from below by the implied metal consumption in maintenance in 1911 itself, and from above by the implied ratio of metal consumption per worker in new production to that in maintenance decades earlier; and the margin between these two bounds turns out to be pleasantly narrow.

In practice, of course, the internal subdivisions of the industry cannot be ignored, and in Tables F.46 – F.49 the estimates of value added and employment in maintenance are to be obtained for rows 2 – 4, 11, 14, and 19. In 1911 (Table F.46), these estimates are obtained on the assumption that maintenance was everywhere a small-shop handicraft activity performed with minimal tooling; value added per worker is estimated as the average small-shop wage (the ratio of Table F.03, col. 8, to the sum of Table F.02, cols. 5 and 8, with rows 3 and 8 there combined to obtain row 4 here, and rows 6 and 7 there combined to obtain row 11 here; the implicit assumption that that the share of women, boys, and girls was the same whether the

small shop engaged in maintenance or new production is inevitable, given the typical preponderance of maintenance activity among the small shops), times 1.125 to allow for labor-related capital costs (as in section F01.04 above), times a further scale factor *f* that captures the residual differences between maintenance and new production (for example, a differential use of hand tools; this parameter is presumably near 1.00, but not necessarily above it). The industry-specific share of maintenance is then estimated on the assumption that the large shops covered by the industrial census were devoted entirely to new production, with a "high" value added per worker, and that the remaining (small) shops, with a "middling" value added per worker, were a mix of new-production shops with a "high" value added per worker equal to that in the large shops, and of maintenance shops with the estimated "low" value added per worker; given the way the employment and value added estimates were constructed (above, chapter F.01), the algorithm in effect uses the shops' relative size and power-intensity to discriminate between maintenance and new production. With the "middling" small-shop value added per worker thus defined as a weighted average of the "high" figure in new production and the "low" one in maintenance, the higher the "low" figure, the greater its weight in the "middling" one; and given average wages, that "low" (maintenance) figure varies directly with the above-mentioned scale factor *f*, for as *f* rises so do the estimated shares of (small-shop and total) value added and employment absorbed by maintenance. On the logic outlined above, as the maintenance share of total value added (and employment) increases, the overall metal-consumption constraint is more readily met without pushing other estimates beyond their reasonable limits; by (reasonable) assumption, however, the maintenance share of small-shop (value added and) employment can nowhere exceed 100%. To keep all the industries at hand below the latter limit, *f* is here set equal to 1.025; the resulting estimates of value added per worker in maintenance in 1911 are transcribed in Table F.46, rows 2 – 4, 11, 14, and 19, col. 6. In blacksmithing, therefore, average value added per worker in large (industrial-census) shops is estimated as the ratio of value added (69.68 million lire, Table F.03, row 1, col. 7) to employment (39,750 workers, Table F.02, row 1, col. 2), or 1,752.96 lire; average value added per worker in other shops is similarly estimated (as the ratio of 146.98 million lire, Table F.03, row 1, col. 10 to 110,850 workers, Table F.02, row 1, col. 5 plus col. 8), at 1,325.94 lire. Setting $1{,}325.94 = a1{,}292 + (1 - a)1{,}752.96$ and solving, *a* (the share of maintenance in total other-shop employment) works out to just over 92.6%. In Table F.46, row 2, therefore, the maintenance-employment estimate in col. 4 equals 102,690 workers (*a* times 110,850), and the corresponding value added estimate in col. 1 (132.68 million lire) is simply the product of cols. 4 and 6; with $f = 1.00$, and not 1,292 but 1,260 lire per worker in col. 6, for example, the estimates in cols. 1 and 4 would be 120.99 million lire and 96,020 workers, respectively.

The corresponding estimates of value added and employment in other fabricated-metal maintenance in Table F.46, rows 3 and 4, cols. 1 and 4 are obtained exactly like those in row 2, using the corresponding estimates in Tables F.02 and F.03 (respectively rows 2, and 3 plus 8, there for rows 3 and 4 here). The calculated maintenance shares of small-shop employment equal some 90.3% for other smiths (row 3), near the figure obtained for blacksmiths, and 31.8% for the residual; the disparity between these figures suggests on the one hand that some hardware received no maintenance at all (thus nails, tin cans, and so on), and on the other that the maintenance workers were mostly general-purpose smiths (and of course knife-grinders, who account for about half of those attributed to the residual in row 3). Table F.46, row 5, cols. 1 and 4 report the estimates of aggregate value added and employment in the maintenance of fabricated metal, obtained as the sum of the partial estimates in rows 2 – 4. With these last in place, the estimates of value added and employment in the new production of fabricated metal in Table F.46, row 1, cols. 1 and 4 are obtained as residuals, deducting the maintenance totals in row 5 from the industry totals in row 6. The rest of the new-production estimates in row 1 are

immediately obtained: output (col. 2) as the ratio of total value added (col. 1) to value added per unit (col. 5); total metal consumption (col. 3) as output (col. 2) times the input/output ratio (col. 7); value added per worker, as the ratio of total value added (col. 1) to employment (col. 4); and metal consumption per worker (col. 8), as the ratio of total metal consumption (col. 3) to employment (col. 4). This last figure works out to 5.49 tons per worker, or 4.07 tons of output per worker, and perhaps 4.35 tons of output per blue-collar worker (from the large-shop estimates in Table F.02, rows 1 – 3 and 8, cols. 1 – 2): below the median, but well above the fortieth percentile, of the distribution obtained from Grioni's sample (Table F.43, panel A, col. 7).

The derivation of the estimates for the precision-instruments industry is similarly straightforward. The estimates of value added and employment in maintenance in Table F.46, row 14, cols. 1 and 4 are obtained exactly like those in row 2, using the corresponding estimates in row 9 of Tables F.02 and F.03; the calculated maintenance shares of small-shop activity equals 53.2%. The estimates of value added and employment in new production in Table F.46, row 13, cols. 1 and 4 are then obtained exactly like those in row 1, by deducting the maintenance figures (here simply row 14) from the corresponding industry totals (row 15); and these yield the remaining new-production estimates in row 13, through the same simple calculations as were used to complete row 1. Again proceeding as above, one deduces from the resulting estimate of metal consumption per worker (col. 8) that the implied output per blue-collar worker was something under two quintals per year, a figure well within the broad range defined by the few relevant figures in Grioni's sample (Table F.43, panel E, col. 7).

In the case of watchmaking, the algorithm used above yields a "low" value added per worker of 1,535 lire, whence a low-value added small-shop employment share of no less than 99.5%, or 7,760 workers with a value added of 11.91 million lire; but in watchmaking these low-value-added handicraft activities presumably include the assembly of imported parts. The above estimate of 1,535 lire per worker thus appears in Table F.46, col. 6, both in row 16 (assembly) and in row 19 (maintenance). Mere assembly (row 16) is allowed 8,000 lire per ton (col. 5) and 160 tons of output (col. 2, from Table F.52, col. 6, derived below, section F04.08), whence a value added of 1.28 million lire (Table F.46, row 16, col. 1), and, given value added per worker (col. 6), 830 workers (col. 4). Since the large shops employed just 900 blue-collar workers (Table F.02, row 10, col. 1), and as noted the Borletti works alone over 600, these assembly workers were at least preponderantly in small, artisanal shops. For simplicity, and ignoring possible exceptions (*Riassunto industriale*, vol. 1, p. 58), all are here attributed to such shops; maintenance is accordingly attributed the residual "low value added per worker" value added, or (11.91 – 1.28) = 10.63 million lire (row 19, col. 1), and employment, or (7,760 – 830) = 6,930 workers (row 19, col. 4). The estimates of value added and employment in new production from metal in Table F.46, row 17, cols. 1 and 4 are of course the industry totals (row 20) less those attributed to assembly and maintenance together (11.91 million lire and 7,760 workers, separated into assembly in row 16 and maintenance in row 19); and these yield the remaining estimates in row 17, through the usual simple calculations. Total value added and employment in new production (row 18, cols. 1 and 4) are of course the simple sums of the separate estimates for assembly (row 16) and production from metal (row 17).

The derivation of the estimates for the general equipment industry is the most complex. Here, the application of the usual algorithm to the relevant data in Tables F.02 and F.03 (summing over rows 6 and 7) yields an estimated "low" value added per worker of 1,331 lire; this figure is attributed to maintenance (Table F.46, row 11, col. 6). The difficulties stem from the distinctions within new production. As in watchmaking, new production includes the assembly of imported parts; but whereas assembling watch mechanisms was plausibly the work of artisans, the assembly of machines that were made of, or incorporated, imported parts was

presumably the work of (large) new-production shops. Value added per worker is accordingly estimated as average large-shop labor costs per worker (Table F.03, row 6 plus row 7, col. 4, divided by Table F.02, row 6 plus row 7, col. 2), again times 1.125 to allow for labor-related capital costs (as in section F01.04 above), and again times the scale factor $f = 1.025$, or 1,387 lire per worker (Table F.46, row 7, col. 6). Assembly is further allowed 14,180 tons of output (col. 2, from Table F.52, col. 2, derived below, section F04.09) and 300 lire of value added per ton (col. 5), whence a total value added of 4.25 million lire (col. 1), and, given value added per worker (col. 6), an estimated employment of 3,060 workers (col. 4). With assembly assigned to large shops, the latter are attributed, for their new production from metal, a value added of 167.55 million lire (the 171.8 in Table F.03, rows 6 plus 7, col. 7, less that in assembly) and 75,740 workers (the 78,800 in Table F.02, rows 6 plus 7, col. 2, less those in assembly), or a value added per worker just over 2,212 lire. Again taking the small shops' value added per man (Table F.03, rows 6 plus 7, col. 10, divided by Table F.02, rows 6 plus 7, col. 5, or just over 1,587 lire), as a weighted sum of the large-shop average in new production from metal and the average in maintenance (1,331 lire), maintenance is attributed just under 71% of total small-shop employment (Table F.02, rows 6 plus 7, col. 7), or 24,690 workers (Table F.46, row 11, col. 4) and, at a value added of 1,331 lire each (col. 6), a total value added of 32.86 million lire (col. 1).

Deducting the maintenance value added and employment estimates in Table F.46, row 11, cols. 1 and 4 from the industry totals in row 12 yields the new-production totals in row 10; further deducting those attributed to assembly (row 7), one is left with a value added of 189.92 million lire, and 85,850 workers, for general-equipment new production from metal, that is, for the manufacture of truss-structure components on the one hand (row 8) and the residual on the other (row 9). The output of truss-structure components is estimated at 41,770 tons (row 8, col. 2), again from independent evidence (Table F.52, col. 3, derived below, section F04.09); it implies a value added of 14.62 million lire (Table F.46, row 8, col. 1, from cols. 2 and 5), and a metal consumption of 50,120 tons (col. 3, from cols. 2 and 7; in fact, as explained in section F04.09 below, the output estimate is actually derived from the metal-consumption estimate, rather than vice-versa, but the point is here immaterial). The residual is accordingly left with the remaining 175.30 million lire of value added (row 9, col. 1), which in turn implies an output of 194,780 tons (col. 2, from cols. 1 and 5) and a metal consumption of 234,480 tons (col. 3, from cols. 2 and 7), whence a total metal consumption in new production of 293,600 tons (row 10, col. 3, from rows 7 – 9). All that remains is the allocation to truss-structure components and other production from metal of the 85,850 workers assigned to the two together; and given the other estimates the work-force figures in col. 4 obviously determine value added per worker (col. 6, obtained as col. 1/col. 4) and metal consumption per worker (col. 8, obtained as col. 3/col. 4). The compatible estimates in rows 8 and 9, cols. 4, 6, and 8 vary inversely to each other; and with the manufacture of components in row 8 a much smaller industry than the residual in row 9, a given relative change in row 9 will involve a much larger relative change in row 8, and vice versa. In general, one would expect value added and metal consumption per worker to be significantly higher in truss-structure components than in the residual, as the former involved only the (capital-intensive) fabrication of the metal, while the latter typically included the (labor-intensive) assembly of the resulting pieces. The most useful data here seem to be the output weights per blue-collar worker in Grioni's sample (Table F.43, col. 7); median values are there near 9.3 tons per man in structures (panel B), and 3.0 in general machinery (panels C – E, merged and purged of six low precision-equipment figures). Allowing for the slightly different input-output coefficients, these output tonnages point to an input tonnage per man in structural components 3.0 times that in general machinery; metal consumption is here set at 9.09 tons in structural components (row 8, col. 8), whence a corresponding work force of

5,510 (row 8, col. 4, obtained as col. 3/col. 8), leaving to the residual industry 80,340 workers (row 9, col. 4) with a metal consumption of 3.03 tons per worker (col. 8, obtained as col. 3/col. 4). The resulting estimates of value added per worker are obtained as the ratio of col. 1 to col. 4; the figure obtained for (capital-intensive) structural components (row 8, col. 6) is over 20% higher than that in the residual (row 9, col. 6) and some 90% higher than that in (labor-intensive) assembly (row 7, col. 6), and these proportions too do not appear unreasonable.

Table F.46, rows 21 and 22 transcribe the new-production and maintenance totals. New-production value added, metal consumption, and employment (row 21, cols. 1, 3, and 4) are simply the sums of the industry figures in rows 1, 10, 13, and 18, and these yield the per-worker averages in cols. 6 and 8. Maintenance value added and employment (row 22, cols. 1 and 4) are similar sums of industry figures (rows 5, 11, 14, and 19); metal consumption (col. 3) is obtained as a residual (row 23 minus row 21), and the per-worker averages are again obtained from the obvious ratios. Interestingly, maintenance appears to account for 40% of value added, and half the work force, but a trivial share of metal consumption (ca. 1%, as calculated, equivalent to perhaps half a quintal per worker; but this an obviously imprecise residual).

The last step is the allocation of estimated total metal consumption in maintenance (row 22, col. 3) to its components: maintenance by blacksmiths (row 2) and by other smiths (row 3), of other fabricated metal (row 4), of general equipment (row 11), of precision instruments (row 14), and of clocks and watches (row 19). This allocation is in proportion to the employment estimates in col. 4, suitable weighted. Blacksmiths (row 2) and other fabricated-metal workers (row 4) are allowed a unit weight; since iron pieces are typically far heavier, for any given size and shape, than pieces of copper or other metal, even if, conversely, more often reforged than patched, the employment of coppersmiths, tinsmiths, and the like (row 3) is discounted by four fifths. Because the maintenance of precision equipment seems in the main to result from maladjustment rather than breakage, and the parts involved are typically small, the corresponding employment figures (rows 14 and 19) are discounted by seven eighths. To reabsorb the resulting rounding error, finally, the largest metal-consumption estimate, that for blacksmiths, is reduced by 10 tons.

In general equipment, on the other hand, maintenance was in essence the maintenance of machinery, as the maintenance even of metal structures is attributed to the construction industry; and the manufacturing of replacement parts for machines would seem to consume far more metal per worker than repairs by blacksmiths, which would appear typically to involve reforging, with no more than minor patching. General-equipment maintenance workers (row 11) are accordingly attributed a treble weight. Dividing the resulting metal consumption (row 11, col. 3) by the corresponding input/output ratio (row 9, col. 7), the implied production of replacement parts works out to some 3,000 tons. Value added in the maintenance of general equipment is calculated at near 33 million lire (row 11, col. 1); with a value added per ton of parts of 900 to 1,200 lire (1.5 to 2.0 times the 600 lire allowed above for parts of new machines, to allow for the relative inefficiency of one-off production), the share of that value added represented by the manufacture of replacement parts works out in turn to some 8 to 11%, which appears reasonable enough.

The metal-consumption (subtotals and) totals in rows 5 – 6, 12, 15, and 20, col. 3, are then obtained as the obvious sums; the corresponding per-worker estimates in col. 8 are in turn obtained as the ratios of the corresponding metal-consumption figures in col. 3 and employment estimates in col. 4.

Maintenance and assembly are considered hand processes throughout the period at hand: the estimates of per-worker value added (at 1911 prices) and metal consumption in Table F.46, rows 2 – 4, 7, 11, 14, 16, and 19, cols. 6 and 8 are repeated in the corresponding cells of Tables F.47 – F.49.

F04.08 Precision equipment: new production and maintenance, 1861-1913

The precision-equipment industries were relatively small: in all four benchmark years, instruments and time-pieces together accounted for near 3% of the labor force of the group at hand (Tables F.46 – F.49, ratio of row 15 plus row 20 to row 23, col. 4). In 1911, and presumably earlier as well, these industries' metal consumption was a tiny share of the group total (0.1%, Table F.46, ratio of row 15 plus row 20 to row 23, col. 3): the path of that total is essentially irrelevant to the estimates for these particular industries, and of course vice versa.

The estimates for precision instruments are derived on the assumption that new production moved as imports did, but relatively less (and less quickly), and that maintenance varied directly with the extant stock, which in turn grew with new acquisitions. At the benchmark years, the implied maintenance work force is deducted from the census-based total to obtain the new-production work force, and, given the output estimate, product per worker. In the event, the assumed import-elasticity of production determines productivity growth, which turns out to be implausibly high with an elasticity near unity, and implausibly low with an elasticity of half that or less; the present figures are derived assuming an intermediate elasticity, equal to 63%.

The net import series used here is presented in Table F.45, col. 23. It is calculated as the sum of Table F.45, cols. 16 – 19, tentatively augmented by 40 tons per year in 1861-66 and 10 per year in 1867-70 to allow for border changes, as loosely suggested by the data in Bonelli (1961), pp. 191, 195, and Glazier (1966), pp. 191, 203; in addition, 250 tons of net imports are shifted from 1887 to 1888 (to allow for the inventory movements suggested by the import spike in 1887, which curiously occurred in the absence of a tariff increase). In 1911, net imports equaled 3,540 tons, against an estimated output of just 277 tons (Table F.46, row 13, col. 2). The *Riassunto industriale*, vol. 1, p. 57, noted that domestic production was far below the volume of imports, and that the latter had risen with the diffusion of electrical equipment; the assumption that output followed imports with a limited elasticity here seems to capture not only the limited cyclical variability of output but the growing comparative disadvantage of domestic industry as electrical equipment became increasingly significant. In the first instance, therefore, the 1911 output estimate is extrapolated to 1861-1913 on the assumption that, year over year, the relative change in production was 63% of the relative change in net imports. The domestic share of the domestic market (the ratio of output to output plus net imports) is then calculated, from 1861 to 1913. Duties on precision instruments equaled 20 lire per quintal in 1861-64, 10 in 1866-77, and then 30; to allow very roughly for the attendant changes in net protection, the first-round market-share series is multiplied by a coefficient equal to (5/6) in 1861-64, (3/4) in 1865, (2/3) in 1866-77, again (5/6) in 1878, and unity from 1879 to 1913, and output is reestimated (in 1861-78) to yield the tariff-corrected market share. Finally, on the assumption that production adjusted to market shifts less quickly than imports, the (partly reestimated) output series is shifted forward half a year, leaving the 1861 figure unchanged, and finally slightly rescaled to restore the 277-ton output estimate in 1911. The resulting output series appears in Table F.52, col. 5, and the corresponding metal-consumption series (obtained simply as output times the 2.5 tons-per-ton input/output ratio) in Table F.52, col. 12. The benchmark-year output and metal-consumption estimates are also transcribed in Tables F.47 – F. 49, row 13, cols. 2 and 3; using the coefficient in col. 5, one obtains the (1911-price) value added estimate in col. 1.

The maintenance estimates for precision instruments are in turn obtained by assuming a 5,000-ton stock at the end of 1860, and calculating the succeeding year-end stocks by adding the sum of the year's estimated output (Table F.52, col. 5) and net imports (Table F.45, col. 23) to 96% of the previous year-end stock (in effect assuming a virtually constant stock per capita,

replenished essentially by imports, in the years following Unification). The figures so obtained are then shifted forward half a year to approximate mid-year stocks, and used as indices to extrapolate the (1911-price) value added, metal consumption, and work force estimates in Table F.46, row 14, cols. 1, 3, and 4. The value added and metal consumption series appear as Table F.53, cols. 5 and 12, respectively. The benchmark-year value added, metal consumption, and work force estimates are also transcribed in Tables F.47 – F. 49, row 14, cols. 1, 3, and 4; the industry (new production and maintenance) value added and metal-consumption totals in row 15, cols. 1 and 3 are obtained as the sums of the partial figures in rows 13 and 14, while the new-production work force in row 13, col. 4 is obtained as the census-based industry total in row 15 less the maintenance estimate in row 14 (for a figure in 1900 of over 1,000, which is again reasonable next to the numbers in the *Riassunto industriale*, vol. 1, p. 57). The new-production estimates of value added and metal consumption per worker in rows 13 and 15, cols. 6 and 8 are then obtained from cols. 1, 3, and 4. On these assumptions, output per worker increased at an average annual rate between 2.2% and 2.6% in all three intercensal periods, which seems reasonable enough. With a unit import-elasticity of output the post-1881 average productivity growth rates jump to over 5% and then almost 7% annually (which seem excessive, especially for the last intercensal period, given the prevalence of large shops at least by the turn of the century); reducing that elasticity to one half cuts those productivity growth rates to near 1.7% and then just 0.7% annually, which seem altogether too low (especially, once again, in the last intercensal period). These productivity growth rates are in contrast relatively insensitive to variations in the initial stock or the depreciation rate; the present assumptions are justified by the reasonable (low, positive) initial growth rate of the calculated stock.

The clock and watch industry included the assembly of parts as well as new production from metal and of course maintenance. The production estimates for clocks and watches assembled from imported parts are based directly on the data provided by the *Movimento commerciale* and transcribed above in Table F.45, col. 20. Neglecting lags, the weight of the output is here identified very simply with that of the corresponding imported parts, with minimal adjustments. In the case at hand, imports of clock and watch parts into pre-1867 Venetia appear to have been negligible (*Movimento commerciale 1866*, p. 491), and those into pre-1871 Latium are assumed to have been negligible as well; the only modification to the import series is the transfer to 1888 of 30 tons of parts imported in 1887, to allow for likely inventory swings as part imports exploded in 1887 and collapsed in 1888 (presumably not because of an anticipated tariff increase, but simply because in 1887 sales fell short of those expected before the bubble burst). The resulting new-production series is transcribed directly in Table F.52, col. 6. The output estimates for the benchmark years are transcribed in Tables F.46 – F.49, row 16, col. 2; using the 1911-price value added coefficients in cols. 5 (per ton) and 6 (per worker), these yield the estimates of aggregate 1911-price value added in col. 1, and of the corresponding work force in col. 4. Metal consumption, total and per worker (cols. 3 and 8), is of course zero.

The estimates for the residual parts of the clock and watch industry (production from metal and maintenance) are again so derived as to reconcile the census and import data. Net imports of assembled pieces are estimated as Table F.45, col. 21, tentatively augmented by 12 tons per year in 1861-66 and 2 per year in 1867-70 to allow for border changes, again as loosely suggested by the data in Bonelli (1961), pp. 191, 195, and Glazier (1966), pp. 191, 203; this series too shows an import peak in 1887, but the series is smooth enough, and there is no apparent need to correct for inventory movements. Adding the estimates of watches assembled from imported parts (Table F.52, col. 6) yields the estimated total imports (of assembled and unassembled clocks and watches). This series displays negligible growth from 1861 to 1875, followed by rapid growth to 1887, decline and recovery, and renewed growth from the turn of

the century; the initial boom was no doubt abetted by the tariff cut (from one lira per ordinary pocket watch to 1883 to half that from 1884), but the essential driver appears to be the diffusion of cheap (Roskopf) watches, documented by the decline in import values (from 30 lire per watch with a silver or base-metal case in 1874 to 20 in 1884, 11 in 1894, 8 in 1904, and finally, in 1911, 10 lire per watch with a silver case, and just 3.50 lire per watch with a case of base metal).

Domestic production from metal is estimated in two parts. The Borletti works are attributed the output calculated from the firm's reported annual product (Grioni, 1914, vol. 2, p. 329), again allowing 100 grams per watch and 300 grams per alarm clock; the resulting series (extended to 1913 assuming 10% growth from the previous year) is transcribed in Table F.50, col. 1. In 1911, their calculated product equals some 105 tons, leaving an estimated 49 tons to other producers. The latter figure is extrapolated assuming a 50% elasticity with respect to total imports, using the same algorithm as was used above for precision instruments; here too, the initial results are shifted forward half a year, leaving the estimate for 1861 unchanged, and marginally rescaled to restore the 49-ton output estimate in 1911. The resulting series is transcribed in Table F.50, col. 2. The sum of these two series is the estimated tonnage of clocks and watches produced from metal, transcribed in Table F.52, col. 7; the corresponding metal-consumption series (again obtained simply as output times the 2.5 tons-per-ton input/output ratio) appears in Table F.52, col. 12. The benchmark-year output and metal-consumption estimates are further transcribed in Tables F.47 – F.49, row 17, cols. 2 (whence the 1911-price value added estimates in col. 1) and 3.

The maintenance index requires careful calibration, as the diffusion of cheap, simple (Roskopf) watches presumably reduced both the pieces' average life, and the maintenance burden per unit; and since maintenance appears to have absorbed the larger part of the industry's work force the residual available for new production is highly sensitive to the assumed path of the quality-corrected stock. Absent more direct evidence on the appropriate correction, the maintenance series is here obtained by estimating the benchmark-year new-production work force directly, obtaining the maintenance work force as a residual, and constructing the stock series in the light of the latter.

Employment in new production from metal is estimated on the assumption that productivity grew at 1.5% per year from 1895 (with the growth of factory production), and one third of that in the previous years; the resulting benchmark-year estimates are transcribed in Tables F.47 – F.49, row 17, col. 4, and the averages in cols. 6 and 8 are then obtained as the obvious ratios. The new-production totals in row 18, cols. 1 – 4 are in turn the sums of rows 16 and 17, and the per-worker averages in row 18, cols. 6 and 8 are again obtained as the obvious ratios; in 1871, rounding error raises the average in row 18 above those in rows 16 and 17. Benchmark-year employment in maintenance (Tables F.47 – F.49, row 19, col. 4) is obtained as a residual (row 20 less row 18, col. 4); the stock series that maintains a virtually constant ratio to these figures is obtained in two steps, as follows. First, the actual stock is estimated, much as above for precision instruments, by assuming an initial stock at the end of 1860, and calculating the succeeding year-end stocks by adding the year's total additions (estimated output from imported parts and from metal, Table F.52, cols. 6 and 7, and net imports of assembled pieces, Table F.45, col. 21, modified in 1861-70 as indicated above) to an estimated surviving percentage of the previous year-end stock, and shifting the resulting forward half a year to approximate mid-year stocks. The surviving percentage is set at 98% from 1861 through 1881, and then assumed to decline by one quarter of a percentage point per year to (.98)(.9975) = .97755 in 1882 and so on to just over .90 in 1913; the low initial depreciation rate seems warranted for a time when watches were expensive and handed down from generation to generation, and its subsequent rise allows for a reasonable reduction in the average life of a

time-piece. With the assumed depreciation rate, selecting an initial stock of 800 tons at the end of 1860 yields an actual-mid-year-stock series, here transcribed in Table F.50, col. 3, which grows from 1871 to 1881 at a rate very similar to that of the estimated maintenance labor force. In later years, this stock series implies that the (estimated) number of maintenance workers per stock ton declined from 2.77 in 1871 and 1881 to 2.46 in 1900 and 1.91 in 1911; assuming that this decline reflected the diffusion of simple watches with a relatively low average maintenance burden per unit, the quality-corrected stock is estimated by attaching to the actual (mid-year) stock a weight that declines at a constant geometric rate (ca. .9938) from 1.00 in 1881 to (2.46/2.77) in 1900, and then at a somewhat higher rate (ca. .9769) to .6870 in 1911 and ca. .6557 in 1913. The resulting quality-corrected stock series is the index used here to extrapolate the value added and metal consumption estimates for 1911 (Table F.46, row 19, cols. 1 and 3); the value added and metal consumption series appear as Table F.53, cols. 6 and 13, respectively. The benchmark-year value added and metal consumption estimates are also transcribed in Tables F.47 – F. 49, row 19, cols. 1 and 3 (which of course return the assumed averages in cols. 6 and 8). The industry (new production and maintenance) value added and metal-consumption totals in row 20, cols. 1 and 3 are obtained as the sums of the partial figures in rows 18 and 19, whence, through the obvious ratios, the averages in cols. 6 and 8.

The clock-and-watch maintenance series in Table F.53, col. 6 is unusual, in that it does not display (near-)monotonic growth, but rather rises to a peak in the mid-1890s and then declines. This late decline is driven essentially by the census data, which point to virtual stagnation in total industry employment between 1900 and 1911, and therefore, in the face of rapidly growing (employment in) new production, a decline in the number of maintenance workers (Tables F.46 and F.47, rows 16 – 20, col. 4). At a deeper level, of course, the decline is driven by the argument, advanced above (F01.02), that there were no significant maintenance workers in the industry beyond those counted in category 4.53; and that argument can be extended here. The *Censimento 1871* and *1881* list only "watchmakers" (*orologiai*, engaged also in selling and repairing, categories II.14.5 and II.XII.6, respectively); the *Censimento 1901* lists only watch-and-clock "manufacturers and repairers" (*fabbricatori e aggiustatori di orologi*, category XIV.5); the *Censimento demografico* is the first to mention sellers of clocks and watches in a service-sector category (9.116, sellers also of jewels, medals, coins, paintings, statuary, antiques, etc.). The latter includes almost 7,000 persons, suggesting that the apparent decline in clock-and-watch maintenance workers could be eliminated by adding a minority of those to the workers in category 4.53; but that course does not appear prudent. The general argument from the principles that appear to have guided the census-takers was developed above; a specific argument is based on the census figures themselves. The *Censimento 1901* counted some 7,400 workers in category XVIII.8 (sellers of jewels, musical instruments, and toys), and a further 900 in XVIII.10 (artwork, antiques); the comparable set from the *Censimento demografico* includes the above-noted near-7,000 in category 9.116, a further 700 or so in categories 9.111 and 9.113 (sellers of musical instruments and sellers of toys, respectively), and perhaps a further 800 in 9.112 (sellers of luxuries, brushes, combs, pipes, etc.). The increase from some 8,300 to some 8,500 is trivial, and far below the growth in overall employment in trade (from 485,000 in category XVIII in the earlier census to 542,000 in categories 9.1 – 9.3 in the later one): there is nothing in these numbers to suggest that significant numbers of watch-and-clock repair workers counted in industry in the *Censimento 1901* were instead counted in the services in the *Censimento demografico*.

The decline in the number of watch-and-clock repairmen seems real enough, and tied as noted to the diffusion of cheap watches. It bears notice, in this connection, that by 1911 the cheapest time-pieces apparently cost a fraction of a skilled worker's daily wage (Introna, 1996, p. 21), so that replacement was easily cheaper than repair. This industry thus appears to have

pioneered the pattern that is now the norm throughout the developed world, but remained unusual in Europe if not in North America as recently as the mid-twentieth century.

F04.09 Assembled machine parts and truss-structure components: new production, 1861-1913

The production estimates for general machinery assembled from imported parts are transcribed in Table F.52, col. 2 and again, for the benchmark years, in Tables F.46 – F.49, row 7, col. 2 (whence again the 1911-price value added and work force estimates in cols. 1 and 4, using the coefficients in cols. 5 and 6, and of course zeroes in cols. 3 and 8). In principle, as noted, it is not clear to what extent the imported parts were in fact the components of entire machines, as appears to have been the (at least predominant) case for clocks and watches, or simply foreign-made parts incorporated in otherwise domestic machines; but this does not affect the estimates, which can be interpreted (as they are here) simply as an assembly activity that is added to that of the parts produced in Italy, or (more subtly) as an implicit deduction for imported parts from a total output of assembled machines that includes them, and is allowed the value added in production from metal. In practice, the derivation of the desired series is relatively complex, as in the *Movimento commerciale* machine parts are separately identified, in general, only from 1888.

The relevant net-import data are summarized in Table F.45 by two time series: one for firearm parts, available throughout but involving only small quantities (col. 14), and one for (other) machine parts, involving very significant quantities but available only from 1888 (col. 10). The latter series is here adjusted, and extrapolated, as follows. From 1887 to 1888 the tariff on ordinary parts practically doubled, from the 60 lire per ton levied on general machinery and machine parts to 110 lire per ton, and some parts were no doubt acquired, to avoid the higher levy, earlier than they would otherwise have been; to allow for that, the output estimate for 1888 is 110% of the year's actual imports of parts. The estimates for 1861-87 are in turn derived from the aggregate net imports of ordinary machinery, including parts (the sum of cols. 10 – 13 in Table F.45), twice modified. First, to allow for Latium and Venetia, the reported figures for the Kingdom are augmented annually by 400 tons in 1861-66 and 200 tons in 1867-70, as suggested by the data in Bonelli (1961), pp. 191, 195, and Glazier (1966), pp. 191, 203. Second, to allow for likely inventory movements in anticipation of the tariff hike in 1888, imported parts actually used in 1888 are as noted estimated as 110% of the reported figure (col. 18); extra 3,044 tons of imports thus attributed to 1888 are deducted from the total reported for 1887. After 1888, it may be noted, machine-part imports vary more, over the cycle, than aggregate machine imports (including parts): the share of parts falls over the downswing from (an estimated) 27% in 1888 to nearer 9% in 1896-1906, and then recovers, over the subsequent upswing, to 16% in 1913. In 1861-87, therefore, the share of parts is assumed to vary in rough step with the aggregate that includes them; here, machine-part imports are estimated by setting their share of that aggregate at .09 in 1861-68, .12 in 1869-71, .15 in 1872-74, again .12 in 1875-79, and then a ratio that rises annually by .03 to .27 over the cyclical peak-import years 1884-87. The rest of that aggregate is of course the corresponding estimate of the net imports of assembled machinery.

Again neglecting production lags, the estimated tonnages of general machinery assembled from imported parts (Table F.52, col. 2) are obtained as the (rounded) sum of the reported net imports of firearm parts (Table F.45, col. 14) and of other machine parts (Table F.45, col. 10, corrected and extrapolated as above); since firearms are not separately weighted in production from metal, their imported parts are not separately weighted either. Altogether similarly, the aggregate net imports of assembled general machinery are estimated as the simple sum of firearm imports (Table F.45, col. 15), and other imports (in 1861-88, the aggregate

including parts estimated as described, less the tonnage attributed to parts; from 1889, the sum of cols. 11 – 13 in Table F.45). The resulting time series is transcribed in Table F.45, col. 24.

The production estimates for truss-structure components (of bridges, canopies, and power-line towers) are presented in Table F.52, col. 3. These are obtained as the corresponding metal-consumption figures in Table F.52, col. 10, divided by the input/output ratio (1.2: Table F.46, row 8, col. 7); the metal-consumption estimates themselves tease a time series from the limited evidence in the *Atti C.I.C. 1885* and Grioni (1914) through extensive indexation (and much sanding and filling). As noted above (section F4.02), in 1884 the production of iron bridges and canopies is said to have consumed some 15,000 tons of metal. Since this industry was then apparently competitive in world markets at world prices (as it sought access to those markets rather than increased protection at home), and also benefited from net protection (as its products were considered fabricated metal, and paid specific duties per ton practically double those levied on heavy machinery), its metal consumption seems reasonably indexed, in the first instance, directly by weighted domestic construction. The estimates of new construction generated below include separate 1911-price value added series for railway construction, and the part thereof represented by renovations and improvements (Table K.10, cols. 21 and 20, respectively); public buildings, and other public works (Table K.05, cols. 6 and 10, respectively); and private buildings (Table K.58, col. 5). Bridges and canopies seem tied relatively strongly to railway construction (and especially improvements, which include the doubling of track and the extension of railway stations in response to traffic growth), less to other public works (of which roads were only a part), and least to public and especially private buildings. Allowing also for the relative ratios of value added to value (near half in railway construction and other public works, near a third in the construction of buildings), weighted domestic construction is here calculated as Table K.10, col. 21 plus twice col. 20 (in effect allowing railway improvements a triple weight, as they are already included in col. 21), plus half of Table K.05, cols. 6 and 10, plus one quarter of Table K.58, col. 5; the resulting series is transcribed in Table F.50, col. 4.

The bridges-and-canopies metal-consumption series in Table F.50, col. 6 is the point estimate of 15,000 tons in 1884, indexed by the construction series in col. 4, with adjustments in the years 1890-1913 on the one hand, and 1861-72 on the other. The more straightforward is the later adjustment, which adds an allowance for the industry's exports made with metal imported duty-free. Col. 5 transcribes the quantities recorded by the *Movimento commerciale* as reexports of duty-free metal imports from 1890; earlier exports may have been non-zero (Bozzoni, 1885, p. 105), but they are here considered negligible. From 1890 to 1913, therefore, the metal-consumption estimates in col. 6 are those obtained from col. 4, augmented by 1.2 times the exported product in col. 5. One notes that (once again) exports were particularly significant when domestic sales were depressed.

The more tentative adjustment is to the estimates for the early years. As noted in section F04.02 above, the industry was lobbying for duty-free imports as early as 1873; but the industry seems to have reached maturity only with the growth of Cottrau's own firm, created in the summer of 1870 (Fatica, 1984). An earlier data point is provided by Giordano (1864, pp. 347-353), also discussed above. Giordano lists firms producing bridges and canopies (in Genoa, Lucca, Milan, Naples, and Padua) with an aggregate of some 1,650 blue-collar workers; some appear to have been significant producers (p. 103), but for others such products appear to be mere sidelines, and the effective equivalent number of workers is perhaps half of those 1,650. Giordano rarely supplies output or metal-input weights, but the Lucca firm also producing tubular bridges is attributed a metal consumption of 440 tons for 79 workers (pp. 362-363), or 5.57 tons per worker. Taking half that figure as representative for truss structures (as loosely suggested by Grioni's sample discussed in section F04.02 above), aggregate metal consumption

in the production of bridges and canopies in 1864 is here estimated at 2,300 tons, or just 23.47% of the initial estimate for that year obtained through the construction index in col. 4. Allowing a couple of years for Cottrau's firm to work up to speed, the metal-consumption estimates in col. 6 in 1861-1872 are the initial estimates obtained from col. 4, times .2347 in 1861-70, .50 in 1871, and .75 in 1872.

Three comments may here be in order. The first is that the present output estimates for 1871-80 total some 62,000 tons; Cottrau's firm, then the largest of the three still in the business, appears to have accounted for perhaps 40,000 tons (above, section F04.02). That the clearly dominant firm should have supplied some 65% of the market seems reasonable enough, and so therefore, by implication, does the construction index used to generate those estimates. The second is that the imports of fabricated metal (Table F.45, col. 19) are broadly constant over the 1860s and 1870s, and do not show a step decline to offset the surge in output here attributed to the early 1870s; it would seem that in the 1860s the actual market was smaller than the construction index in Table F.50, col. 4 would suggest, perhaps because in the immediate aftermath of Unification the railway net was rapidly expanded over relatively easy terrain (and bringing railway service to secondary towns, with correspondingly modest stations). The third is that the productivity estimate for 1864 also appears reasonable in its own right. Adding 10% to the blue-collar numbers to allow for white-collar personnel, truss-structure production is here assigned a metal consumption of 2,300 tons for 908 total workers, or some 2.53 tons per worker in 1864, against 9.09 tons per worker in 1911 (Table F.46, row 8, col. 8). The implied rate of annual productivity growth is 2.64%, comparable to the 2.44% obtained for railway-vehicle work in section F04.05 above.

Bridges and canopies appear to have been the only significant truss-work metal structures erected over the early decades of the period at hand, but not, clearly, from the turn of the century: while in 1913 the production of bridge-and-canopy components appears not to have exceeded some 18 thousand tons (Table F.50, col. 6 divided by 1.2), the total output of structural components by the firms in Grioni's sample is near 50,000 tons (Table F.43). In point of fact, the biggest producers in that sample (the Togni, SIFGCM, SICG, and Savigliano works) all appear to have been heavily, if not primarily, involved in producing components for the utilities, notably (fabricated) pressure pipelines and power-line towers for the production and distribution of hydroelectric energy: in short, for a new and rapidly growing market created by technical progress. Here too, there is a useful data point: the indication in Grioni (1914), vol. 2, p. 259, that the Savigliano works alone had produced towers for 7,000 kilometers of power lines.

The corresponding time-series estimates are built up from this bit of evidence, as follows. The Savigliano works would appear to have been the largest producers of such towers; allowing the other producers together a shade over as much again, the aggregate length of power lines (with Italian-built towers) is estimated at 15,000 kilometers. Towers have become more complex over time; they now seem to range up from 15 tons/kilometer, rising with voltages (Kiessling, Nefzger, and Nolasco, 2003, p. 17). Taking the present-day minimum as representative of the early average, the total weight of the (domestic) towers then in place is estimated at 225,000 tons (corresponding to a total metal consumption of 1.2 times that, using the figure estimated for the structurally similar bridges, or 270,000 tons). The selected unit weight suggests that the Savigliano works had produced some 105,000 tons of towers; if a tenth of those had been produced in 1913, towers would have represented a not unreasonable 60% or so of the 18,000 tons of components they produced in that year (Table F.43). The estimated total year-end capacity of commercial hydroelectric plants is reported below (Table J.01, col. 8); the annual increments in that series are transcribed in Table F.50, col. 7. The total capacity in place at the end of 1913 equaled 463,500 kW, suggesting a mean

metal consumption for (Italian) tower components of some .6 tons/kW. The annual power-line-tower metal consumption estimates are transcribed in Table F.50, col. 8; they are obtained by shifting the capacity-added figures in col. 7 half a year backward (on the assumption that the lines were built in time to be in place when the plant came on stream), repeating in 1913 the figure so obtained for 1912, and multiplying the resulting series by .6 tons/kW. Aggregating finally over Table F.50, cols. 6 and 8, one obtains the estimated aggregate metal consumption for bridges, canopies, and power-line towers transcribed directly in Table F.52, col. 10, and, through the input/output ratio, the corresponding output series in Table F.52, col. 3.

The output estimates (Table F.52, col. 3) and metal-consumption estimates (Table F.52, col. 10) so obtained for the benchmark years are transcribed in Tables F.46 – F.49, row 8, cols. 2 and 3; the derivation of the other estimates for 1911 in Table F.46, row 8 has been described above. In Tables F.47 – F.49, too, the estimate of aggregate 1911-price value added at the previous benchmarks in row 8, col. 1 is obtained directly as the product of cols. 2 and 5. At those benchmarks metal consumption per worker (row 8, col. 8) is in turn estimated from the 9.09 tons per man estimated for 1911 as described above, assuming a constant annual productivity growth equal to the 2.64% calculated above (without amending the 1900 figure to allow for unemployment, for as noted in section F04.11 below the year appears to have been a good one for the general-equipment industry as a whole). The work force (col. 4) is then obtained as the ratio of metal consumption (col. 3) to metal consumption per worker (col. 8), and 1911-price value added per worker (col. 6) as the ratio of 1911-price value added (col. 1) to the work force (col. 4). These last estimates of course decline as one goes back in time, because value added per unit is frozen at the level of 1911, and fails to reflect the lower productivity that prevailed in earlier years.

No attempt is made here to separate out the production of other structural components, including in particular the gasholders and pressure pipelines also tied to the growth of the utilities, for a variety of reasons. One is that the domestic production of these (heavier) structures appears to have been import-competing, and import data are limited to gasholders over little more than a decade (above, section F04.04); another, that the hydroelectric plants actually fed by pressure pipelines are not readily identified. The main reason, already adumbrated (section F04.06), is that the present residual seems broadly balanced. It includes as noted the no doubt rapidly expanding production of pressure pipelines, which appears to account for the very high tons-per-man registered among some firms in Grioni's sample (Table F.43). It also includes, however, that other thriving newborn, also practically non-existent before the turn of the century, the metal road vehicles industry; and in Grioni's sample the latter yields the tons-per-man figures at the opposite end of the combined distribution for heavy equipment. With the growing production of metal vehicles and pressure pipelines, the residual at hand becomes increasingly heterogeneous, as the tons-per-man (and therefore value-added-per- ton) distribution becomes much wider; but the tails expand together, and tend accordingly to offset each other. Combining the census data and Grioni's sample, one may hazard a further calculation for the last years of the period at hand. The *Censimento industriale* points to some 8,000 blue-collar workers in the vehicle industry's large shops (Table F.01), presumably devoted to new production; Grioni's sample suggests a mean product near 1.23 tons per worker (excluding the four works that merely produced parts, Table F.43), or some 10,000 tons in all. Assuming similar coverage in the two parts of Grioni's sample, and allowing for likely underestimate of the structural-components employment attributed to the Savigliano works in Table F.43, aggregate blue-collar employment in the structural components industry was probably similar; deducting some 6,000 in the production of bridges, canopies, and towers (from the employment estimate in

Table F.46, row 8, col. 4, obtained as described below, less 10% to allow for white-collar personnel) leaves 2,000 blue-collar workers in other structural components. Allowing these 20 tons/man (about the third quartile of Grioni's sample), one obtains a total, for vehicles and unidentified components together, of some 10,000 workers and 40,000 tons of output: 4 tons/man, on average, or near the middle of the Grioni-sample distribution for general machinery. The implied total product of structural components, including the 42,000 tons attributed to bridges, canopies, and towers (Table F.45, row 8, col. 2), is something over 80,000 tons, again not unreasonable in light of the Grioni-sample total, under 50,000 tons (Table F.43).

In short, truss-structure components are here separated out from other general equipment because they should be (value added per ton of metal is unusually low, and their share of the industry's metal consumption seems to have been much higher in the 1880s, judging from Cottrau's prominence at the time, than in later years) and can be (at least to an acceptable approximation). Other production from metal is not disaggregated. It is not evident that it needs to be, as while the product mix becomes increasingly diverse it appears to remain reasonably uniform on average; and it follows that if it were, to maintain a reasonably uniform residual one should separate out both low-end products (other structural components) and high-end products (metal vehicles). The corresponding estimates could be constructed, but they would be highly uncertain (as noted above for other structural components, and below, section F04.10, for metal vehicles); and since as noted they would in any case be largely offsetting this particular game does not appear to be worth the candle.

In fact, the more serious deficiency of the present estimates is their failure to separate out the (residual) production of weapons, for these were at once relatively high-end products, and sold in a very particular market; but (naval vessels aside) the requisite data do not seem to be available in published sources, as procurement figures seem (purposely?) hidden in the public budgets and the trade statistics identify only handguns, and an archival search to resolve this particular data problem is simply *ultra vires*.

F04.10 Fabricated metal and general equipment: maintenance, 1861-1913

In Table F.46, rows 2 – 4 refer to the maintenance of fabricated metal, row 11 to that of general equipment. These estimates for 1911 are here extrapolated to 1861-1913 with component-specific indices; for simplicity, and in light of the very limited technical progress in maintenance, the same indices are applied to 1911-price value added (col. 1), metal consumption (col. 3), and employment (col. 4). Table F.51, like Table F.50, presents some intermediate series. The estimated maintenance (1911-price) value added series, which are parts of the industry's aggregate product, are presented in Table F.53, cols. 1 – 4; the corresponding metal-consumption series, to be deducted from the industry's aggregate metal consumption (Table F.44, col. 14) to obtain the estimated residual consumed in new production, in Table F.53, cols. 8 – 11. The employment series are not reported; only the census-benchmark estimates enter further calculations, and these are transcribed directly into Tables F.47 – F.49 (col. 4).

The maintenance of fabricated metal has been divided into three components to allow for differences in metal consumption per worker, or in the series' time paths. In general, presumably, blacksmiths maintained agricultural implements; other smiths and other (ferrous-metal) hardware workers can instead be presumed to have maintained the copper- and ironware either directly incorporated in buildings (copper drainpipes, iron gates and hinges, and the like) or broadly complementary in particular to residential structures (kitchenware).

The time-series estimates of value added, metal consumption, and employment in blacksmiths' maintenance simply extrapolate the 1911 figures in Table F.46 (row 2, cols. 1, 3

and 4) at the long-term growth rate of the agricultural population; the latter is here set at 0.64% p. a., against 0.63% over 1861-1901 and 0.65% over 1871-1901 (calculated from the data in Table K.57, col. 3; the 1911 census figure is not used here, as that census was taken in summer and not, like the others, in winter). The estimates are not adjusted to allow for the changing mix of labor-intensive crops on the one hand and land-intensive crops on the other: the former would appear to have expanded with the post-Unification liberalization of trade (especially significant in the South) and again, notoriously, in the 1880s, only to decline with the growth of grain protection (and, with falling prices and fixed specific tariffs, of protection in general) from 1887 to 1895, and to expand again thereafter (as rising prices reduced the burden of protection at unchanged specific rates); but the shift from plowlands to vineyards and citrus or olive groves may well have reduced the wear and tear on the tools in use, and the appropriate correction is not clear. The value added and metal-consumption figures so obtained are transcribed in Table F.53, cols. 1 and 8, respectively.

The time-series estimates of value added, metal consumption, and employment in other smiths' maintenance, and in other fabricated-metal maintenance, instead extrapolate the estimates in Table F.46 (rows 3 and 4, cols. 1, 3 and 4) in proportion to the estimated maintenance of private structures (Table K.58, col. 8); to allow for the progressive diffusion of metal (including, with growing incomes, the likely rise of kitchenware per capita), the year-to year growth rates obtained from that series are here augmented by a quarter of a percentage point from 1861 to 1895, and half a percentage point from 1896 to 1913. The value added and metal-consumption figures so obtained are transcribed in Table F.52, cols. 2 – 3 and 9 – 10, respectively.

As noted, the calculated maintenance-employment series are not reported, but the estimates for the census benchmarks appear in Tables F.47 – F. 49, rows 2 – 4, col. 4. In general, these figures appear reasonable next to the (adjusted) census data, not only in the aggregate, but for the individual categories involved; in particular, the estimate of the work force in other fabricated-metal maintenance in 1871 (some 4,000 workers) sits well with the reported number of knife-grinders (some 3,600, category II.13.4), and correspondingly provides empirical support for the selected augmentation of the growth rate in the maintenance of private structures.

The maintenance of general equipment appears in Table F.46 as a single aggregate (row 11); since the maintenance of structures, including metal structures, is the province of the construction industry, this aggregate represents in essence the maintenance of ordinary machinery, excluding of course the ships and railway vehicles separately considered above. The estimates of value added, metal consumption, and employment in the maintenance of (such) machinery in 1911 (Table F. 46, row 11, cols. 1, 3, and 4) are here extrapolated with an index that combines two components: a major one, related to power-driven machinery, and a minor one, related to user-driven (modern, metal) machinery. The construction of this index is documented in Table F.51.

The maintenance of power-driven machinery is here taken to have varied with its level of activity, itself indexed by its apparent consumption of energy. Table F.51, col. 1 documents the net imports of coal (and coke), as reported by the *Movimento commerciale* (from 1862, with the assumption here of no change from 1861 to 1862), with the addition, to allow for Latium and Venetia, of 35,000 tons p. a. in 1861-66 and 10,000 tons in 1867-70 (compare Glazier, 1966, pp. 185, 197, Bonelli, 1961, pp. 191, 195). Some solid mineral fuels were produced within Italy, but the corresponding (calorie-content-weighted) quantities were quite minor (Bardini, 1991). Col. 2 complements col. 1: it refers to the coal-equivalent consumption of liquid and gaseous fuels, estimated from the calorie-content series in Bardini (1991), Table 2, assuming the same consumption in 1861 and 1862 as in 1863, and using Bardini's own calorie-

content coefficient for coal (7.4 million kilocalories per ton, ibid., p. 112). In the early years, in particular, petroleum may have been used primarily in oil lamps; but the quantities of petroleum that enter col. 2 are small enough that even their total elimination does not materially affect the final index.

Table F.51, cols. 3 - 14 concern the estimated deductions for the here irrelevant uses of coal (and other mineral fuels). Col. 3 refers to coal consumption by the railways (the net deduction for all steam transportation, on the presumption that the net imports in col. 1 are already net of the quantities "reexported" to fuel steam-powered ships). These figures are taken directly as reported in 1875-1903 (e.g., *Relazione S.F.I. 1876*, p. 370, *1901*, p. 388); the reported figure for 1875 is extrapolated back to 1861 in proportion to railway locomotive ton-miles (Table F.41, col. 1). In 1906-13 col. 2 is obtained as the sum of separate figures for the State and minor railways. In 1906 and 1908-12 the State-railway figures are the reported fuel-consumption totals, including separately counted minor operations, net of wood, fuel oil, and charcoal (e.g., *Statistica F.S. 1906*, pp. 332-337, col. 421, *1912*, pp. 302-304, col. 10). For 1907 and 1913, only the main-network total is reported (retrospectively, the following year); net consumption over the full network is here estimated as that total times 1.002 in 1907 (by analogy to 1906), and .994 in 1913 (by analogy to 1912). In 1906-10 the minor-railway coal-consumption figures are taken as reported (e.g., *Relazione S.F.C. 1906*, p. 354); the 1910 figure is extrapolated forward to 1913 in proportion to the corresponding locomotive mileage (Table F.40, col. 6). Finally, col. 2 in 1904 and 1905 is estimated by interpolation, using the total locomotive ton-mileage figures in Table F.41, col. 1 (and setting the ratio between the two series at .2683 in 1904 and .2689 in 1905, against .2678 in 1903 and .2694 in 1906).

Table F.51, cols. 4 – 14 refer instead to coal (or coke) used by various industries, but not to power machinery. In the main, these are adjusted weighted sums of the physical production series estimated within this study, where the weights are of course the estimated consumption of coal, not for steam power, per ton of output. These weights emerge directly, or by analogy, from the coefficients used to estimate the value added weights attached to these same series; the series will here be identified, the reference to the corresponding calculation of value added at 1911 prices is left implicit. The adjustments to these series allow in turn for the substitution of coal for wood or charcoal, using evidence for the mid-1860s provided by the Corpo delle miniere.

Col. 4 is an allowance for the (net) coal consumption of gas works, documented in Table J.03 below. Coal was distilled for illuminating gas, yielding coke as a by-product, but part of that coke was burned to distil the coal (below, section J03.04), and much of the rest was presumably used for domestic heating; the data in the *Statistica mineraria* referred to above suggest that only a quarter or so of the coke produced was in fact consumed by the industries already considered. Col. 13 is accordingly calculated as the tonnage of coal distilled, itself estimated as the gross coke by-product in Table J.03, col. 4, times (1,287.1/792.6), that is, their ratio in 1911 (ibid., cols, 3 and 4), less 25% of that same coke by-product (Table J.03, col. 4; see also col. 3); in practice, col. 4 is obtained as the coke series in Table J.03, col. 4, times approximately 1.374.

Cols. 5 and 6 refer to coal consumption, not for steam power, by the kiln-products industry. Col. 5 is the preliminary series obtained as the weighted sum of the output series for plaster, lime, cement, bricks and tiles, terra cotta, ceramic, and glass (Table C.04, cols. 5 – 8, and Table C.07, cols. 7 – 9, respectively), allowing .10, .20, .30, .06, .06, .06, and .40 tons of coal, respectively, per ton of output. The resulting preliminary estimate for 1865 equals 271,000 tons of coal; the *Statistica mineraria*, pp. 82-89 suggests that the kilns of the day were mostly wood-fired, and that only some 23,400 tons of coal or coke were actually used then within the Kingdom. Allowing 25,000 tons, including Latium, the ratio of actual to calculated

coal consumption in 1865 is (25/271). Allowing for relative energy content, coal at seaport prices was always far cheaper than wood (*Sommario*, pp. 181, 194); inland, however, coal surely became relatively cheaper only as the rail network was extended and inland transport costs fell. The railway net, and in particular the inland railway net, grew far more rapidly over the 1880s and early 1890s than before or after (Table K.10); assuming that coal had effectively replaced wood by the mid-1890s, the final estimate of coal consumption in col. 6 is the preliminary estimate in col. 5 multiplied by a ratio that equals (25/271) in 1861-65, that then grows annually at 5.5% in 1866-80 and at 11% in 1881-95, and then simply equals unity.

Cols. 7 and 8 similarly refer to coal consumption, not for steam power, by the chemical and related industries. Again, the preliminary series in col. 7 is obtained as the weighted sum of selected output series. The tons of coal allowed are 3.00 per ton of magnesium carbonate (Table D.35, col. 1), 2.00 per ton of calcium citrate and tartaric acid (Table D.52, col. 2, and Table D.54, col. 2), 1.25 per ton of metallurgical coke (Table D.44, col. 3, excluding the early product, for locomotives, implicitly included in col. 3), 1.00 per ton alum and aluminum sulfate (Table D.28, cols. 4 and 5), tar and petroleum products (Table D.46, col. 1), ammonium sulfate (Table D.48, col. 8), concentrated lemon juice (Table D.52, col. 3), and cream of tartar (Table D.54, col. 4), .80 per ton of aqueous ammonia (Table D.49, col. 4), .67 per ton of sulfuric acid (Table D.03, col. 2) and calcium carbide (Table D.24, col. 1), .50 per ton of sodium dichromate (Table D.38, col. 1), .30 per ton of solid sodium silicate (Table D.39, col. 9), .25 per ton of rubber products (Table D.10, col. 1), .20 per ton of Leblanc hydrochloric acid (Table D.05, col. 1), borax and refined boric acid (Table D.29, cols. 2 and 3, respectively), and copper sulfate (Table D.31, col. 2), .18 per ton of soda nitric acid (Table D.04, col. 10), and .10 per ton of refined sulfur (Table D.26, col. 4), liquid sodium silicate (Table D.39, col. 14), and artificial asphalt, asphalt powder, asphalt mastic, and paving stones (Table D.46, col. 2, and Table D.47, cols. 3, 7, and 8). Again, the *Statistica mineraria*, pp. 47, 56-61 suggests that the (mineral-based) chemical industries it covered used coal or coke for only some 35% of their heat requirements. With the same logic as used above for col. 6, the final estimate of coal consumption in col. 8 is the preliminary estimate multiplied by a share that equals .35 in 1861-65, that then grows annually at 2.4% in 1866-80 and at 4.7% in 1881-95, and then simply equals unity. Since the production of metallurgical coke proper did not begin until 1900, none is implicitly assumed to have been obtained from anything but coal.

Cols. 9 and 10 similarly refer to coal consumption, not for steam power, by the metalmaking industries. Again, the preliminary series in col. 9 is obtained as the weighted sum of selected output series. The tons of coal allowed are, for ferrous-metal products, .25 per ton of rails (Table E.02, col. 9), and .40 per ton of (other) wrought iron and steel and .15 per ton of cast iron (Table E.03, cols. 12 and 13); for non-ferrous metal products, .20 per ton of semi-finished aluminum (Table E.04, col. 3), .50 per ton of antimony (Table E.05, col. 8), 10.00 per ton of ingot copper and .50 per ton of semi-finished copper and copper alloys (Table E.06, cols. 3 and 5), .50 per ton of gold and of silver (Table E.07, col. 2, and Table E.08, col. 6), .40 per ton of ingot lead and .10 per ton of semi-finished lead (Table E.08, col. 7, and Table E.09, col. 4), 1.65 (reduced to coke) per ton of mercury (Table E.1, col. 1), .20 per ton of semi-finished tin (Table E.11, col. 5), and .30 per ton of semi-finished zinc (Table E.12, col. 5). Again, it is clear from the *Statistica mineraria*, pp. 30-45, that at that time the metalmaking industries' fuel of choice was in fact charcoal. Coal and coke accounted for just 16% of the sample firms' heat requirements, and even that figure is much swollen by the coal consumption of included engineering works; excluding these (and their foundries), which used coal and coke almost exclusively, that figure drops to just 9%. The blast furnaces, in particular, used charcoal exclusively, and probably continued to do so until large-scale pig-iron production got under way around the turn of the century; and since the metallurgical coke they then used is already

included as an output of the chemical industry (which provided enough to suggest negligible imports), pig iron production (Table E.02, col. 1) is here attributed a zero (net) consumption of coal throughout the period at hand. With the same logic as used above, the final estimate of coal consumption in col. 9 is the preliminary estimate multiplied by a share that equals .10 in 1861-65, that then grows annually at 5.3% in 1866-80 and at 10.7% in 1881-95, and then simply equals unity.

Col. 11 refers to coal consumption, not for steam power, by the engineering industries; in light of the evidence just noted, these seem to have relied on coal and coke even in the early years of the period at hand, and the usual adjustment to allow for the displacement of other fuels is here unnecessary. The figures in col. 11 are simply the estimated total metal consumption by the engineering industry (Table F.44, cols. 3 plus 14), times an allowance of .40 tons of coal per ton of metal (Falco, 1916, p. 36).

Within residual manufacturing, the most significant user of fuel, not for motive power, seems to have been the sugar industry, both to extract raw sugar from the beet, and to refine (domestic or imported) raw sugar; the corresponding coal-consumption estimates are transcribed in Table F.51, col. 12. Col. 13 transcribes the net imports of raw sugar, as reconstructed from the usual retrospectives in the *Movimento commerciale*. Some uncertainty surrounds the ca. 5,000 tons imported annually, to be refined and reexported, in the early 1890s; the present figures would appear to include these (certainly in 1896, as is made clear by the notes to the current-year data in the *Movimento commerciale 1896*, p. 28). No additional imports are allowed for Latium and Venetia in the early years: the trade data in Bonelli (1961) and Glazier (1966) refer only to "sugar" (which may have been imported already refined), and in any case the present figures do not jump up in 1867 or 1871. Col. 12 is obtained as the sum of two components, weighted by the coal-input coefficients reported in *Censimento i. e c., Monografia N. 1*, p. 20. Coal consumption in the extraction of raw sugar from the beet is calculated from the beet output reported in the *Sommario*, p. 108 (itself calculated from sugar output, documented by the production tax), allowing 55.3 kilograms of coal per ton of beet. Coal consumption in the refining of raw sugar is calculated as the net imports in col. 11, plus the domestic output reported in the *Sommario*, p. 126 (the label is ambiguous, but with the exception of a few early figures too small to matter the numbers are those earlier identified as raw sugar output, e.g., *Annuario 1905-07*, p. 505), allowing .328 tons of coal per ton of raw sugar. Exceptionally, in 1885-89, the wildly fluctuating imports in col. 13 are replaced by a constant 90,000 tons per year, on the assumption that inventories were held in raw sugar, and that they varied in response to anticipated legislation. Also exceptionally, following the indication in Maestri (1867), p. 132, the imports reported in 1863 and 1864 are replaced by a linear interpolation of those reported for 1862 and 1865. Like col. 11, col. 12 is not adjusted: domestic beet-sugar production did not get seriously under way until the turn of the century, and most imported raw sugar was surely refined, with imported coal, at the seaport.

Col. 14, the final deduction from col. 1, is an allowance for the consumption of coal to generate electric power used for lighting, rather than for power. Loosely extrapolating later evidence on the uses of electric power (*Enciclopedia italiana*, vol. 13, p. 683), this allowance is obtained simply as half the total commercial thermal power output (Table J.01, col. 9), times an input-output coefficient that equals one ton of coal per thousand kWh in 1911 (below, section J2.03), and declines geometrically over time, as suggested in Bardini (1991, p. 114), at an annual rate equal to the fiftieth root of (12/21.5).

Summing cols. 1 and 2, and deducting cols. 3, 5, 7, 9 – 10, and 12 – 13, one obtains the present estimate of the coal (more precisely, the coal equivalent of all significant mineral fuels) actually used to generate steam for motive power. To allow for the surely considerable fluctuations in coal inventories, that sum is here smoothed: from 1863 to 1911 by taking its

five-year moving average, in 1862 and 1912 its three-year average, and in 1861 and 1913 the simple average of the first two, and last two, elements of the series. That smoothed series is then corrected to allow for the growing thermal efficiency of steam engines; following Bardini, as above, it is divided by an index that equals 1.00 in 1911, and declines geometrically over time at an annual rate equal to the fiftieth root of (12/21.5). Finally, the resulting series (in efficiency units) is adjusted to allow for losses in mechanical transmission through gears, belting, and the like. The industrial-census data for 1911 (excluding half the figures for the utilities) suggest that about one third of the thermal power then in use was converted to electricity. The present adjustment for mechanical transmission losses is a simple deduction that equals 20% in 1861-91, and then drops linearly, to allow for the diffusion of electric transmission, through two thirds of that in 1911. The resulting net equivalent coal-consumption series appears here as col. 15

Cols. 16 and 17 refer to the power generated by other sources of energy. Letting the presumably very minor quantities of wood used for steam offset the presumably equally minor residual quantities of coal not used for power, these estimates refer simply to water power. Col. 16 refers to hydroelectric power: it is the total production of power estimated by Bardini (1991, Table 1), less, as above, half the estimated output of commercial plants (Table J.01, col. 10), again allowed for lighting.

Col. 17, in turn, refers to hydraulic power used directly as motive power. The present series is the time series reconstructed by Bardini (1991, Table 1), thrice adjusted. First, Bardini's early figures are modified, as follows. The brief description in Bardini (1991, p. 105) suggests that he extrapolated the (data-based) figures for 1877-1913 backwards at their average rate of growth from 1877 to 1884 (when the relevant law was changed), that is, at a growth rate near 2.5% per year (the 3.5% quoted in his text appears to be a misprint); but his series displays two unexplained jumps, the timing of which suggests that they reflect corrections for here irrelevant border changes. Here, Bardini's figure for 1877 is extrapolated back to 1861 at a steady growth rate, ignoring border changes; and since the engineering-industry metal-consumption series suggests that the level of investment in 1861-76 was annually some 60% of that in 1877-84 (when the upswing of the 1880s was getting under way), that growth rate is here set at 1.5% per year. Second, the (resulting) series is tentatively reduced to allow for the energy absorbed by (here also irrelevant) traditional, wooden machines. Very tentatively, the latter are assumed to have absorbed 75% of the estimated 466 million kilowatt-hours generated in 1861, or 350 million kilowatt-hours. In 1911, the census data for small shops indicate the use some 148,000 hydraulic horsepower, of which some 100,000 in grain mills, not converted to electricity (*Censimento industriale*, vol. 2, pp. 486, 498). Assuming that one third of these ca. 200,000 kilowatts of power still drove wooden machines, as of old, and allowing them a relatively modest 1,500 hours per year, the again tentative reduction in 1911 is estimated at 100 million kilowatt-hours. The present allowance for the energy absorbed by wooden machines simply declines annually by 5 million kilowatt-hours from 350 million in 1861 to, and through, 100 million in 1911; this is equivalent to a slowly accelerating rate of replacement of the surviving wooden machines by metal ones. Third, the resulting residual is reduced by a uniform 20%, to allow for losses in mechanical transmission.

Cols. 16 and 17 are here summed into an estimate of the total energy delivered to water-driven machinery, and that sum is converted to an index set equal to 1.00 in 1911. Col. 15 is similarly converted to an index, again set equal to 1.00 in 1911, of the (usable) energy delivered to steam-driven machinery. The prime-mover horsepower-in-use data in the 1911 industrial census, net of half those attributed to the utilities (and discounting by 20% those not converted to electricity), suggest that 56% of the power used in industry was hydraulic, and 44% thermal; the hydraulic-energy and thermal-energy indices just described are accordingly combined with

weights equal to .56 and .44, respectively, into the overall index transcribed in col. 18, here interpreted as the index of the maintenance of power-driven machinery.

Overall, the profile of this index is much as one would have predicted, with relatively steady growth save for a marked slow-down over the 1890s. Its long-term growth rate also seems reasonable, in light of a further calculation. In 1911, excluding only half the utilities, the industrial census counted 1.225 million horsepower; the present index in col. 18 converts that to some 64,000 horsepower in 1861. The wool and cotton industries were perhaps the first to adopt modern factory methods. In 1911, the power of their prime movers and their motors running on purchased electricity totaled .129 million horsepower; as estimated in chapters H.02 and H.03 below, their combined value added at 1911 prices grew from 37.1 million lire in 1861 to 272.8 million in 1911, suggesting that in 1861 they used some 18,000 horsepower. The implication that in 1861 those pioneering industries employed some 28% of the corresponding national total seems entirely acceptable.

An alternative index can be calculated by converting col. 15 into kilowatt-hours, adding the result to the hydraulic kilowatt-hours in cols. 16 and 17, and rescaling. Using Bardini's own coefficients (7,400 kilocalories per kilogram of coal, and, given 21,500 kilocalories of coal per kilowatt-hour in 1863 and 12,000 in 1913, some 12,283 in 1911; this last coefficient is applied to col. 15 throughout, as it already allows for thermal efficiency gains and mechanical transmission losses), one implies that in 1911 steam supplied just over half of the energy that drove machinery, which clashes with the census evidence cited above; but the resulting index is in any case very close to that in col. 18 (which is not surprising, as it is in essence a mere recalculation of the present one with a minor modification of the weights attached to its two components). The present index (and the appropriate shares of steam and water power in 1911) can be recovered with this alternative procedure, assuming a coal consumption per kilowatt hour some 35% higher than suggested by Bardini; and since mean thermal efficiency seems very difficult to pin down (far more so, it would seem, than its improvement, Bardini, 1991, pp. 113-114), the matter can rest.

Traditional wood machines were often powered, like the hand loom and the spinning wheel, directly by the user. Two modern, user-powered metal machines also came into widespread use in the latter part of the period at hand. They are the sewing-machine and the bicycle, here handled as follows. Table F.51, col. 19, transcribes from 1888 the reported net imports of sewing machines (a component of Table F.45, col. 17); these figures are extended back to 1887 assuming growth by 400 tons p. a., as in subsequent years, and negligible imports before then. Domestic production can be presumed negligible: Grioni (1914), vol.1, pp. 125, 412, lists a single source, which was indeed a large firm, but it included sewing machines as just one of many different products. Table F.51, col. 20 is the estimated mid-year stock; it is obtained from col. 19, calculating the current year-end stock as the sum of the current year's imports plus 97.5% of the previous year-end stock, and shifting the resulting series half a year forward. These figures suggest a mid-year stock of some 52,000 tons of machines in 1911.

Cols. 21 and 22 refer instead to bicycles. With only a few exceptions, such as military vehicles, all bicycles were subject to an annual tax, from 1898 on (*legge 22 luglio 1897, n. 318*; *legge 10 dicembre 1905, n. 582*; *legge 30 dicembre 1909, n. 794*). Col. 21 refers from 1897 to 1913 to the number of bicycles taxed in the fiscal years beginning July 1 of the indicated year, as documented first in the *Relazione demanio*, e.g., *1898-99*, p. 159, and from 1907-08 in the *Tasse affari*, e.g., *1908-09*, p. 206; the earlier figures simply assume linear growth, over half-a-dozen years, to the first recorded figure. The figures in col. 21 for 1906-13 simply sum over the reported numbers of taxed single- and multi-seat bicycles, while those for 1897-1905 normally sum over the reported numbers of bicycles paying 10 lire (single-seaters) or 15 lire (multi-seaters), excluding those paying 1 lira (for a replacement tag) or 20 lire (actually motorcycles:

Relazione demanio 1903-04, p. 197); that for 1899 is obtained as the reported total (128,245) less an allowance of 3,000 for replacement tags and motorcycles, those for 1903 and 1904 are the reported number of single-seaters (239,236 and 271,641, respectively) plus a constant allowance of 400 for multi-seaters, and that for 1905 is the reported number of vehicles that paid the "bicycle" tax (306,394), less an allowance of 10,000 for replacement tags, motorcycles, and automobiles (see *Relazione demanio 1905-06*, pp. 190, 195, *Tasse affari 1908-09*, p. 206). On the assumption that the reported figure here attributed to 1913, for example, corresponds closely to the stock at the end of the fiscal year 1913-14, that is, circulating in mid-1914, the mean stock actually circulating in 1913 is here estimated from the figures in col. 21 by summing one quarter of those for 1911 and 1913 to half that for 1912, and so on. Col. 22 is the estimated weight of that mean circulating stock, calculated allowing 20 kilograms per vehicle.

Motorcycles and automobiles (including trucks) were also taxed, and the data were reported along with those for bicycles; these data show a very perplexing decline from 1906-07 to 1907-08 (in response to a tax that should have been trivial, for anyone wealthy enough to afford a motor vehicle: *Tasse affari 1907-08*, p. 179, noting the weak explanation offered on p. 180), and are here used only to refine the bicycle-maintenance estimate. Excluding the small numbers of permits for trials, the numbers of motor vehicles taxed in fiscal 1909-10, 1910-11, and 1911-12 equal 5,700, 7,473, and 9,129 motorcycles, respectively, and 7,737, 10,655, and 13,430 automobiles, respectively; applying the same algorithm as above, the mean circulating stocks in 1911 are here estimated at some 7,400 motorcycles and 10,600 automobiles. Again allowing .05 tons per motorcycle and 1.04 tons per automobile (with .04 allowed for the extra weight of the small number of trucks, *Tasse affari 1913-14*, p. 291), the mean stock of circulating motor vehicles in 1911 is here assessed at some 11,400 tons, against 17,000 tons for bicycles (col. 22).

Assuming that the relative simplicity and reliability of bicycles more than offset their lighter construction, so that from this particular point of view two tons of bicycles (100 units) were then the equivalent of one ton of motor vehicles (e.g., one automobile), in 1911 bicycles may have accounted for some 40% of these vehicles' joint maintenance burden; perhaps 40%, then, of 71% (for simplicity, the share calculated above, section F04.07, for general machinery) of the ca. 6,700 small-shop workers attributable to category 4.43 (Table F.01), or some 1,900 workers. With roughly one million bicycles in use, that estimate works out to some five available maintenance man-hours per bicycle per year, which seems reasonable enough in its own right.

The estimated mid-1911 stock of sewing machines was, by weight, some 3.1 times that of bicycles (Table F.51, cols. 20 and 22); but sewing machines were probably not used much more intensively than bicycles, as most appear to have been household goods (the estimated sewing-machine tonnage corresponds to perhaps two million units, and the cloth-processing apparel industry, census category 6.9, employed some 700,000 people, under 80% of them female), and they certainly were not subject to the wear and tear of the open road. The maintenance index for these two user-powered machines together is presented in col. 23. Assuming that in 1911 the ca. two million sewing machines required one-third the overall maintenance burden of the near one million bicycles, that index is the simple sum of the stock-weight series in cols. 20 and 22, rescaled to equal .250 and .750, respectively, in 1911; on the same logic, the estimate of the corresponding employment in 1911 is simply (4/3) times the above figure for bicycles alone, or 2,500 workers.

Given the heavy-equipment maintenance employment estimate of 24,700 (Table F.46, row 11, col. 4), these figures suggest that in 1911 user-driven machinery accounted for some 10%, and power-driven machinery the residual 90%, of the aggregate heavy-equipment maintenance burden. The aggregate heavy-equipment maintenance index presented in Table

F.51, col. 24, is accordingly the sum of the power-driven machinery maintenance index in col. 18, rescaled to equal .90 in 1911, and the user-driven machinery maintenance index in col. 23, rescaled to equal .10 in 1911; the effect of allowing for user-driven machinery is of course mildly to increase the growth rate of the maintenance of machinery over the second half of the period at hand. The value added and metal-consumption series obtained by extrapolating the heavy-equipment maintenance estimates in Table F.46, row 11, cols. 1 and 3 with the index in Table F.51, col. 24 are transcribed in Table F.53, cols. 4 and 11, respectively.

It may be noted, before proceeding, that the 10% weight here allowed user-powered (consumer) durables in 1911 seems reasonable enough. Against the ca. 70,000 tons allowed for sewing machines and bicycles, one can hazard that the total stock of general machinery was some five to ten times the estimated 285,000 tons produced, assembled, and imported in 1911 alone (Table F.45, col. 23, and Table F.46, rows 7 and 9, col. 2), or roughly 20 to 40 times the present estimate for sewing machines and bicycles, whence for the latter a 2.5 to 5.0% share, by weight, of the total. On the other hand, ordinary producer durables were of altogether heavier construction. Per unit of weight, as noted in section F04.06 above, their ordinary ferrous-metal parts were worth just a sixth or so as much as bicycle and sewing-machine parts; allowing the latter six times as many parts per ton as in general machinery, they may have represented some 15 to 30% of the aggregate number of parts incorporated in the extant stock. The latter percentages should be deflated (perhaps by a factor of ten to fifteen, to 1.0 to 3.0%) to reflect mean utilization, and partly reinflated (perhaps fivefold, to 5 to 15%) to reflect the consumer durables' much higher likelihood of breakage per hour of use, as relative to producer durables their design favored lightness over ruggedness. The relevant ballpark is not small, but such as it is it easily contains the present estimate: once again, the census numbers do not suggest that significant repair work was carried out by personnel not counted in categories 4.3 – 4.5.

The maintenance value added estimates so obtained for the early benchmark years are transcribed from Table F.53, respectively cols. 1 – 4, to Tables F.47 – F.49, respectively rows 2 – 4 and 11, col. 1; the parallel metal-consumption estimates, similarly, from Table F.53, respectively cols. 8 – 11, to Tables F.47 – F.49, respectively rows 2 – 4 and 11, col. 3. As noted, the corresponding maintenance work-force figures, calculated as described above, are inserted directly into Tables F.47 – F.49, rows 2 – 4 and 11, col. 4. In cols. 1, 3, and 4, the sums of rows 2 – 4 yield the maintenance totals in row 5 (and, derivatively, the maintenance averages in cols. 6 and 8, which change little from benchmark to benchmark).

With the detailed maintenance estimates thus completed, the maintenance aggregate value added, metal consumption, and work force estimates at the early benchmarks are obtained as their simple sums (Tables F.47 – F.49, row 22, cols. 1, 3, and 4, obtained as the sums of rows 5, 11, 14, and 19); the related averages (cols. 6 and 8) are then obtained from these as the obvious ratios. The new-production metal and work-force aggregates are in turn obtained as residuals (row 21, cols. 3 and 4, obtained as row 23 less row 22). Average metal consumption per worker (col. 8) is the ratio of the corresponding totals (cols. 3 and 4); even in 1871, the new-production average (row 21) is comfortably in excess of an order of magnitude greater than the corresponding maintenance average (row 22).

F04.11 Fabricated metal and general equipment: new production, 1861-1913

In Tables F.47 – F.49, too, the new-production work force in fabricated metal (row 1, col. 4) is obtained as the difference between the census-based total (row 6) and the maintenance total (row 5). The new-production work force in general equipment (row 10, col. 4) is similarly obtained as the difference between the census-based total (row 12) and the maintenance total (row 11); further deducting the work force attributed to assembly (row 7) and truss-structure components (row 8) yields the work force in the rest of the industry (row 9). These figures

suggest a slow, inconstant growth in the fabricated-metal new-production work force (row 1, col. 4), from some 78,000 in 1871 to 81,000 in 1881 and 79,000 in 1900, before the step up to 90,000 in 1911, and a much more rapid growth of the residual-general-equipment new-production labor force (row 9, col. 4), from some 4,000 in 1871 to 6,000 in 1881, surging to 46,000 in 1900, and on to 80,000 in 1911. A similar path is observed directly in the census-based general-equipment aggregates (row 12, col. 4), from 8,000 in 1871 to 15,000 in 1881, 60,000 in 1900, and 114,000 in 1911: at the early benchmarks as in 1911, this particular branch of the industry appears to have operated at capacity, with essentially full employment. In 1900, in particular, total metal consumption was well below the previous peak (Table F.44, col. 14); but it is hard to imagine that the general-equipment industry could have grown after 1881 so much faster than it actually did, on average, to 1900, as to yield a peak employment before that year significantly higher than that here attributed to 1900 itself.

In the light of these considerations, and of the fact that the equipment at hand seems ever to have been produced in relatively large concerns, labor productivity (metal consumption per worker, row 9, col. 8) is estimated at the early benchmarks on the simple assumption that it grew at a uniform 2.44% per year, as obtained for railway-vehicle work in section F04.05 above. In Tables F.47 – F.49, row 9 is then readily completed: metal consumption (col. 3) is obtained as the product of the work force (col. 4) and metal consumption per man (col. 8), output (col. 2) as metal consumption (col. 3) divided by the input/output ratio (col. 7), value added at 1911 prices (col.1) as output (col. 2) times value added per ton (col. 5), and value added per man (col. 6) as the ratio of value added (col. 1) to the work force (col. 4). The general-equipment new-production totals in row 10 are then obtained by summing over rows 7 – 9, and the corresponding averages as the obvious ratios; and so too, adding maintenance (row 11), the general-equipment totals in row 12, and from these the corresponding averages.

On these assumptions, it may be noted, metal consumption per man in the production of (residual) general equipment is taken to decline, as one goes back in time, from 3.03 tons in 1911 to 2.32 in 1900, 1.47 in 1881, and just 1.16 in 1871 (Tables F.46 – F.49, row 9, col. 8). These figures are far below the means (near 5.0) obtained for the mid-1880s from Bozzoni's sample; but the within-sample range is very broad, and the means appear inflated by foundry output (above, section F04.02). The present figure for 1911 reflects the medians in Grioni's broader sample (also characterized by enormous internal variation, above, section F04.07 and Table F.43); the estimate for 1871 is not far from the figure for the mid-1860s suggested by the *Statistica mineraria* (perhaps 1.4 tons per blue-collar worker); and all four benchmarks maintain a reasonable ratio (near one third) to the analogous estimates for truss-structure components (Tables F.46 – F.49, row 8, col. 8), which are consistent, by design (above, section F04.07), with the evidence in Giordano (1864). Again, with the present estimates the production of truss-structure components is attributed a uniquely high share of total general-equipment new production in 1881 (some 30%, at 1911 prices), and this is consistent with the highlighting of Cottrau's firm in such contemporary sources as the *Notizie minerarie* and Ellena (1880), also reviewed in section F04.02 above. Most significantly, perhaps, the 1871 productivity estimate yields an output of some 3,700 tons (Table F.49, row 9, col. 2), against some 5,700 tons of imports net of parts (Table F.45, col. 24), implying that domestic industry then captured near 40% of the domestic market, against some 63% in 1900 (from the analogous estimates for the latter year); and these ratios sit very well with direct evidence of those market shares obtained from the boiler-stock figures also reviewed at the end of section F04.02 above. A higher productivity in 1911 with the assumed productivity growth rate, or lower productivity growth with the assumed level in 1911, would raise the productivity estimates at the early benchmarks, bringing them closer to those derived from Bozzoni's sample, but driving the implied market share of domestic producers above the level suggested by the boiler-stock data; and of the two,

the latter seems much the sturdier source. The present estimates for the general-equipment industry in Tables F.46 – F.49, row 9 (and, derivatively, rows 10 and 12) are accordingly accepted as described.

With these in place, Tables F.47 – F.49 can be completed by filling the fabricated-metal new-production cells in row 1. Metal consumption (col. 3) is obtained as a residual (for example as row 23 less the sum of rows 5, 12, 15, and 20), whence on the one hand metal consumption per worker (col. 8, using the work force estimate in col. 4), and, on the other, output (col. 2, using the input/output ratio in col. 7), and then value added (col. 1, using the per-unit figure in col. 5) and value added per man (col. 6, again using the work force estimate in col. 4); as one goes back in time this last figure rapidly declines, reflecting the rapid growth in productivity (ca. 4% per year in the first intercensal period, 1% in the second, 8% in the third, and 4% over the full forty years). Presumably, the high mean productivity growth rate reflects the substitution of factory production for traditional smithing, while the intertemporal pattern reflects the long cycle in metal consumption, and in particular the underemployment that prevailed around the turn of the century and was reabsorbed by 1911. A constant productivity growth rate from 1881 to 1911 would require a fabricated-metal new-production work force numbering some 49,000, rather than the estimated 79,000; the 30,000 equivalent unemployed correspond to some 14% of the total fabricated-metal work force, or, say, an average work day of eight to nine hours rather than ten.

The time-series estimates for these two industries, reported in Table F.52, cols. 1 and 4, are obtained by interpolating and extrapolating these benchmarks with the aid of various bits of evidence. One such is of course the joint constraint on their production represented by their joint metal consumption, which is of course the industry-group aggregate (Table F.44, col. 14) less the metal consumption attributed on the one hand to maintenance (Table F.53, col. 14, itself obtained as the sum of cols. 8 – 13), and on the other to other new production (of truss-structure components, precision instruments, and clocks and watches, Table F.52, cols. 10, 13, and 14); this series is transcribed for convenience in Table F.44, col. 15 It may be noted that the residual metal consumption attributed to the two industries at hand displays a time path very similar to that of the entire industry group (Table F.44, col.14): both these series vary over almost a full order of magnitude, but their ratio remains in a relatively narrow band (.87 to .94).

The data in Giordano (1864), pp. 354-373 are also used here, specifically to generate a fifth, early benchmark, for 1864. Excluding arsenals, railway-vehicle works, swordsmiths and other producers of fabricated metal (or allowing for these components in the case of integrated works), taking the mid-points of the indicated work-force ranges, and adding direct estimates where needed, the blue-collar labor force of Giordano's firms is taken to have included the following numbers of individuals: on p. 354, 120 (Baldantoni), 40 (Calzoni), and 70 (Bolognese); on p. 356, 250 (Glisenti), 115 (Ragazzoni), and 100 (Rubini); on p. 358, 170 (Benini), 30 (Cosimini), 125 (Ansaldo), and 175 (Balleydier); on p. 360, 400 (the two Robertson works), 200 (Orlando), 275 (Westermann), and 100 (Della Beffa); on p. 362, 200 (the four works in Leghorn), 79 (Ferrovie Livornesi), 275 (Bauer), and 26 (Süffert); on p. 364, 115 (Gujoni), 90 (Bouffie), and 50 (Pietrarsa); on p. 366, 500 (Macry), 500 (Goupy), 100 ("Ooomens"), 66 (Guller), 13 (Geminardi), and 20 (Scheuber); on p. 368, 30 (Canepa), 50 (Squindo), 10 (Cartetto), 5 (Ricca), 275 (Florio), 25 (Lopresti), 30 (Fiorenzi), and 15 (in Pisa); on p. 370, 30 (in Tivoli), 120 (Colla), 80 (Beneck), 50 (Gautier), and 200 (Huguet); on p. 372, 50 (Collalto), 120 (Rocchetti), 100 (Palazzi), 250 (Giacomelli), and 180 (Neville). These figures sum to 5,824 workers, including those of the foundries attached to most of these establishments; deducting an estimated 2,038 foundry workers (35%, compatible with the relative weight-productivities suggested by the *Statistica mineraria*, above, section F04.02) and a further 825 attributed to truss-structure components (above, section F04.09) reduces the total

to some 2,960. Inflating the latter by a fifth to allow for managers, white-collar personnel, and omitted shops brings the final estimate to some 3,550. Again extrapolating average metal consumption per worker assuming a productivity growth rate of 2.44% per year, the former is set at .98 tons per man in 1864, for a total of perhaps 3,480 tons. This last figure corresponds to an output of some 2,780 tons (at 1.25 tons per ton); it also leaves an estimated 83,490 tons of metal to the fabricated-metal industry, which in turn corresponds to an output of some 61,840 tons (at 1.35 tons per ton).

The other evidence that is brought to bear is that provided by the international trade data summarized in Table F.45. These are here further combined into two series, one for (residual, henceforth understood) general equipment and the other for fabricated metal, that serve to diagnose relative market fluctuations. In the case of general equipment, the diagnostic series used here is the simple sum of the machine-part import series in Table F.52, col. 2, and the assembled-machine import series transcribed in Table F.45, col. 24; it is transcribed for convenience in Table F.45, col. 25.

In the case of fabricated metal, the (diagnostic) trade series is that transcribed in F.45, col. 26; it is obtained as follows. To allow for the inventory cycles possibly set in motion by the 1888 tariff increase, 15% of the net imports of hardware (col. 7) and of unspecified fabricated metal (col. 8) in 1887 are very tentatively transferred to 1888. To allow for Latium and Venetia, secondly, col. 7 is augmented by an annual 300 tons of tools in 1861-70, and col. 8 by an annual 300 tons in 1861-66, and 100 tons in 1867-70, of unspecified products, as suggested by the data in Bonelli (1961), pp. 191, 195, and Glazier (1966), pp. 191, 203, 205. From 1861 through 1881, the diagnostic aggregate in Table F.45, col. 26 is constructed simply as the sum of cols. 6 – 9, thus amended; from 1882 to 1913 it is obtained as the sum of cols. 7 – 9 and 21 – 22, minus .2 times col. 6. Col. 6 refers to sheet-metal products, from 1882 increasingly exported; an increase in such net exports, *ceteris paribus*, is accordingly read not as a decline of net imports and thus (presumptively) of domestic demand, but as an increase in the index of domestic and foreign demand together (with the foreign component receiving a reduced weight, as exports track only themselves, while imports track the entire domestic market).

These diagnostic series are of course to be evaluated with some care, as the significance of their movements depends in part on changes in tariffs. Table F.45, cols. 27 and 28 report the estimated net tariff, calculated as that on output less the input/output ratio times the tariff on the input. In the case of general equipment, the tariff on output is calculated in general as the average of those (reported or estimated, early on, in the presence of ad valorem rates) on general machinery on the one hand (in 1913, category 821) and stationary steam engines (category 800) on the other, with weights equal to .75 and .25, respectively; in that of fabricated metal, as the simple average of those on simple fabricated metal (itself the average of categories 711 and 715) on the one hand, and ordinary tools on the other (category 721). In both cases, the tariff on the input is simply the tariff on heavy plate (category 680a); exceptionally, the average net tariffs in 1865 and 1878 are calculated as the simple average of those obtained for the immediately neighboring years.

Two considerations are in order. On the one hand, what matters is of course not so much the net tariff as its ratio to value added; and that can here be computed only for the end of the period at hand. In fabricated metal, allowing a value added of 415 lire per ton and a net tariff of 35.5 lire per ton, the rate of net protection works out to near 9%; for general machinery, allowing a value added of 900 lire per ton and a net tariff of 17.5 lire per ton, that rate is nearer 2%. Over time, constant specific net tariffs (as estimated here) yielded varying rates of net protection: in response, presumably, not so much to the (Kondratieff) price cycle (which would tend to have broadly parallel effects output and input prices) as to technical progress, which would tend to reduce value added over time (not regularly so, but since the periods of rapid

output growth were the periods at once of rapid capacity expansion and modernization, and therefore productivity growth, and of an offsetting wage growth, the net cyclical deviations from trend were presumably minor). In 1864, at a guess (with unit value added falling at some 1.5% per year), value added per ton may have been twice what it was in 1911; the estimated net tariffs would then correspond to rates of some 3% for fabricated metal, and −2% for general machinery. All that can safely be assumed is that in the presence of technical progress unchanged specific rates meant slowly rising rates of positive net protection (or slowly worsening rates of negative net protection, in the presence of the latter).

On the other hand, for present purposes, relative net protection matters more than industry-specific net protection. The net tariff on fabricated metal appears to have peaked in 1879-87, but that on general machinery varied more, and grew monotonically; the path of the relative net tariff is dominated by the latter, and the ratio of that on general machinery to that on fabricated metal also grew monotonically, in a series of steps, from near –2.0 initially to near zero in 1879-87 and finally near .5 from 1888 (Table F.45, col. 29, obtained as col. 27 divided by col. 28; the extra 5% protection on railway work introduced in 1885 is ignored, as it applied to both fabricated metal and general equipment). With value added per ton in machinery roughly double that in fabricated metal the relative rates of net protection were roughly half the relative net tariffs: in 1911, as calculated, and throughout, assuming that technical progress reduced value added at similar rates in the two industries at hand (which is consistent with differential rates of labor productivity growth, in the presence of differential changes in relative capital-intensity). Here, therefore, the time-series estimates for the general-equipment and fabricated-metal industries use the diagnostic import series (Table F.45, cols. 25 and 26) in conjunction with the relative-net-tariff series (Table F.45, col. 29) to interpolate and extrapolate the available benchmarks.

The fabricated metal and (residual) general equipment output estimates in Table F.52, cols. 1 and 4 are obtained together, subject to the constraint of their joint metal consumption (Table F.44, col. 15). Their benchmark shares of that joint consumption (respectively *sf* and *sg*, calculated from Tables F.46 – F.49, col. 3, rows 1 and 9, and the above figures for 1864) equal some 96.0% and 4.0%, respectively in 1864, 95.3% and 4.7% in 1871, 94.2% and 5.8% in 1881, 62.5% and 37.5% in 1901, and 67.1% and 32.9% in 1911; the relative growth in *sg* from the previous benchmark, henceforth *rsg*, equals approximately 1.17 in 1871, 1.24 in 1881, 6.41 in 1900, and .88 in 1911. These benchmark shares are here interpolated, and extrapolated to 1913, by estimating annual metal-consumption shares that reflect the differential demand cycles suggested by the trade and relative-net tariff series (Table F.45, cols. 25, 26, and 29). Once again, the series for the smaller industry (*sg*) is estimated directly and that for the larger (*sf*) as the residual (1 – *sg*), as any relative adjustment to (or error in) the far smaller estimates implies a relatively much smaller one, rather than a much larger one, in the residual.

The selected algorithm proceeds as follows. The first step is the calculation of the market-induced relative growth in the share of metal consumption absorbed by the general-equipment industry. On the presumption that domestic production responded to market fluctuations less quickly than imports, the diagnostic import series (Table F.45, cols. 25 and 26) are shifted forward half a year, keeping the initial values unchanged. The year-on-year relative change is then calculated for each of these shifted series, and the figures obtained for (shifted) general-equipment imports are divided by those obtained for fabricated metal. The annual index of relative demand-induced fluctuations *ai* is in turn obtained as those ratios, raised to the power .25 (well under unity, as the relative output cycle is presumably, in light of likely supply elasticities, a heavily damped, as well as .lagged, version of the relative import cycle). Finally, this index is multiplicatively cumulated, that is, in year *t* the cumulative index *ci* equals the product of all the *ai* from 1862 to *t*. In 1861, too, in the absence of relevant evidence, *ci* is set

equal to 1.00. This cumulative index is transcribed, rounded, in Table F.45, col. 30; subsequent references to that column actually refer to the underlying unrounded figures, which are those used in the subsequent calculations.

The estimates of *sg* from 1900 to 1913 are here obtained first, not least because their derivation is particularly straightforward. The index *ci* is rescaled, from 1900 to 1913, to set it equal to 1.00 in 1900; in 1911, this rescaled index *rci* equals approximately .86, whereas as seen above *rsg*, the actual relative change in *sg* from 1900, was then nearer .88. Since nominal tariffs remained unchanged, the general-equipment industry's current share of metal consumption *sg* is estimated simply as *sg* in 1900, multiplied by the current value of *rci* and again by (*rsg*/*rci*) in 1911 (approximately 1.02) to a power equal to (1/11) in 1901, (2/11) in 1902, and so on through (11/11) in 1911 to (13/11) in 1913.

The estimates of *sg* from 1881 to 1900 are obtained next. The index *ci* is rescaled, from 1881 to 1900, to set it equal to 1.00 in 1881; in 1900, this rescaled index *rci* equals approximately 1.17, whereas as seen above *rsg*, the actual relative change in *sg* from 1881, was then nearer 6.41, or near 5.48 times as much. This relative growth is presumably tied to the considerable growth in the relative protection of the general-equipment industry with the tariffs of 1878 and 1887 (Table F.45, col. 29). Here, in part to avoid occasionally implying implausible annual growth rates, 60% of the growth in (*rsg*/*rci*) is attributed to a progressive long-term reaction to those tariff increases, assuming a stronger reaction to the (later) introduction of net protection than to the (earlier) reduction in negative protection and a tapering off after a decade from the later tariff hike, and 40% to a short-term reaction to the tariff hike in 1888, distributed over three years, slightly lagged. Specifically, 60% of (*rsg*/*rci*), or about 3.29, is distributed over the years from 1882 to 1899, allowing (1/29) of that increase in each year to 1887, (2/29) in each year from 1888 to 1898, and again (1/29) in 1899; the residual relative increase (1/.6 = 5/3) is distributed evenly from mid-1888 to mid-1891. In each year, therefore, the share *sg* is estimated as its value in 1881 (approximately .058), multiplied by three magnitudes. The first is the current value of *rci*; the second is, to the power *pl*, the twenty-ninth root of 60% of (*rsg*/*rci*), or about 1.042; the third is, to the power *ps*, the cube root of (5/3), or about 1.19. The exponent *pl* rises annually by 1.0 from 1.0 in 1882 to 6.0 in 1887, and then by 2.0 from 8.0 in 1888 to 28.0 in 1898, and again by 1.0 in 1899, to 29.0 in 1899 and 1900, while *ps* equals 0.0 in 1881-87, .5 in 1888, 1.5 in 1889, 2.5 in 1890, and 3.0 in 1891-1900 (whence by construction the benchmark share in 1900).

The estimates of *sg* from 1871 to 1881 are obtained next. The index *ci* is again rescaled, from 1871 to 1881, to set it equal to 1.00 in 1871; in 1881, this rescaled index *rci* equals approximately 1.22, whereas as seen above *rsg*, the actual relative change in *sg* from 1881, was then nearer 1.24, or just 1.02 times as much, despite the intervening (algebraic) increase in protection (Table F.45, col. 27). To allow for the presumable effects of the latter, both short-term and long-term, with a simple algorithm, the share *sg* is estimated initially in 1877-80 as its value in 1871 times the current *rci* divided by 1.05 in 1880, 1.11 in 1879, 1.18 in 1878, and 1.22 in 1877. In 1877, *sg* works out to some .99 times its level in 1871, against a current *rci* near 1.21, yielding a ratio between these two variables near .82. In 1872-76, *sg* is estimated simply as its value in 1871 times the current *rci*, times the sixth root of that ratio (approximately .97) to the power *p*, where *p* rises linearly from 1.0 in 1872 to 5.0 in 1876, implicitly returning in 1877 the *sg* backcast from 1881.

The estimates of *sg* from 1861 to 1871 are obtained last. The index *ci* is again rescaled, from 1861 to 1871, to set it equal to 1.00 in 1864; in 1881, this rescaled index *rci* equals approximately 1.18, barely greater than *rsg*, the actual relative change in *sg* from 1881, then near 1.17. Ignoring the small reductions in negative net protection between 1861 and 1871 (Table F.45, col. 27), *sg* is here estimated simply as its value in 1864, times the current *rci*,

times a trend-correction equal to the seventh root of (*rsg*/*rci*) in 1871, or barely less than 1.0, to the power *p*, with *p* rising linearly by 1.0 from –3.0 in 1861 through 0.0 in 1864 to 7.0 in 1871.

With the *sg* time series thus complete, the estimated metal consumption by the (residual) general-equipment industry from 1861 to 1913 is obtained as *sg* times the joint metal-consumption estimates (Table F.44, col. 15); the resulting figures are transcribed in Table F.52, col. 11. Divided by the input/output ratio (1.25), these figures yield the (residual) general-equipment production estimates in Table F.52, col. 4 (returning, by construction, the benchmark estimates obtained above). The estimated metal consumption by the fabricated-metal industry is in turn the relevant residual (Table F.44, col. 15, less Table F.52, col. 11), transcribed in Table F.52, col. 8. Divided by the input/output ratio (1.35), these figures yield the (residual) general-equipment production estimates in Table F.52, col. 1 (again returning, by construction, the benchmark estimates obtained above). In the 1860s and 1870s, it may be recalled, the fabricated-metal industry consumed far more metal than the general-equipment industry: the path of the former is essentially dictated by that of their joint metal consumption, and is thoroughly insensitive to the actual path attributed to its much smaller counterpart.

F05. Precious-metal products

F05.01 Introduction

In the *ISIC*, group 3901 covers the production of jewelry and related articles. In the 1911 *Censimenti* the corresponding categories appear to be 4.59, goldsmiths and silversmiths, and 4.510, precious medals and coins; the only apparent difference of note is that *ISIC* group 3901 seems not to cover the mounting of mosaics, explicitly included in category 4.59 of the *Censimenti*.

The working of precious metals covers everything from the production of entirely new pieces from semi-finished gold and silver (and minor metals) to the resetting of stones and the hammering out of dents; nor does there seem to be any useful evidence on the actual composition of production. The industry's product is accordingly captured by a synthetic measure, the equivalent weight of new silverware. This product is estimated in 1911 from the census benchmark, and then extrapolated with an index of luxury-good consumption, allowing for international trade.

F05.02 International trade

Table F.54, cols. 1 and 2 report the net imports of gold products, and of silver products, calculated from the *Movimento commerciale*. In 1913, col. 1 aggregates over categories 838-840 (fabricated gold), 845 (goldsmithry), and 847-848 (gold jewels); col. 2, over categories 842-844 (fabricated silver), 846 (silverware) and 849 (silver jewels). The trade categories appear to be invariant from 1878 to 1913, save for a greater disaggregation in the early years (e.g., *Movimento commerciale 1906*, p. 640, *1900*, pp. 450-451, *1896*, p. 331, *1888*, p. 633, *1880*, p. 322); and those same categories were applied to the trade flows of 1874-77 as well, in the retrospective summary in the *Movimento commerciale 1878*, pp. 179-180. From 1874 to 1913, therefore, the figures in cols. 1 and 2 are obtained as simple (net) sums of the figures in the sources.

In 1861-77, different trade categories were in use: gold and silver goods were not always separated, and in a number of single categories imports were divided, from 1864, into a part measured by weight and another by value (or measured only in value terms). The present estimates for 1861-73 are accordingly obtained from the data in the sources through more complex transformations, suggested by the double classification available from 1874 to 1877.

Fabricated gold is identified with the sum of gold thread, gold on silk, and gold leaf. In 1861-73, gold thread is held to represent half the imports, and all the exports, of gold and silver thread (respectively 370 and 0 kilograms in 1873); gold on silk is held to represent 71.5% of imports, and 100% of exports, of gold and silver on silk (respectively 1,015 and 378 kilograms in 1873); and the gold leaf figures (respectively 349 and 20 kilograms in 1873) are taken as reported. Trade in goldsmithry is taken as reported on the export side (23.2 kilograms in 1873), but imports are reported part in weight (0.6 kilograms in 1873), and part in value (63,123 lire in 1873); splicing the series in 1874, imports are estimated as the reported quantities, plus the reported values times (412 – 312)/46,234 (the inverse of the implicit price in 1874, given the value figure and the quantity to which it was taken to correspond). Trade in gold jewels is estimated in exactly the same way: it is taken as reported on the export side (264.4 kilograms in 1873), but imports are reported part in weight (76.0 kilograms in 1873), and part in value (2,644,190 lire in 1873); splicing the series in 1874, imports are estimated as the reported quantities, plus the reported values times (5,242 – 525)/2,493,437. The net sums of these partial estimates are the figures for 1862-73 reported in col. 1

Fabricated silver is identified with the sum of silver thread, silver on silk, and silver leaf. The first two of these are estimated from the reported totals for gold and silver together,

deducting the part allocated to gold; and the silver leaf figures (respectively 683 and 0 kilograms in 1873) are taken as reported. Trade in silverware is calculated like that in goldsmithry: as reported on the export side (2,212 plus 202 kilograms in 1873), and on the import side as the sum of the reported quantity (452 plus 40 kilograms in 1873) plus the complementary reported value (210,894 plus 129,313 lire in 1873), with this last multiplied by (1,414 – 301)/362,376. Trade in silver jewels is also calculated in the same way: as reported on the export side (3 plus 1 plus 460 kilograms in 1873), and on the import side as the sum of the reported quantity (27 plus 17 kilograms in 1873) plus the complementary reported value (140,776 plus 35,969 plus 24,083 lire in 1873), with this last multiplied by (768 - 30)/(244,584 + 47,100 + 13,239). The net sums of these partial estimates are the figures for 1862-73 reported in col. 2.

Col. 3 transcribes the estimates of aggregate net imports, in silverware value added equivalent; they are the sum of cols. 1 and 2, with the gold-products component (col. 1) multiplied by the estimated ratio of 1911-price value added per ton of gold products to that of silver products. The *Movimento commerciale 1911* indicates unit values, including applicable tariffs, equal to 239 lire per kilogram for silverware (category 846), and 90 lire per kilogram for silver bar (category 841). The cost of ancillary materials and of energy for heat and power was surely trivial in comparison to that of the metal itself, and the net losses of the latter in processing were surely kept to a minimum; deducting a small allowance from the gross margins implied by these value figures, value added is here estimated at 145 lire per kilogram. The *Movimento commerciale 1911* similarly indicates unit values, including applicable tariffs, equal to 3,540 lire per kilogram of goldsmithry (category 845) and 2,600 lire per kilogram of gold bar (category 1,200); unit value added is here estimated at 910 lire per kilogram, against 145 for silverware. Taking these estimates for silverware and goldsmithry as representative of all silver and gold products, respectively, from 1871 to 1913 col. 3 is obtained as col. 1 times (910/145), plus col. 2.

From 1862 to 1870 col. 3 is obtained as after 1871, with an additional allowance of .328 tons of net imports in 1862-66 to allow for the trade of the Venetian provinces, and as much again in 1862-70 to allow for that of the Roman ones. This figure of .328 tons is obtained from the data in the *Movimento commerciale 1866* for the trade of the Venetian provinces in November and December of that year, transformed exactly as the national figures considered above, and multiplied by six; absent further information, it is applied to the previous years as well, and also to the Papal states. Finally, trade is simply assumed unchanged from 1861 to 1862.

F05.03 Production and consumption

Value added in the working of precious metals in 1911 was estimated in chapter F01 above at 31.84 million lire (Table F.03, panel A, row 11, col. 11). At 1911 prices, value added per ton of silverware was estimated above at (the equivalent of) 145,000 lire per ton. Together, these estimates of total and unit value added yield an estimated physical product of 219.6 tons of silverware equivalent. In 1911, net imports are estimated at 78.6 tons of silverware equivalent (col. 3); the resulting estimate of total consumption equals 298.2 tons of silverware equivalent.

Table F.54, col. 4 presents the time-series estimates of precious-metals consumption, in silverware equivalent. These are constructed by extrapolating the above estimate for 1911 in proportion to the consumption of another luxury good, dyed silk (Table H.11, col. 7). Col. 5 presents the time-series estimates of output, in those same units. To capture at least the likely medium-term movements of production, these are obtained by deducting aggregate net imports in col. 3 from estimated consumption in col. 4, taking a three-year moving average of the resulting residual (leaving the first and last figures unchanged), and (mildly) rescaling that smoothed series to force it through the original production estimate for 1911. The

corresponding value added per ton at 1911 prices, as estimated above, equals 145,000 lire; the estimates are reported rounded to the kilogram to contain the value-added rounding error, and not to claim a spurious precision.

F05.04 The census benchmarks

In 1911, the *Censimento demografico* reports a total of 21,510 workers, many of them artisans, in categories 4.59 and 4.510 together. Of these, 2,557 were of up to 15 years of age, and presumably not engaged directly in the working of the precious metal, for a net total of 18,953.

In the census of 1871 the corresponding categories appear to be grouped in the luxury-goods industries (II.18 or, on p. LX, II.r), respectively, sub-category 5 (goldsmiths and assayers), 6 (jewellers and lapidaries), 7 (mosaicists), and 8 (silversmiths, gold-beaters, electroplaters); they total 16,543 total workers (80% of them in category 5), of whom 1,449 under age 15, for a net figure of 15,094.

In the census of 1881, in turn, the corresponding categories appear to be categories II.XVI.1 (gold-beaters, silversmiths, etc.), 2 (goldsmiths and jewellers), and 4 (mosaicists), with 18,449 total workers (86% of them in category 2), of whom 1,644 through age 14, for a net total of 16,805. Category 7, in turn, lists just 54 electroplaters, suggesting that the number included in the above total for 1871 can be neglected.

In the census of 1901, finally, jewellers, goldsmiths, silversmiths, and the like are counted together in category XIV.6; 20,525 are reported, of whom 2,488 to age 15, for a net total of 18,325; again, these are here referred to 1900.

The estimates in col. 5 thus imply an equivalent product per man near 7 kilograms per worker over 15 in 1871 and 1881, 8 in 1901, and nearer 12 in 1911. Since output appears to have been relatively high, compared to the preceding years, at each census benchmark, this time path seems to reflect actual productivity growth; and it points to rapid progress in the early twentieth century after decades, if not centuries, of stagnation. At the same time, however, in 1911 the precious-metals industry was marked by a strikingly low ratio of horsepower to workers (Table F.02), in relative terms much further below that of the other components of the engineering industry than in 1938 (Table F.03): this evidence suggests that early in the twentieth century productivity growth in precious-metal work was tied to the diffusion of hand- (or foot-) powered machinery, analogous, if one will, to the sewing machine.

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Table F.01
Reported Labor Force and Factor Employment in Engineering in 1911

Census category		*Censimento demografico* (labor force)		*Censimento industriale* (total)			
				Employment		Unduplicated horsepower in use	
Code	Content	Blue-collar	Total[c]	Blue-collar	Total	Primary	Electric
4.31	Blacksmiths, wrought iron work	86,879	150,582	20,230	50,302	3,653	1,218
4.32	Coppersmiths, tinsmiths, braziers	29,736	49,168	10,104	19,435	853	2,099
4.33	Metal furniture	5,717	7,318	5,064	6,085	44	357
4.34	General hardware	7,431	8,856	5,930	6,807	1,326	1,401
4.35	Cables, springs, tin cans	5,500	7,259	3,717	4,548	1,168	809
4.36	Ordinary-metal medals and coins	127	176	17	27		18
4.37	Ordinary table- and kitchen-ware	2,239	2,761	1,958	2,262	699	212
4.38	Knives, scissors, swords	1,871	3,027	1,272	1,996	535	245
4.39	Knife-grinders	1,710	3,922	275	812	34	202
4.3$\underline{10}$	Ordinary bullets, shot, fuses, cases	503	*551*	260	300	86	58
4.3$\underline{11}$	Enamelware, other metal objects	3,045	4,316	2,272	3,125	243	917
4.3ω	(4.31 - 4.3$\underline{11}$)			2,269	2,745	329	436
4.3	Fabricated metal products	144,758	237,936	53,368	98,444	8,970	7,972
4.41	Structural components, machinery	49,245	*61,692*	46,020	58,087	11,237	14,362
4.42	Rail-guided vehicles	44,120	*48,147*	42,049	45,747	17,889	15,284
4.43	Bicycles, automobiles	12,809	*16,781*	11,843	15,556	674	3,432
4.44	Shipyards and boatyards	28,932	*31,347*	26,151	28,227	8,407	8,566
4.45	Aircraft	1,286	*1,434*	403	460	61	118
4.4ω	(4.41 - 4.45)			7,348	7,925	1,325	2,831
4.4	Heavy equipment, machinery	136,392	*159,401*	133,814	156,002	39,593	44,593
4.51	Optical and precision instruments	1,226	1,722	734	1,002	92	260
4.52	Common weights and scales	1,980	2,995	1,537	2,275	39	162
4.53	Clocks and watches	3,861	8,801	1,468	2,417	161	218
4.54	Business machines	145	*226*	97	131	1	13
4.55	Electrical apparatus	7,717	*8,715*	7,157	7,884	259	2,753
4.56	Metal musical instruments	922	1,234	622	771	20	69
4.57	Firearms, grenades, torpedoes	9,551	*11,316*	8,093	9,244	4,196	3,564
4.58	Other apparatus and equipment	10,571	*13,453*	10,294	12,798	1,450	4,390
4.59	Goldsmiths and silversmiths	13,487	21,064	7,993	11,051	64	711
4.5$\underline{10}$	Precious-metal medals and coins	285	446	227	277	25	45
4.5ω	(4.51 - 4.5$\underline{10}$)			434	659		67
4.5	Light equipment, precious-metal products	49,745	69,972	38,656	48,509	6,307	12,252

Table F.01 (continued)

Census category		*Censimento demografico* (labor force)		*Censimento industriale* (total)			
				Employment		Unduplicated horsepower in use	
Code	Content	Blue-collar	Total[c]	Blue-collar	Total	Primary	Electric
4.ω1	(4.1 - 4.5)[d]			27,411	29,286	18,884	9,513
4.ω2	(4.3 - 4.5)			11,733	14,321	3,058	2,489
4.ω				39,144	43,607	21,942	12,002
ω.31	(3.1[e], 3.2[f], and 4[f])			9,588	10,980	1,657	1,893
ω.71	(4[d] and 5[g])			3,607	4,371	3,062	520

Table F.01 (continued)

Census category		*Censimento industriale* (large shops)[a]				*Censimento industriale* (small shops)[b]			
		Employment		Unduplicated horsepower in use		Employment		Unduplicated horsepower in use	
Code	Content	Blue-collar	Total	Primary	Electric	Blue-collar	Total	Primary	Electric
4.31	Blacksmiths, wrought iron work	2,870	3,222	1,514	198	17,360	47,080	2,139	1,020
4.32	Coppersmiths, tinsmiths, braziers	3,157	3,491	502	1,856	6,947	15,944	351	243
4.33	Metal furniture	3,797	4,197	34	271	1,267	1,888	10	86
4.34	General hardware	5,160	5,577	1,219	1,280	770	1,230	107	121
4.35	Cables, springs, tin cans	3,041	3,308	1,062	547	676	1,240	106	262
4.36	Ordinary-metal medals and coins	0	0	0	0	17	27	0	18
4.37	Ordinary table- and kitchen-ware	1,846	1,958	544	202	112	304	155	10
4.38	Knives, scissors, swords	837	927	238	152	435	1,069	297	93
4.39	Knife-grinders	40	45	9	0	235	767	25	202
4.3$\underline{10}$	Ordinary bullets, shot, fuses, cases	242	264	79	55	18	36	7	3
4.3$\underline{11}$	Enamelware, other metal objects	1,182	1,380	231	377	1,090	1,745	12	540
4.3ω	(4.31 - 4.3$\underline{11}$)	1,950	2,102	225	391	319	643	104	45
4.3	Fabricated metal products	24,122	26,471	5,657	5,329	29,246	71,973	3,313	2,643
4.41	Structural components, machinery	34,878	38,819	9,601	11,710	11,142	19,268	1,636	2,652
4.42	Rail-guided vehicles	41,673	45,276	17,346	14,028	376	471	543	1,256
4.43	Bicycles, automobiles	8,039	8,862	573	2,839	3,804	6,694	101	593
4.44	Shipyards and boatyards	26,116	28,186	8,407	8,551	35	41	0	15
4.45	Aircraft	383	436	6	114	20	24	55	4
4.4ω	(4.41 - 4.45)	7,103	7,509	1,309	2,798	245	416	16	33
4.4	Heavy equipment, machinery	118,192	129,088	37,242	40,040	15,622	26,914	2,351	4,553
4.51	Optical and precision instruments	479	621	91	206	255	381	1	54
4.52	Common weights and scales	684	779	34	104	853	1,496	5	58
4.53	Clocks and watches	907	1,015	150	205	561	1,402	11	13
4.54	Business machines	45	52	1	12	52	79	0	1
4.55	Electrical apparatus	6,777	7,336	38	2,625	380	548	221	128
4.56	Metal musical instruments	482	529	12	51	140	242	8	18
4.57	Firearms, grenades, torpedoes	7,661	8,229	4,173	3,521	432	1,015	23	43
4.58	Other apparatus and equipment	8,152	9,466	1,291	4,149	2,142	3,332	159	241
4.59	Goldsmiths and silversmiths	4,669	5,274	57	525	3,324	5,777	7	186
4.5$\underline{10}$	Precious-metal medals and coins	227	275	25	45	0	2	0	0
4.5ω	(4.51 - 4.5$\underline{10}$)	202	220	0	53	232	439	0	14
4.5	Light equipment, precious-metal products	30,285	33,796	5,872	11,496	8,371	14,713	435	756

Table F.01 (continued)

Census category		*Censimento industriale* (large shops)[a]				*Censimento industriale* (small shops)[b]			
		Employment		Unduplicated horsepower in use		Employment		Unduplicated horsepower in use	
Code	Content	Blue-collar	Total	Primary	Electric	Blue-collar	Total	Primary	Electric
4.ω1	(4.1 - 4.5)[d]	27,138	28,901	18,797	9,415	273	385	87	98
4.ω2	(4.3 - 4.5)	10,116	10,941	2,932	2,295	1,617	3,380	126	194
4.ω		37,254	39,842	21,729	11,710	1,890	3,765	213	292
ω.31	(3.1[e], 3.2[f], and 4[d])	8,977	9,610	1,418	1,831	611	1,370	239	62
ω.71	(4[d] and 5[g])	3,305	3,916	3,047	437	302	455	15	83

[a]shops with more than ten subordinate workers.
[b]shops with up to ten subordinate workers.
[c]the italicized figures include no artisans.
[d]metalmaking, engineering.
[e]wood products excluding cane, reed, and straw ware.
[f]cane, reed, and straw ware.
[g]non-metallic mineral products, construction.

Sources: *Censimento demografico*, *Censimento industriale*.

Table F.02
Estimated Factor Employment in Engineering in 1911

	Census code	Census category	(1) *Censimento industriale* large shops[a] Employment Blue-collar	(2) *Censimento industriale* large shops[a] Employment Total	(3) *Censimento industriale* large shops[a] Unduplicated horsepower in use	(4) *Censimento industriale* small shops[b] Employment Blue-collar	(5) *Censimento industriale* small shops[b] Employment Total	(6) *Censimento industriale* small shops[b] Unduplicated horsepower in use
1.	4.31	Blacksmithing	37,750	39,750	20,500	17,350	47,100	3,150
2.	4.32	Other smithing	3,150	3,500	2,350	7,250	17,400	650
3.	other 4.3	Other fabricated metal	18,100	19,750	6,900	4,950	8,950	2,200
4.	4.42	Rail-guided vehicles	43,700	47,700	32,900	400	450	1,800
5.	4.44	Shipyards and boatyards	28,900	31,300	18,750	50	50	0
6.	other 4.4	Other heavy equipment, machinery	48,150	53,500	27,650	15,200	26,400	5,100
7.	4.54/5/7/8	Other ordinary machinery	22,850	25,300	15,850	5,150	8,400	1,300
8.	4.52	Weights and scales	700	800	150	850	1,500	50
9.	4.51/6	Precision instruments	950	1,150	350	400	600	100
10.	4.53	Clocks and watches	900	1,000	350	550	1,400	0
11.	4.59/10	Precious-metal products	4,900	5,550	650	3,300	5,800	200

	Census code	Census category	(7) Other shops Employment Blue-collar	(8) Other shops Employment Total	(9) Other shops Unduplicated horsepower in use	(10) Industry totals Employment Blue-collar	(11) Industry totals Employment Total	(12) Industry totals Unduplicated horsepower in use
1.	4.31	Blacksmithing	31,800	63,750	6,400	86,900	150,600	30,050
2.	4.32	Other smithing	19,350	28,250	4,250	29,750	49,150	7,250
3.	other 4.3	Other fabricated metal	5,100	9,500	1,550	28,150	38,200	10,650
4.	4.42	Rail-guided vehicles	0	0	0	44,100	48,150	34,700
5.	4.44	Shipyards and boatyards	0	0	0	28,950	31,350	18,750
6.	other 4.4	Other heavy equipment, machinery	0	0	0	63,350	79,900	32,750
7.	4.54/5/7/8	Other ordinary machinery	0	0	0	28,000	33,700	17,150
8.	4.52	Weights and scales	450	700	50	2,000	3,000	250
9.	4.51/6	Precision instruments	800	1,200	150	2,150	2,950	600
10.	4.53	Clocks and watches	2,400	6,400	100	3,850	8,800	450
11.	4.59/10	Precious-metal products	5,550	10,150	300	13,750	21,500	1,150

[a]shops with more than ten subordinate workers.
[b]shops with up to ten subordinate workers.

Sources: see text.

Table F.03
Estimated Value Added in Engineering in 1911

A. Estimates for 1911

	Industry	(1) Women, boys and girls: Total	(2) Women, boys and girls: Large shops	(3) Women, boys and girls: Other shops	(4) Value added (million lire): Large shops: Labor costs	(5) Value added (million lire): Large shops: Capital costs: Total	(6) Value added (million lire): Large shops: Capital costs: Lire/HP	(7) Value added (million lire): Large shops: Total	(8) Value added (million lire): Small shops: Labor costs	(9) Value added (million lire): Small shops: Capital costs	(10) Value added (million lire): Small shops: Total	(11) Value added (million lire): Total
1.	Blacksmithing	19,500	4,750	14,750	48.03	21.65	763	69.68	124.17	22.81	146.98	216.66
2.	Other smithing	5,950	650	5,300	4.09	2.30	763	6.39	51.60	10.19	61.79	68.18
3.	Other fabricated metal	9,150	7,300	1,850	20.90	10.04	1,077	30.94	21.03	6.67	27.70	58.64
4.	Rail-guided vehicles	2,300	2,300	0	60.25	64.91	1,654	125.16	0.00	.00	.00	125.16
5.	Shipyards and boatyards	1,350	1,350	0	39.32	35.80	1,647	75.12	0.00	.00	.00	75.12
6.	Other heavy equipment, mach.	7,100	5,250	1,850	65.33	54.04	1,659	119.37	30.57	12.28	42.85	162.22
7.	Other ordinary machinery	5,700	4,900	800	29.44	22.99	1,218	52.43	9.60	2.78	12.38	64.81
8.	Weights and scales	300	150	150	.93	.28	1,077	1.21	2.55	.43	2.98	4.19
9.	Precision instruments	500	200	300	1.35	1.29	3,195	2.64	2.21	1.08	3.29	5.93
10.	Clocks and watches	700	500	200	.98	1.24	3,195	2.22	10.38	1.62	12.00	14.22
11.	Precious-metal products	3,900	2,100	1,800	5.84	2.18	2,229	8.02	20.18	3.64	23.82	31.84

Table F.03 (continued)

B. Data for 1938

	1938 census code	Industry	(1) 1911 census code	(2) Large industrial shops[a] Employment	(3) Large industrial shops[a] Installed horsepower	(4) Large industrial shops[a] Wage bill[b]	(5) Large industrial shops[a] Value added[b]	(6) Large industrial shops[a] Net capital costs per horsepower[c]	(7) Other shops Employment	(8) Other shops Value added[d]
1.	80	Non-electric motors	other 4.4	29,272	59,466	192.962	582.651	5,417	96	1.015
2.	81-82	Transmissions, lifting equip.	other 4.4	14,022	33,427	74.491	170.718	2,099	161	2.392
3.	83-86	Machine tools and bits	other 4.4	11,709	23,918	55.508	147.234	3,023	560	4.976
4.	87-92	Industrial machinery	other 4.4	30,927	46,909	134.362	341.156	3,406	1,804	19.457
5.	93	Pumps, compressors, faucets	other 4.4	12,562	21,061	68.440	149.179	2,696	653	7.342
6.	94-96	Structures, furniture, safes	other 4.4	20,528	29,831	85.225	204.206	2,989	2,149	19.344
7.	97-98	Ovens, thermal machinery	4.58	10,583	15,515	46.115	109.617	3,053	554	7.435
8.	99-100	Locks, small hardware, cans	other 4.3	23,336	20,028	77.236	181.423	3,852	3,234	21.688
9.	101-104	Springs, nuts/bolts, kitchenw.	other 4.3	31,478	51,061	113.536	247.861	1,852	2,533	16.129
10.	105-110	Precision equipment	4.51/2/6	22,745	19,931	124.018	310.317	7,169	2,017	14.426
11.	111-112	Coins, medals, jewelry	4.59/10	5,844	3,498	24.153	50.097	5,000	5,253	27.732
12.	113-122	Transport equipment	4.42-45	208,900	372,939	1,120.284	2,893.180	3,702	986	14.624
13.	123-126	Electrical machinery and equip.	other 4.4	59,403	97,032	259.546	740.448	4,020	935	11.151
14.	127-131	General trades	4.31/2, 41	29,519	37,629	129.772	239.626	1,712	138,298	396.414
15.	133	Other industries	4.57	95,416	221,747	392.124	993.439	2,093	1,067	38.918

[a]non-artisanal shops with more than ten workers.
[b]million lire.
[c]lire (estimated).
[d]calculated from the reported values of goods manufactured, and of materials consumed; million lire.

Sources: see text.

Table F.04
Naval Vessels Built in Italy, 1861-1913: Armored Frigates, Frigates and Corvettes

	Displacement (tons)	Construction dates			Source[a]	Estimated construction (years, tons/year)						Ship notes
		laid down	launched	completed								
Armored frigates												
Conte Verde	3,930	2.03.63	29.07.67	.12.71	N	*1863:*	373	*1864-70:*	447	*1871:*	428	(a)
Messina	3,930	28.09.61	20.12.64	. .67	N	*1861:*	172	*1862-66:*	683	*1867:*	343	(a)
Palestro	5,854	.08.65	2.10.71	11.07.75	N,A	*1865:*	223	*1866-74:*	595	*1875:*	276	(a)
Principe Amedeo	5,854	.08.65	15.01.72	15.12.74	N,A	*1865:*	236	*1866-73:*	627	*1874:*	602	(a)
Principe di Carignano	3,501	.01.61	15.09.63	11.06.65	N	*1861:*	746	*1862-64:*	778	*1865:*	421	(a)
Principe Umberto	3,501	.12.60	22.08.62	1.11.63	I	*1860:*	50	*1861-62:*	1,218	*1863:*	1,015	(b)
Roma	5,814	.02.63	18.12.65	15.06.68	N	*1863:*	940	*1864-67:*	1,073	*1868:*	582	(a)
Venezia	5,814	.02.63	21.01.69	1.04.73	N	*1863:*	503	*1864-72:*	574	*1873:*	145	(a)
Frigates and corvettes												
Caracciolo	1,578	.10.65	18.01.69	20.07.70	E	*1865:*	70	*1866-69:*	332	*1870:*	180	(a)
Etna	1,563	17.03.60	17.07.62	1.07.63	E	*1860:*	376	*1861-62:*	475	*1863:*	237	(a)
Gaeta	3,680	1.09.60	31.08.63	16.07.65	I	*1860:*	256	*1861-64:*	768	*1865:*	352	(a)
Italia	3,080	2.09.57	6.04.61	3.03.62	I	*1857:*	224	*1858-61:*	672	*1862:*	168	(a)
Magenta	2,712	.09.59	17.07.62	22.12.63	E	*1859:*	184	*1860-63:*	632			(a)
Principessa Clotilde	2,182	15.03.61	10.08.64	19.04.66	E	*1861:*	340	*1862-65:*	429	*1866:*	126	(a)
Vettor Pisani	1,962	11.05.67	22.07.69	10.04.71	E	*1867:*	313	*1868-70:*	501	*1871:*	146	(a)

Ship notes:
(a) wood-built.
(b) wood-built. Classed as (unarmored) frigate, actually armored, sister of the *Principe di Carignano*.

[a]A: *Annuario 1884*; E: *Esploratori*; I: *Incrociatori*; N: *Navi di linea*.

Sources: see text.

Table F.05
Naval Vessels Built in Italy, 1861-1913: Battleships

	Displacement (tons)	Construction dates: laid down	launched	completed	Source[a]	Estimated construction (years, tons/year)						Ship notes
Ammiraglio di Saint Bon	9,800	.07.94	29.04.97	1.02.01	N	*1894:*	687	*1895-00:*	1,498	*1901:*	125	
Andrea Doria	11,204	7.01.82	21.11.85	1.07.91	N	*1882:*	1,133	*1883-90:*	1,185	*1891:*	591	
Andrea Doria	22,964	24.03.12	30.03.13	13.03.16	N	*1912:*	4,352	*1913-15:*	5,801	*1916:*	1,209	
Benedetto Brin	13,427	30.01.99	7.11.01	1.09.05	N	*1899:*	1,868	*1900-04:*	2,040	*1905:*	1,359	
Caio Duilio	11,138	24.04.73	8.05.76	6.01.80	N	*1873:*	1,112	*1874-79:*	1,671	*1880:*	0	
Caio Duilio	22,964	24.02.12	24.04.13	10.05.15	N	*1912:*	5,888	*1913-14:*	7,066	*1915:*	2,944	
Conte di Cavour	23,088	10.08.10	10.08.11	1.04.15	N	*1910:*	1,872	*1911-14:*	4,992	*1915:*	1,248	
Dante Alighieri	19,500	6.06.09	20.08.10	15.01.13	N	*1909:*	3,138	*1910-12:*	5,379	*1913:*	225	
Emanuele Filiberto	9,800	5.10.93	29.09.97	6.09.01	N	*1893:*	309	*1894-00:*	1,238	*1901:*	825	
Enrico Dandolo	11,138	6.01.73	10.07.78	11.04.82	N	*1873:*	732	*1874-81:*	1,255	*1882:*	366	
Francesco Morosini	11,204	4.12.81	30.07.85	21.04.89	N,F	*1881:*	127	*1882-88:*	1,519	*1889:*	444	
Giulio Cesare	23,088	24.06.10	15.10.11	14.05.14	N	*1910:*	2,980	*1911-13:*	5,958	*1914:*	2,234	
Italia	13,898	.07.76	29.09.80	16.10.85	N	*1876:*	686	*1877-84:*	1,503	*1885:*	1,188	
Leonardo da Vinci	23,088	18.07.10	14.10.11	17.05.14	N	*1910:*	2,760	*1911-13:*	6,023	*1914:*	2,259	
Lepanto	13,898	.10.76	17.02.83	16.08.87	N	*1876:*	266	*1877-86:*	1,283	*1887:*	802	
Napoli	12,833	12.10.03	10.09.05	1.09.08	N	*1903:*	335	*1904-07:*	2,678	*1908:*	1,786	
Re Umberto	13,300	10.07.84	17.10.88	21.07.93	N	*1884:*	676	*1885-92:*	1,478	*1893:*	800	
Regina Elena	12,691	27.03.01	19.06.04	11.09.07	N	*1901:*	1,474	*1902-06:*	1,965	*1907:*	1,392	
Regina Margherita	13,427	20.11.98	30.05.01	14.04.04	N	*1898:*	309	*1899-03:*	2,479	*1904:*	723	
Roma	12,791	20.09.03	21.04.07	17.12.08	N	*1903:*	711	*1904-07:*	2,436	*1908:*	2,336	
Ruggiero di Lauria	11,204	3.08.81	9.08.84	1.12.88	N,F	*1881:*	636	*1882-87:*	1,528	*1888:*	1,400	
Sardegna	13,860	24.10.85	20.09.90	16.02.95	N	*1885:*	248	*1886-94:*	1,492	*1895:*	184	
Sicilia	13,400	3.11.84	6.07.91	4.05.95	N	*1884:*	1,000	*1885-94:*	1,200	*1895:*	400	
Vittorio Emanuele	13,035	18.09.01	12.10.04	1.08.08	N	*1901:*	1,267	*1902-07:*	1,787	*1908:*	1,046	
For export:												
Vasco da Gama	2,972	. .02	. .	. .03	B,J	*1902:*	743	*1903:*	743			(a)
Messoudieh	9,120	. .01	. .	. .02	B,J	*1901:*	2,280	*1902:*	2,280			(b)

Table F.05 (continued)

Ship notes:
(a) rebuilt for Portugal.
(b) rebuilt for Turkey.

[a]B: *Brassey's 1913*; F: Fraccaroli (1970); J: *Jane's 1914*, *1919*; N: *Navi di linea*.

Sources: see text.

Table F.06
Naval Vessels Built in Italy, 1861-1913: Armored Cruisers

	Displacement (tons)	Construction dates: laid down	launched	completed	Source[a]	Estimated construction (years, tons/year)						Ship notes
Amalfi	9,832	24.07.05	5.05.08	1.09.09	I	*1905:*	1,091	*1906-08:*	2,384	*1909:*	1,589	
Carlo Alberto	6,832	.01.93	23.09.96	1.05.98	I	*1893:*	1,237	*1894-97:*	1,291	*1898:*	431	
Francesco Ferruccio	7,350	19.08.99	23.04.02	1.09.05	I	*1899:*	454	*1900-04:*	1,217	*1905:*	811	
Giuseppe Garibaldi	7,350	8.06.98	29.06.99	5.04.01	I	*1898:*	1,513	*1899-00:*	2,594	*1901:*	649	
Marco Polo	4,580	7.01.90	27.10.92	21.07.94	I			*1890-93:*	1,008	*1894:*	548	
Pisa	9,832	20.02.05	15.09.07	1.09.09	I	*1905:*	1,894	*1906-08:*	2,165	*1909:*	1,443	
San Giorgio	10,167	4.07.05	27.07.08	1.07.10	I	*1905:*	1,017	*1906-09:*	2,033	*1910:*	1,018	
San Marco	10,700	2.01.07	20.02.08	7.02.11	I			*1907-10:*	2,620	*1911:*	220	
Varese	7,350	21.04.98	6.08.99	5.04.01	I	*1898:*	1,759	*1899-00:*	2,485	*1901:*	621	
Vettor Pisani	6,720	7.12.92	14.08.95	1.04.98	I	*1892:*	105	*1893-97:*	1,260	*1898:*	315	
For export:												
General Belgrano	7,350	.06.96	. .97	. .99	F,J	*1896:*	1,309	*1897-98:*	2,416	*1899:*	1,209	(a)
General Garibaldi	7,350	. .94	. .95	. .96	F	*1894:*	1,838	*1895:*	3,674	*1896:*	1,838	(a)
General Pueyrredon	7,350	.08.96	. .97	. .01	F,J	*1896:*	564	*1897-00:*	1,508	*1901:*	754	(a)
General San Martín	7,350	. .95	. .96	. .98	F	*1895:*	1,225	*1896-97:*	2,450	*1898:*	1,225	(a)
Giorgios Averoff	9,832	. .07	. .10	. .11	B,J	*1907:*	1,229	*1908-10:*	2,458	*1911:*	1,229	(b)
Kasuga	7,350	.03.02	. .02	.01.04	F,J	*1902:*	3,174	*1903:*	4,009	*1904:*	167	(c)
Nisshin	7,350	.05.02	. .03	.01.04	F,J	*1902:*	2,756	*1903:*	4,410	*1904:*	184	(c)
Cristóbal Colón	7,350	. .95	. .96	. .97	F,M	*1895:*	1,443	*1896:*	2,885	*1897:*	2,765	(d)

Ship notes:
(a) to Argentina
(b) to Greece; displacement estimated: see text.
(c) to Argentina (as the *Rivadavia* and *Moreno*), which resold them to Japan.
(d) to Spain; "date completed" is date exported, still incomplete.

[a]B: *Brassey's 1913*; F: Fraccaroli (1970); I: *Incrociatori*; J: *Jane's 1914*; M: *Movimento commerciale 1897*.

Sources: see text.

Table F.07
Naval Vessels Built in Italy, 1861-1913: Colonial, Protected, and Scout Cruisers

	Displacement (tons)	Construction dates			Source[a]	Estimated construction (years, tons/year)						Ship notes
		laid down	launched	completed								
Amerigo Vespucci	2,705	9.12.79	31.07.82	1.09.84	I	*1879:*	24	*1880-83:*	575	*1884:*	381	
Basilicata	2,778	9.08.13	23.07.14	1.08.17	I	*1913:*	263	*1914-16:*	702	*1917:*	409	
Calabria	2,492	.02.92	20.09.94	12.07.97	I	*1892:*	403	*1893-96:*	460	*1897:*	249	(a)
Campania	2,778	9.08.13	23.07.14	18.04.17	I	*1913:*	284	*1914-16:*	758	*1917:*	220	
Cristoforo Colombo	2,173	.02.73	17.09.75	16.11.76	I	*1873:*	507	*1874-75:*	579	*1876:*	508	(b)
Cristoforo Colombo	2,560	. .90	24.09.92	16.10.94	I	*1890:*	298	*1891-93:*	597	*1894:*	471	
Elba	2,732	22.09.90	12.08.93	1.12.95	I	*1890:*	344	*1891-94:*	486	*1895:*	444	
Etna	3,530	19.01.83	26.09.85	3.12.87	I	*1883:*	694	*1884-86:*	724	*1887:*	664	
Etruria	2,281	1.04.89	23.04.91	11.07.94	I	*1889:*	324	*1890-93:*	431	*1894:*	233	
Ettore Fieramosca	3,595	31.12.85	30.08.88	16.11.89	I	*1885:*	0	*1886-88:*	928	*1889:*	811	
Flavio Gioia	2,760	26.06.79	12.06.81	26.01.83	I,F	*1879:*	386	*1880-82:*	770	*1883:*	64	
Libia	3,800	. .07	11.11.12	25.03.13	I,F	*1907:*	330	*1908-12:*	661	*1913:*	165	(c)
Liguria	2,281	1.07.89	8.06.93	1.12.94	I	*1889:*	211	*1890-93:*	421	*1894:*	386	
Lombardia	2,389	19.11.88	12.07.90	16.02.93	I	*1888:*	70	*1889-92:*	562	*1893:*	71	
Marsala	3,575	15.02.11	24.03.12	4.08.14	I	*1911:*	165	*1912-13:*	1,320	*1914:*	770	
Nino Bixio	3,575	15.02.11	30.12.11	5.05.14	I	*1911:*	182	*1912-13:*	1,454	*1914:*	485	
Puglia	2,538	.10.93	22.09.98	26.05.01	I	*1893:*	69	*1894-00:*	333	*1901:*	138	
Quarto	3,281	11.11.09	19.08.11	11.05.12	I	*1909:*	165	*1910-11:*	1,312	*1912:*	492	
Savoia [Vulcano]	2,853	4.07.80	25.06.83	11.04.85	I	*1880:*	299	*1881-84:*	595	*1885:*	174	
Stromboli	3,450	31.08.84	4.02.86	21.03.88	I	*1884:*	325	*1885-87:*	974	*1888:*	203	
Umbria	2,281	1.08.88	23.04.91	16.02.94	I	*1888:*	171	*1889-93:*	412	*1894:*	50	
Vesuvio	3,427	10.07.83	21.03.86	16.03.88	I	*1883:*	338	*1884-87:*	734	*1888:*	153	
For export:												
Adamastor	1,962	. .	. .96	. .97	B	*1893:*	244	*1894-96:*	491	*1897:*	245	(d)

Table F.07 (continued)

Ship notes:
(a) wood-sheathed.
(b) wood-built; displacement estimated: see text.
(c) laid down as the *Drama*, for the Turkish navy.
(d) to Portugal.

[a]B: *Brassey's 1913*; F: Fraccaroli (1970); I: *Incrociatori*.

Sources: see text.

Table F.08
Naval Vessels Built in Italy, 1861-1913: Despatch Boats, Scouts, and Torpedo Cruisers

	Displacement (tons)	Construction dates			Source[a]	Estimated construction (years, tons/year)						Ship notes
		laid down	launched	completed								
Agordat	1,350	18.02.97	11.10.99	26.09.00	I	*1897:*	327	*1898-99:*	372	*1900:*	279	
Agostino Barbarigo	743	19.08.76	23.01.79	11.07.79	E	*1876:*	96	*1877-78:*	255	*1879:*	137	(a)
Alessandro Poerio	1,131	25.06.13	4.08.14	22.05.15	E	*1913:*	302	*1914:*	603	*1915:*	226	
Archimede	966	1.08.85	8.03.87	6.02.88	E	*1885:*	161	*1886-87:*	386	*1888:*	33	
Aretusa	846	1.06.89	14.03.91	1.09.92	I	*1889:*	152	*1890-91:*	260	*1892:*	174	
Calatafimi [Tersicore]	846	15.09.91	18.03.93	16.01.94	I	*1891:*	106	*1892-93:*	363	*1894:*	14	
Caprera [Clio]	846	27.07.91	6.05.94	12.12.95	I	*1891:*	82	*1892-94:*	193	*1895:*	185	
Cesare Rossarol	1,131	30.06.13	15.08.14	1.08.15	E	*1913:*	271	*1914:*	543	*1915:*	317	
Coatit	1,350	8.04.97	15.11.99	1.10.00	I	*1897:*	277	*1898-99:*	390	*1900:*	293	
Confienza	768	.09.87	28.07.89	11.04.90	I	*1887:*	87	*1888-89:*	297	*1890:*	87	
Euridice	846	14.02.89	22.09.90	1.05.91	I	*1889:*	335	*1890:*	383	*1891:*	128	
Galileo Galilei	966	1.09.85	3.05.87	1.10.88	E	*1885:*	105	*1886-87:*	313	*1888:*	235	
Goito	857	.09.85	6.07.87	16.02.88	I	*1885:*	103	*1886-87:*	355	*1888:*	44	
Guglielmo Pepe	1,131	1.07.13	17.09.14	20.08.15	E	*1913:*	266	*1914:*	532	*1915:*	333	
Iride	846	21.02.89	20.07.91	1.11.92	I	*1889:*	200	*1890-91:*	228	*1892:*	190	
Marcantonio Colonna	782	1.01.77	6.08.79	1.05.80	E	*1877:*	235	*1878-79:*	235	*1880:*	77	
Messaggero	1,021	. .	13.07.85	11.10.88	E	*1884:*	209	*1885-87:*	209	*1888:*	185	
Minerva	846	1.02.89	27.02.92	20.08.92	I	*1889:*	219	*1890-91:*	239	*1892:*	149	
Montebello	814	25.09.85	14.03.88	21.01.89	I	*1885:*	63	*1886-88:*	247	*1889:*	10	
Monzambano	870	25.08.85	14.03.88	11.08.89	I	*1885:*	73	*1886-88:*	220	*1889:*	137	
Partenope	840	8.06.88	23.12.89	11.09.90	I	*1888:*	203	*1889:*	373	*1890:*	264	
Pietro Micca	570	.03.75	1.08.79	. .	A	*1875:*	85	*1876-79:*	108	*1880:*	53	(b)
Rapido	1,523	.10.73	16.11.76	1.05.77	E	*1873:*	90	*1874-76:*	430	*1877:*	143	
Staffetta	1,652	.09.73	24.06.76	1.12.77	E	*1873:*	114	*1874-76:*	393	*1877:*	359	(a)
Tripoli	848	10.06.85	25.08.86	1.12.86	I	*1885:*	315	*1886:*	533			
Urania	846	16.02.89	18.06.91	21.07.93	I	*1889:*	167	*1890-92:*	192	*1893:*	103	
Vedetta	828	. .62	24.10.66	16.04.69	E	*1862:*	61	*1863-68:*	122	*1869:*	35	
For export:												
El-Baschir	1,200	. .92	. .97	. .99	B,M	*1892:*	87	*1893-98:*	171	*1899:*	87	(c)

Table F.08 (continued)

Ship notes:
(a) displacement estimated: see text.
(b) classed as "torpedo launcher."
(c) to Morocco.

[a]A: *Annuario 1884*; B: *Brassey's 1895*; E: *Esploratori*; I: *Incrociatori*; M: *Marina mercantile 1897* and *Movimento commerciale 1899*.

Sources: see text.

Table F.09
Naval Vessels Built in Italy, 1861-1913: Destroyers

	Displacement (tons)	Construction dates			Source[a]	Estimated construction (years, tons/year)						Ship notes
		laid down	launched	completed								
Alpino	395	4.12.05	27.11.09	11.02.10	C	*1905:*	8	*1906-09:*	94	*1910:*	11	
Animoso	780	9.05.12	13.07.13	20.05.14	C	*1912:*	244	*1913:*	390	*1914:*	146	
Antonio Mosto	770	9.10.13	20.05.15	6.07.15	C	*1913:*	110	*1914:*	440	*1915:*	220	
Aquilone	330	10.09.99	16.10.02	12.10.03	C	*1899:*	24	*1900-02:*	81	*1903:*	63	
Ardente	672	4.04.12	15.12.12	5.08.13	C	*1912:*	378	*1913:*	294			
Ardito	672	.02.12	20.10.12	1.11.13	C	*1912:*	344	*1913:*	328			
Artigliere	395	24.07.05	18.01.07	18.09.07	C	*1905:*	101	*1906:*	172	*1907:*	122	
Ascaro	395	. .11	6.12.12	21.07.13	C	*1911:*	55	*1912:*	220	*1913:*	120	(a)
Audace	780	25.04.12	4.05.13	14.03.14	C	*1912:*	277	*1913:*	416	*1914:*	87	
Bersagliere	395	11.07.05	2.10.06	5.06.07	C	*1905:*	97	*1906:*	211	*1907:*	87	
Borea	330	2.10.99	12.12.02	6.10.03	C	*1899:*	20	*1900-02:*	83	*1903:*	61	
Carabiniere	395	7.12.05	12.10.09	26.01.10	C	*1905:*	8	*1906-09:*	95	*1910:*	7	
Corazziere	395	23.10.05	11.12.09	16.05.10	C	*1905:*	14	*1906-09:*	87	*1910:*	33	
Espero	330	. .	9.07.04	1.04.05	C	*1901:*	24	*1902-04:*	94	*1905:*	24	
Folgore	370	. .	29.09.86	16.02.87	T	*1883:*	40	*1884-86:*	106	*1887:*	12	(b)
Francesco Nullo	770	24.09.13	12.11.14	1.05.15	C	*1913:*	122	*1914:*	486	*1915:*	162	
Fuciliere	395	28.10.05	21.08.09	26.01.10	C	*1905:*	15	*1906-09:*	93	*1910:*	8	
Fulmine	298	14.07.97	4.12.98	26.10.00	C	*1897:*	41	*1898-99:*	91	*1900:*	75	
Garibaldino	395	23.10.05	12.02.10	1.06.10	C	*1905:*	15	*1906-09:*	86	*1910:*	36	
Giuseppe Cesare Abba	770	19.08.13	25.05.15	5.07.15	C	*1913:*	154	*1914:*	411	*1915:*	205	
Granatiere	395	24.07.05	27.10.06	5.06.07	C	*1905:*	90	*1906:*	215	*1907:*	90	
Impavido	672	2.01.11	22.03.13	8.11.13	C			*1911-12:*	237	*1913:*	198	
Impetuoso	672	9.12.10	23.07.13	19.05.14	C	*1910:*	8	*1911-13:*	197	*1914:*	73	
Indomito	672	1.06.10	10.05.12	20.01.13	C	*1910:*	149	*1911-12:*	256	*1913:*	11	
Insidioso	672	15.07.12	30.09.13	6.07.14	C	*1912:*	157	*1913:*	343	*1914:*	172	
Intrepido	672	15.06.10	7.08.12	6.02.13	C	*1910:*	139	*1911-12:*	256	*1913:*	21	
Ippolito Nievo	770	19.08.13	24.07.15	31.08.15	C	*1913:*	142	*1914:*	377	*1915:*	251	
Irrequieto	672	7.06.10	12.12.12	5.06.13	C	*1910:*	131	*1911-12:*	224	*1913:*	93	
Lanciere	395	24.07.05	28.02.07	1.08.07	C	*1905:*	83	*1906:*	197	*1907:*	115	
Nembo	330	6.08.99	18.05.01	26.06.02	C	*1899:*	47	*1900-01:*	113	*1902:*	57	
Pilade Bronzetti	770	12.09.13	26.10.15	15.12.15	C	*1913:*	100	*1914:*	342	*1915:*	328	
Pontiere	395	18.11.05	3.01.10	1.04.10	C	*1905:*	12	*1906-09:*	90	*1910:*	23	

Table F.09 (continued)

	Displacement (tons)	Construction dates: laid down	launched	completed	Source[a]	Estimated construction (years, tons/year)						Ship notes
Rosolino Pilo	770	10.08.13	24.03.15	25.05.15	C	*1913:*	161	*1914:*	430	*1915:*	179	
Saetta	370	. .	30.05.87	16.02.88	T	*1884:*	40	*1885-87:*	106	*1888:*	12	(b)
Simone Schiaffino	770	12.09.13	11.09.15	28.10.15	C	*1913:*	106	*1914:*	362	*1915:*	302	
Turbine	330	20.08.99	21.11.01	28.08.02	C	*1899:*	42	*1900-01:*	108	*1902:*	72	
Zeffiro	330	. .	14.05.04	1.04.05	C	*1901:*	24	*1902-04:*	94	*1905:*	24	

Ship notes:
(a) laid down for the Chinese navy, in the second semester of the year.
(b) scout torpedo boat.

[a]C: *Cacciatorpediniere*; T: *Torpediniere*.

Sources: see text.

Table F.10
Naval Vessels Built in Italy, 1861-1913: Submarines

	Displacement (tons)	Construction dates: laid down	launched	completed	Source[a]	Estimated construction (years, tons/year)						Ship notes
Argo	250	26.09.10	14.01.12	6.09.12	S	*1910:*	33	*1911:*	130	*1912:*	87	
Argonauta	255	11.03.13	5.07.14	18.02.15	S	*1913:*	40	*1914:*	191	*1915:*	24	(a)
Balilla	728	18.08.13	8.08.15	8.08.15	S	*1913:*	139	*1914:*	372	*1915:*	217	(b)
Delfino	95	. .89	. .90	29.04.92	F	*1889:*	6	*1890-91:*	38	*1892:*	13	(c)
Fisalia	250	3.10.10	25.02.12	13.09.12	S	*1910:*	32	*1911:*	128	*1912:*	90	
Foca	185	.04.07	8.09.08	15.02.09	S	*1907:*	71	*1908:*	101	*1909:*	13	
Galileo Ferraris	355	2.06.12	9.11.13	5.12.14	S	*1912:*	83	*1913:*	142	*1914:*	130	
Giacinto Pullino	355	2.06.12	21.07.13	12.12.13	S	*1912:*	134	*1913:*	221			
Glauco	160	1.08.03	9.07.05	15.12.05	S	*1903:*	28	*1904:*	67	*1905:*	65	
Jalea	250	10.03.11	3.08.13	1.09.13	S	*1911:*	81	*1912:*	102	*1913:*	67	
Jantina	250	2.08.10	20.11.12	14.05.13	S	*1910:*	37	*1911-12:*	90	*1913:*	33	
Medusa	250	29.05.10	30.07.11	1.06.12	S	*1910:*	73	*1911:*	125	*1912:*	52	
Narvalo	160	. .04	21.10.06	16.05.07	S	*1904:*	28	*1905-06:*	56	*1907:*	20	
Nautilus	225	1.08.11	25.04.13	9.09.13	S	*1911:*	44	*1912:*	106	*1913:*	75	
Nereide	225	1.08.11	12.07.13	20.12.13	S	*1911:*	39	*1912:*	95	*1913:*	91	
Otaria	160	1.05.05	25.03.08	1.07.08	S	*1905:*	34	*1906-07:*	51	*1908:*	24	
Salpa	250	25.08.10	14.05.12	10.09.12	S	*1910:*	41	*1911:*	122	*1912:*	87	
Squalo	160	.01.04	10.06.06	1.09.06	S	*1904:*	58	*1905:*	61	*1906:*	41	
Tricheco	160	6.11.05	6.06.09	15.10.09	S	*1905:*	7	*1906-08:*	40	*1909:*	33	
Velella	250	5.06.10	25.05.11	10.07.12	S	*1910:*	69	*1911:*	118	*1912:*	63	
Zoea	250	18.10.10	2.03.13	10.07.13	S	*1910:*	12	*1911-12:*	94	*1913:*	50	
For export:												
F1	250	. .12	. .14	. .15	B	*1912:*	56	*1913:*	111	*1914:*	83	(d)
F3	250	. .12	. .14	. .15	B	*1912:*	56	*1913:*	111	*1914:*	83	(d)
F5	250	. .12	. .14	. .15	B	*1912:*	56	*1913:*	111	*1914:*	83	(d)
Dikkeren	103	. .	. .	. .09	B	*1907:*	34	*1908:*	46	*1909:*	23	(d)
Espadarte	245	. .	. .	. .12	B	*1910:*	82	*1911:*	109	*1912:*	54	(d)
Hvalen	185	. .	. .08	. .08	B	*1907:*	52	*1908:*	82	*1909:*	51	(g)

Table F.10 (continued)

Ship notes:
(a) laid down for the Russian navy.
(b) laid down for the German navy.
(c) laid down autumn 1889; first sea trials on 29.04.92.
(d) to Brazil; completed in or before the indicated year.
(e) to Denmark.
(f) to Portugal; completed in or before the indicated year.
(g) to Sweden.

[a]B: *Brassey's 1909*, *1912*, *1915*, *1924*; F: Fraccaroli (1970); S: *Sommergibili*.

Sources: see text.

Table F.11
Naval Vessels Built in Italy, 1861-1913: Torpedo Boats

	Displacement (tons)	Construction dates			Source[a]	Estimated construction (years, tons/year)						Ship notes
		laid down	launched	completed								
Acquario [42 T]	39	. .	. .85	. .85	T	*1883:*	10	*1884:*	20	*1885:*	9	
Airone	210	19.04.06	13.05.07	1.09.07	T	*1906:*	108	*1907:*	102			
Albatros	210	18.08.05	22.01.07	1.08.07	T	*1905:*	40	*1906:*	107	*1907:*	63	
Alcione	210	18.08.05	23.09.06	1.08.07	T	*1905:*	40	*1906:*	107	*1907:*	63	
Ardea	210	18.08.05	10.01.07	15.05.07	T	*1905:*	45	*1906:*	120	*1907:*	45	
Arpia	210	8.06.06	22.08.07	16.11.07	T	*1906:*	76	*1907:*	134			
Arturo [38 T]	39	. .	8.10.83	16.03.85	T	*1882:*	10	*1883-84:*	13	*1885:*	3	
Astore	210	19.04.06	22.06.07	5.09.07	T	*1906:*	108	*1907:*	102			
Calipso	210	.01.08	26.04.09	16.07.09	T	*1908:*	134	*1909:*	76			
Calliope	210	29.06.05	27.08.06	22.11.06	T	*1905:*	76	*1906:*	134			
Canopo	210	22.08.05	28.02.07	22.06.07	T	*1905:*	43	*1906:*	115	*1907:*	52	
Cassiopea [43 T]	39	. .	2.03.85	14.08.85	T	*1883:*	7	*1884:*	20	*1885:*	12	
Cassiopea	210	28.04.05	5.07.06	26.09.06	T	*1905:*	99	*1906:*	111			
Castore [44 T]	39	. .	. .85	. .86	T	*1884:*	10	*1885:*	20	*1886:*	9	
Centauro	210	21.06.05	20.12.06	26.05.07	T	*1905:*	58	*1906:*	107	*1907:*	45	
Cigno [47 T]	39	. .	. .85	. .86	T	*1884:*	10	*1885:*	20	*1886:*	9	
Cigno	210	17.04.05	9.05.06	26.09.06	T	*1905:*	102	*1906:*	108			
Climene	210	.01.08	15.05.09	16.08.09	T	*1908:*	127	*1909:*	83			
Clio	27	. .	. .82	. .84	T	*1881:*	5	*1882-83:*	9	*1884:*	4	(a)
Clio	210	27.07.05	26.11.06	17.04.07	T	*1905:*	51	*1906:*	123	*1907:*	36	
Condore	140	. .97	17.09.98	11.06.00	T,F	*1897:*	24	*1898-99:*	47	*1900:*	22	
Gabbiano	162	2.04.06	9.04.07	1.09.07	T	*1906:*	86	*1907:*	76			
Idra [48 T]	39	. .	16.01.86	8.07.86	T	*1884:*	10	*1885:*	20	*1886:*	9	
Lira [39 T]	39	. .	. .84	. .86	T	*1883:*	7	*1884-85:*	13	*1886:*	6	
Olimpia	221	31.03.05	17.07.06	8.04.07	T	*1905:*	81	*1906:*	108	*1907:*	32	
Orfeo	221	31.03.05	23.04.07	6.09.07	T	*1905:*	69	*1906:*	91	*1907:*	61	
Orione	221	31.03.05	23.03.06	8.04.07	T	*1905:*	81	*1906:*	108	*1907:*	32	
Orsa	221	31.03.05	5.05.06	8.04.07	T	*1905:*	81	*1906:*	108	*1907:*	32	
Pallade	210	25.08.04	1.06.06	26.08.06	T	*1904:*	35	*1905:*	105	*1906:*	70	
Pegaso	210	13.08.04	12.08.05	23.09.05	T	*1904:*	70	*1905:*	140			
Pellicano	171	.07.96	7.04.99	11.12.00	T	*1896:*	18	*1897-99:*	39	*1900:*	36	(b)
Perseo	210	10.08.04	5.12.05	26.08.06	T	*1904:*	39	*1905:*	103	*1906:*	68	

Table F.11 (continued)

	Displacement (tons)	Construction dates			Source[a]	Estimated construction (years, tons/year)						Ship notes
		laid down	launched	completed								
Polluce [45 T]	39	. .	. .85	. .86	T	*1884:*	10	*1885:*	20	*1886:*	9	
Procione [37 T]	39	. .	. .85	. .85	T	*1883:*	10	*1884:*	20	*1885:*	9	
Procione	210	23.08.04	16.12.05	26.08.06	T	*1904:*	35	*1905:*	105	*1906:*	70	
Regolo [49 T]	39	. .	16.01.86	8.07.86	T	*1884:*	10	*1885:*	20	*1886:*	9	
Rigel [41 T]	39	. .	2.08.84	30.03.85	T	*1883:*	14	*1884:*	20	*1885:*	5	
Spica [46 T]	39	. .	14.05.85	26.02.86	T	*1884:*	17	*1885:*	20	*1886:*	2	
Vega [36 T]	39	. .	10.11.83	16.03.85	T	*1882:*	10	*1883-84:*	13	*1885:*	3	
1 PN	120	19.02.10	18.01.11	31.05.11	T,F	*1910:*	81	*1911:*	39			
2 PN	120	19.02.10	3.02.11	10.07.11	T,F	*1910:*	74	*1911:*	46			
3 PN	120	19.02.10	24.06.11	31.07.11	T,F	*1910:*	72	*1911:*	48			
4 PN	120	19.02.10	29.06.11	15.09.11	T,F	*1910:*	66	*1911:*	54			
5 PN	120	19.02.10	5.09.11	20.10.11	T,F	*1910:*	63	*1911:*	57			
6 PN	120	19.02.10	6.11.11	11.01.12	T,F	*1910:*	55	*1911:*	63	*1912:*	2	
7 PN	120	13.03.11	18.04.12	4.07.12	T,F	*1911:*	74	*1912:*	46			
8 PN	120	28.03.11	14.05.12	19.08.12	T,F	*1911:*	65	*1912:*	55			
9 PN	120	9.06.11	26.07.12	21.10.12	T,F	*1911:*	49	*1912:*	71			
10 PN	120	30.09.11	18.09.12	7.12.12	T,F	*1911:*	26	*1912:*	94			
11 PN	120	4.11.11	21.11.12	7.03.13	T,F	*1911:*	15	*1912:*	90	*1913:*	15	
12 PN	120	27.02.12	1.01.13	12.04.13	T,F	*1912:*	89	*1913:*	31			
13 OS	120	.11.10	16.11.11	13.03.12	T,F	*1910:*	11	*1911:*	90	*1912:*	19	
14 OS	120	.11.10	5.12.11	1.04.12	T,F	*1910:*	11	*1911:*	87	*1912:*	22	
15 0S	120	.11.10	27.02.12	26.05.12	T,F	*1910:*	10	*1911:*	78	*1912:*	32	
16 0S	120	.11.10	28.03.12	4.06.12	T,F	*1910:*	10	*1911:*	78	*1912:*	32	
17 0S	120	22.12.10	16.04.12	22.07.12	T,F	*1910:*	3	*1911:*	76	*1912:*	41	
18 0S	120	.12.10	7.05.12	22.07.12	T,F	*1910:*	3	*1911:*	76	*1912:*	41	
19 0S	120	.12.10	8.06.12	15.08.12	T,F	*1910:*	3	*1911:*	72	*1912:*	45	
20 0S	120	.01.11	29.06.12	21.01.13	T,F	*1911:*	58	*1912:*	60	*1913:*	2	
21 0S	120	.01.11	25.07.12	22.01.13	T,F	*1911:*	58	*1912:*	60	*1913:*	2	
22 0S	120	.02.11	17.08.12	10.12.12	T,F	*1911:*	57	*1912:*	63			
23 0S	120	.03.11	12.09.12	1.03.13	T,F	*1911:*	49	*1912:*	61	*1913:*	10	
24 0S	120	.03.11	13.09.12	1.03.13	T,F	*1911:*	49	*1912:*	61	*1913:*	10	
25 AS	120	.01.11	15.05.12	11.11.12	T,F	*1911:*	60	*1912:*	60			

Table F.11 (continued)

	Displacement (tons)	Construction dates: laid down	launched	completed	Source[a]	Estimated construction (years, tons/year)						Ship notes
26 AS	120	.01.11	6.07.12	6.03.13	T,F	*1911:*	55	*1912:*	56	*1913:*	9	
27 AS	120	.01.11	5.08.12	28.01.13	T,F	*1911:*	56	*1912:*	59	*1913:*	5	
28 AS	120	.02.11	17.08.12	21.01.13	T,F	*1911:*	54	*1912:*	61	*1913:*	5	
29 AS	120	.02.11	14.09.12	14.02.13	T,F	*1911:*	53	*1912:*	60	*1913:*	7	
30 AS	120	.02.11	12.10.12	9.03.13	T,F	*1911:*	50	*1912:*	58	*1913:*	12	
31 AS	120	.04.11	4.01.13	21.07.15	T,F	*1911:*	20	*1912-14:*	28	*1915:*	16	
32 AS	120	.04.11	17.06.13	1.08.14	T,F	*1911:*	26	*1912-13:*	36	*1914:*	22	
33 PN	120	14.08.12	2.05.13	12.07.13	T,F	*1912:*	49	*1913:*	71			
34 PN	120	30.08.12	1.05.13	30.07.13	T,F	*1912:*	44	*1913:*	76			
35 PN	120	17.10.12	22.05.13	27.08.13	T,F	*1912:*	29	*1913:*	91			
36 PN	120	11.12.12	7.06.13	5.09.13	T,F	*1912:*	7	*1913:*	113			
37 PN	120	13.03.13	29.07.13	25.10.13	T,F	*1913:*	120					
38 PN	120	29.03.13	25.08.13	21.12.13	T,F	*1913:*	120					
50 T	39	. .	. .86	. .86	T	*1884:*	10	*1885:*	20	*1886:*	9	
51 T	39	. .	8.04.86	10.11.87	T	*1885:*	2	*1886:*	20	*1887:*	17	
52 T	39	. .	.05.86	3.07.87	T	*1885:*	10	*1886:*	20	*1887:*	9	
53 T	39	. .	. .87	11.07.88	T	*1886:*	9	*1887:*	20	*1888:*	10	
54 T	39	. .	26.06.86	11.05.87	T	*1885:*	12	*1886:*	20	*1887:*	7	
55 T	39	. .	21.07.86	16.05.87	T	*1885:*	12	*1886:*	20	*1887:*	7	
56 S [80 S]	80	26.11.86	5.05.88	14.07.88	T	*1886:*	4	*1887:*	49	*1888:*	27	
56 T [80 T]	44	16.01.86	. .88	11.07.88	T	*1886:*	17	*1887:*	18	*1888:*	9	
57 T [81 T]	44	16.01.86	24.09.87	11.07.88	T	*1886:*	17	*1887:*	18	*1888:*	9	
58 T [82 T]	44	16.01.86	16.02.87	11.07.88	T	*1886:*	17	*1887:*	18	*1888:*	9	
59 T [83 T]	44	16.01.86	. .87	16.06.88	T	*1886:*	17	*1887:*	18	*1888:*	9	
60 S	80	16.11.85	10.04.88	10.05.88	T	*1885:*	4	*1886-87:*	32	*1888:*	12	
61 S	80	16.11.85	15.03.88	1.10.88	T	*1885:*	3	*1886-87:*	28	*1888:*	21	
62 S	80	16.11.85	. .88	3.09.88	T	*1885:*	1	*1886-87:*	30	*1888:*	19	
63 S	80	16.11.85	14.07.88	10.11.88	T	*1885:*	1	*1886-87:*	27	*1888:*	25	
64 S	80	15.05.86	19.10.88	1.05.89	T	*1886:*	17	*1887-88:*	27	*1889:*	9	
65 S	80	15.05.86	6.01.89	16.07.89	T	*1886:*	16	*1887-88:*	25	*1889:*	14	
66 S	80	28.11.85	. .88	10.11.88	T	*1885:*	2	*1886-87:*	27	*1888:*	24	
67 S	80	28.11.85	. .88	18.12.88	T	*1885:*	3	*1886-87:*	26	*1888:*	25	

Table F.11 (continued)

	Displacement (tons)	Construction dates			Source[a]	Estimated construction (years, tons/year)						Ship notes
		laid down	launched	completed								
68 S	80	2.11.85	23.08.87	16.10.88	T	*1885:*	5	*1886-87:*	27	*1888:*	21	
69 S	80	2.11.85	. .88	15.09.88	T	*1885:*	5	*1886-87:*	28	*1888:*	19	
70 S	80	2.11.85	. .88	1.11.88	T	*1885:*	4	*1886-87:*	27	*1888:*	22	
71 S	80	2.11.85	3.04.88	16.09.88	T	*1885:*	5	*1886-87:*	28	*1888:*	19	
72 S	80	28.10.85	. .88	1.10.88	T	*1885:*	5	*1886-87:*	27	*1888:*	21	
73 S	80	28.10.85	15.08.88	1.12.88	T	*1885:*	4	*1886-87:*	26	*1888:*	24	
74 S	80	28.10.85	. .88	1.12.88	T	*1885:*	4	*1886-87:*	26	*1888:*	24	
75 S	80	28.10.85	12.09.88	1.12.88	T	*1885:*	4	*1886-87:*	26	*1888:*	24	
78 YA	110	3.10.85	27.11.94	21.10.95	T	*1885:*	3	*1886-94:*	11	*1895:*	8	
79 YA	110	3.10.85	23.03.95	27.04.96	T	*1885:*	5	*1886-95:*	10	*1896:*	5	
86 S	80	26.11.86	5.05.88	1.10.88	T	*1886:*	4	*1887:*	44	*1888:*	32	
87 S	80	26.11.86	. .88	6.12.88	T	*1886:*	3	*1887:*	40	*1888:*	37	
88 S	80	26.11.86	11.07.88	23.11.88	T	*1886:*	3	*1887:*	40	*1888:*	37	
89 S	80	26.11.86	10.07.88	21.01.89	T	*1886:*	3	*1887-88:*	38	*1889:*	1	
90 S	80	26.11.86	26.08.88	1.12.88	T	*1886:*	3	*1887:*	40	*1888:*	37	
91 S	80	26.11.86	. .88	1.08.89	T	*1886:*	3	*1887-88:*	30	*1889:*	17	
92 S	80	26.11.86	. .88	18.03.89	T	*1886:*	3	*1887-88:*	35	*1889:*	7	
93 S	80	6.12.86	. .87	1.10.88	T	*1886:*	4	*1887:*	44	*1888:*	32	
94 S	80	6.12.86	. .87	11.03.88	T	*1886:*	5	*1887:*	62	*1888:*	13	
95 S	80	6.12.86	11.01.88	6.03.88	T	*1886:*	5	*1887:*	64	*1888:*	11	
96 S	80	6.12.86	. .88	12.07.88	T	*1886:*	4	*1887:*	49	*1888:*	27	
97 S	80	6.12.86	. .88	14.06.88	T	*1886:*	4	*1887:*	52	*1888:*	24	
98 S	80	6.12.86	11.03.88	12.07.88	T	*1886:*	4	*1887:*	49	*1888:*	27	
105 S	80	. .	5.11.92	20.11.92	T	*1890:*	5	*1891:*	40	*1892:*	35	
112 S	80	4.04.89	. .89	26.08.90	T	*1889:*	42	*1890:*	38			
113 S	80	4.04.89	31.03.90	17.12.90	T	*1889:*	35	*1890:*	45			
114 S	80	4.04.89	. .90	8.01.91	T	*1889:*	34	*1890:*	46	*1891:*	0	
115 S	80	4.04.89	. .90	8.12.90	T	*1889:*	36	*1890:*	44			
116 S	80	2.04.89	. .90	16.06.90	T	*1889:*	50	*1890:*	30			
117 S	80	2.04.89	. .90	28.07.90	T	*1889:*	45	*1890:*	35			
118 S	80	2.04.89	. .90	21.08.90	T	*1889:*	44	*1890:*	36			
119 S	80	2.04.89	. .90	18.09.90	T	*1889:*	41	*1890:*	39			

Table F.11 (continued)

	Displacement (tons)	Construction dates: laid down	launched	completed	Source[a]	Estimated construction (years, tons/year)						Ship notes
120 S	80	4.04.89	. .90	1.06.90	T	*1889:*	51	*1890:*	29			
121 S	80	4.04.89	. .90	18.05.90	T	*1889:*	53	*1890:*	27			
122 S	80	4.04.89	. .90	1.06.90	T	*1889:*	51	*1890:*	29			
123 S	80	4.04.89	. .90	26.07.90	T	*1889:*	45	*1890:*	35			
124 S	80	1.04.90	. .91	17.11.91	T	*1890:*	37	*1891:*	43			
125 S	80	1.04.90	. .91	8.01.92	T	*1890:*	34	*1891:*	46			
126 S	80	1.04.90	. .91	25.03.92	T	*1890:*	30	*1891:*	40	*1892:*	10	
127 S	80	1.07.90	. .91	23.04.92	T	*1890:*	22	*1891:*	45	*1892:*	13	
128 S	80	2.04.90	. .91	1.12.91	T	*1890:*	36	*1891:*	44			
129 S	80	2.04.90	. .91	1.12.91	T	*1890:*	36	*1891:*	44			
130 S	80	2.04.90	. .92	15.02.92	T	*1890:*	32	*1891:*	43	*1892:*	5	
131 S	80	2.04.90	. .92	31.03.92	T	*1890:*	30	*1891:*	40	*1892:*	10	
132 S	80	. .	. .91	1.12.91	T	*1889:*	3	*1890:*	40	*1891:*	37	
133 S	80	. .	. .91	1.12.91	T	*1889:*	3	*1890:*	40	*1891:*	37	
134 S	80	. .	. .91	1.12.91	T	*1889:*	3	*1890:*	40	*1891:*	37	
135 S	80	. .	. .91	1.12.91	T	*1889:*	3	*1890:*	40	*1891:*	37	
136 S	80	. .	10.12.92	16.12.92	T	*1890:*	35	*1891:*	40	*1892:*	5	
137 S	80	23.06.91	1.02.93	1.02.93	T	*1891:*	25	*1892:*	51	*1893:*	4	
138 S	80	23.06.91	5.03.93	5.03.93	T	*1891:*	24	*1892:*	48	*1893:*	8	
139 S	80	. .	. .92	23.08.92	T	*1890:*	13	*1891:*	40	*1892:*	27	
140 S	80	. .	. .92	10.11.92	T	*1890:*	5	*1891:*	40	*1892:*	35	
141 S	80	. .	. .92	20.11.92	T	*1890:*	5	*1891:*	40	*1892:*	35	
142 S	80	2.07.91	. .93	9.01.93	T	*1891:*	26	*1892:*	52	*1893:*	2	
143 S	80	2.07.91	. .93	20.02.93	T	*1891:*	25	*1892:*	49	*1893:*	6	
144 S	80	2.07.91	. .93	23.03.93	T	*1891:*	23	*1892:*	47	*1893:*	10	
145 S	80	. .	. .92	10.11.92	T	*1890:*	5	*1891:*	40	*1892:*	35	
146 s	80	. .	5.11.92	20.11.92	T	*1890:*	5	*1891:*	40	*1892:*	35	
147 S	80	. .	1.09.94	5.10.94	T	*1892:*	10	*1893:*	40	*1894:*	30	
148 S	80	. .	8.10.94	12.10.94	T	*1892:*	8	*1893:*	40	*1894:*	32	
149 S	80	. .	26.12.94	16.02.95	T	*1893:*	35	*1894:*	40	*1895:*	5	
150 S	80	. .	31.01.95	4.02.95	T	*1893:*	37	*1894:*	40	*1895:*	3	
151 S	80	. .	. .94	26.07.94	T	*1892:*	17	*1893:*	40	*1894:*	23	

Table F.11 (continued)

	Displacement (tons)	Construction dates: laid down	launched	completed	Source[a]	Estimated construction (years, tons/year)						Ship notes
152 S	80	. .	. .94	. .94	T	*1892:*	20	*1893:*	40	*1894:*	20	
153 S	80	. .	13.03.94	.03.94	T	*1892:*	32	*1893:*	40	*1894:*	8	
154 S [117 S]	80	. .	9.05.94	12.07.94	T	*1892:*	18	*1893:*	40	*1894:*	22	
For export:												
A. B.	145	. .	. .01	. .	B	*1899:*	36	*1900:*	73	*1901:*	36	(c)
Ac-Hisar	165	. .	. .04	. .	B	*1902:*	41	*1903:*	83	*1904:*	41	(c)
Angora	165	. .	. .06	. .06	B,M	*1904:*	41	*1905:*	83	*1906:*	41	(c)
Antalia	165	. .	. .06	. .06	B,M	*1904:*	41	*1905:*	83	*1906:*	41	(c)
Deradj	165	. .	. .06	. .06	B,M	*1904:*	41	*1905:*	83	*1906:*	41	(c)
Eliagot	165	. .	. .04	. .	B	*1902:*	41	*1903:*	83	*1904:*	41	(c)
Kulahia	165	. .	. .06	. .06	B,M	*1904:*	41	*1905:*	83	*1906:*	41	(c)
Mossul	165	. .	. .06	. .06	B,M	*1904:*	41	*1905:*	83	*1906:*	41	(c)
Tokat	165	. .	. .06	. .06	B,M	*1904:*	41	*1905:*	83	*1906:*	41	(c)
Urffa	165	. .	. .06	. .06	B,M	*1904:*	41	*1905:*	83	*1906:*	41	(c)

Ship notes:
(a) in service 1885; completed for the Torino exhibition, 1884.
(b) displacement estimated: see text.
(c) to Turkey.

[a]B: *Brassey's 1911*; F: Fraccaroli (1970); M: *Movimento commerciale 1906*; T: *Torpediniere*.

Sources: see text.

Table F.12
Naval Vessels Built in Italy, 1861-1913: Gunboats

	Displacement (tons)	Construction dates: laid down	launched	completed	Source[a]	Estimated construction (years, tons/year)						Ship notes
Alfredo Cappellini [Impavida]	642	. .67	. .68	. .70	S	*1867:*	86	*1868-69:*	171	*1870:*	86	(a)
Andrea Provana	649	. .	. .84	. .85	S	*1882:*	108	*1883-84:*	216	*1885:*	109	
Audace	642	. .70	. .71	. .71	S	*1870:*	257	*1871:*	257			(a)
Brondolo	117	14.01.08	4.12.09	6.12.09	F	*1908:*	60	*1909:*	57			
Curtatone	1,292	. .85	. .88	. .90	S	*1885:*	130	*1886-89:*	258	*1890:*	130	
Faà di Bruno [Temeraria]	642	. .69	. .69	. .70	S	*1869:*	257	*1870:*	257			(a)
Governolo	1,222	. .91	. .94	. .94	S	*1891:*	204	*1892-93:*	407	*1894:*	204	
Guardiano	265	.05.72	1.05.74	. .76	A,N	*1872:*	40	*1873-75:*	64	*1876:*	33	
Guerriera	1,850	. .64	. .66	. .68	S	*1864:*	185	*1865-67:*	370	*1868:*	185	(b)
Marghera	113	14.01.08	29.03.09	11.07.09	F	*1908:*	72	*1909:*	41			
Risoluta	642	. .68	. .68	. .69	S	*1868:*	257	*1869:*	257			(c)
Sebastiano Caboto	877	2.03.11	20.07.12	23.11.12	F	*1911:*	429	*1912:*	448			
Sebastiano Veniero	649	. .	. .84	. .85	S	*1882:*	108	*1883-84:*	216	*1885:*	109	
Sentinella	265	.05.72	31.12.74	. .75	A,N	*1872:*	52	*1873-74:*	85	*1875:*	43	
Volturno	1,056	. .86	. .87	. .89	S	*1886:*	176	*1887-88:*	352	*1889:*	176	
Voragine	1,850	. .64	. .66	. .69	S	*1864:*	148	*1865-68:*	296	*1869:*	148	(b)
For export:												
?	160	. .96	. .00	. .04	B	*1896:*	10	*1897-03:*	20	*1904:*	10	(d)
?	160	. .96	. .00	. .04	B	*1896:*	10	*1897-03:*	20	*1904:*	10	(d)
Bravo	1,200	. .	. .04	. .05	B,M	*1903:*	300	*1904:*	600	*1905:*	300	(e)
Morelos	1,200	. .	. .04	. .05	B,M	*1903:*	300	*1904:*	600	*1905:*	300	(e)
Progreso	1,590	. .04	. .	. .06	B,J,M	*1904:*	400	*1905:*	800	*1906:*	390	(f)
?	450	. .	. .99	. .00	B	*1898:*	113	*1899:*	225	*1900:*	112	(g)

Table F.12 (continued)

Ship notes:
(a) armored
(b) armored floating battery; wood-built.
(c) armored; wood-built.
(d) to Bulgaria.
(e) to Mexico.
(f) to Mexico; cruiser-transport.
(g) to Morocco; dates estimated: see text.

[a]A: *Annuario 1878, 1881;* B: *Brassey's 1895* to *1913*; *1915*, *1924*; F: Fraccaroli (1970); J: *Jane's 1914*; M: *Movimento commerciale 1905, 1906*; N: *Annuario navale 1897*; S: *Almanacco navale*.

Sources: see text.

Table F.13
Naval Vessels Built in Italy, 1861-1913: Tugs

	Displacement (tons)	Construction dates: laid down	launched	completed	Source[a]	Estimated construction (years, tons/year)						Ship notes
Atlante	813	. .89	12.05.92	13.05.92	F,S	*1889:*	143	*1890-91:*	286	*1892:*	98	
Calatafimi	270	.06.64	18.01.66	. .66	A,S	*1864:*	71	*1865:*	132	*1866:*	67	(a)
Cariddi	1,050	.08.72	22.03.75	. .76	A,S	*1872:*	105	*1873-75:*	270	*1876:*	135	(a)
Ciclope	840	15.03.00	15.07.02	14.05.03	F	*1900:*	205	*1901-02:*	266	*1903:*	103	
Ercole	813	. .89	27.02.92	28.02.92	F,S	*1889:*	153	*1890-91:*	306	*1892:*	48	
Ischia	135	. .11	. .13	. .13	S	*1911:*	34	*1912:*	67	*1913:*	34	
Laguna	152	.11.66	28.04.68	. .69	A,N	*1866:*	7	*1867-68:*	58	*1869:*	29	(a)
Luni	448	. .13	. .14	. .14	S	*1913:*	224	*1914:*	224			
Mestre	272	.02.71	25.03.74	. .74	A,N	*1871:*	72	*1872-73:*	80	*1874:*	40	(a)
Murano	270	.02.71	29.09.74	. .75	A,N	*1871:*	60	*1872-74:*	70			(a)
N.1	73	. .	. .86	. .86	S	*1884:*	18	*1885:*	36	*1886:*	19	
N.2	60	. .	. .86	. .86	S	*1884:*	15	*1885:*	30	*1886:*	15	
N.3	43	. .	. .86	. .86	S	*1884:*	11	*1885:*	22	*1886:*	10	
N.4	30	. .	. .86	. .87	S	*1885:*	8	*1886:*	15	*1887:*	7	
N.5	53	. .	. .87	. .88	S	*1886:*	13	*1887:*	27	*1888:*	13	
N.5	99	. .	. .13	. .13	S	*1911:*	25	*1912:*	50	*1913:*	24	
N.6	53	. .	. .87	. .88	S	*1886:*	13	*1887:*	27	*1888:*	13	
N.7	52	. .	. .87	. .88	S	*1886:*	13	*1887:*	26	*1888:*	13	
N.8	30	. .	. .87	. .88	S	*1886:*	8	*1887:*	15	*1888:*	7	
N.9	49	. .	. .88	. .89	S	*1887:*	12	*1888:*	25	*1889:*	12	
N.9	99	. .	. .13	. .13	S	*1911:*	25	*1912:*	50	*1913:*	24	
N.12	61	. .	. .88	. .89	S	*1887:*	15	*1888:*	31	*1889:*	15	
N.13	62	. .	. .89	. .90	S	*1888:*	15	*1889:*	31	*1890:*	16	
N.14	60	. .	. .88	. .92	S	*1887:*	6	*1888-91:*	12	*1892:*	6	
N.15	58	. .	. .89	. .89	S	*1887:*	15	*1888:*	29	*1889:*	14	
N.19	34	. .	. .09	. .09	S	*1907:*	8	*1908:*	17	*1909:*	9	
N.21 [San Paolo]	120	. .	. .	. .93	S	*1891:*	30	*1892:*	60	*1893:*	30	
N.21	27	. .	. .09	. .09	S	*1907:*	6	*1908:*	14	*1909:*	7	

Table F.13 (continued)

	Displacement (tons)	Construction dates laid down	launched	completed	Source[a]	Estimated construction (years, tons/year)						Ship notes
N.22 [Maddalena]	120	. .	. .	. .93	S	*1891:*	30	*1892:*	60	*1893:*	30	
N.22	99	. .	. .13	. .14	S	*1912:*	25	*1913:*	50	*1914:*	24	
N.23 [Palmaria]	120	. .	. .	. .94	S	*1892:*	30	*1893:*	60	*1894:*	30	
N.23	99	. .	. .13	. .14	S	*1912:*	25	*1913:*	50	*1914:*	24	
N.24 [Tino]	120	. .	. .93	. .93	S	*1891:*	30	*1892:*	60	*1893:*	30	
N.24	77	. .	. .11	. .11	S	*1909:*	19	*1910:*	39	*1911:*	19	
N.26 [Rialto]	124	. .	. .	. .01	S	*1899:*	31	*1900:*	62	*1901:*	31	
N.26	77	. .	. .11	. .11	S	*1909:*	19	*1910:*	39	*1911:*	19	
N.27 [Lido]	230	1.10.02	23.07.08	23.07.08	F	*1902:*	9	*1903-07:*	40	*1908:*	21	
N.27	77	. .	. .11	. .11	S	*1909:*	19	*1910:*	39	*1911:*	19	
N.28 [Capri]	128	. .	. .02	. .03	S	*1901:*	32	*1902:*	64	*1903:*	32	
N.28	77	. .	. .11	. .11	S	*1909:*	19	*1910:*	39	*1911:*	19	
N.29 [Capraia]	128	. .	. .03	. .03	S	*1901:*	32	*1902:*	64	*1903:*	32	
N.29	77	. .	. .11	. .12	S	*1910:*	19	*1911:*	39	*1912:*	19	
N.30	87	. .	. .07	. .08	S	*1906:*	22	*1907:*	44	*1908:*	21	
N.31	87	. .	. .08	. .08	S	*1906:*	22	*1907:*	44	*1908:*	21	
N.32	87	. .	. .08	. .08	S	*1906:*	22	*1907:*	44	*1908:*	21	
N.33	99	. .	. .13	. .14	S	*1912:*	25	*1913:*	50	*1914:*	24	
N.34	99	. .	. .13	. .14	S	*1912:*	25	*1913:*	50	*1914:*	24	
Nisida	135	. .11	. .12	. .12	S	*1911:*	67	*1912:*	68			
Ponza	135	. .	. .13	. .14	S	*1912:*	34	*1913:*	67	*1914:*	34	
Porto d'Anzio	157	. .	6.06.14	29.10.14	F	*1912:*	24	*1913:*	79	*1914:*	54	
Porto Empedocle	360	. .	. .13	. .14	S	*1912:*	90	*1913:*	180	*1914:*	90	
Procida	135	. .11	. .12	. .13	S	*1911:*	34	*1912:*	67	*1913:*	34	
Rondine	117	6.03.69	16.02.71	. .72	A,N	*1869:*	25	*1870-71:*	37	*1872:*	18	(a)
Sant'Andrea	146	. .08	. .11	. .11	S	*1908:*	24	*1909-10:*	49	*1911:*	24	
Scilla	1,076	.08.72	10.10.74	. .76	A,N	*1872:*	107	*1873-75:*	277	*1876:*	138	(a)
Titano	788	15.02.11	7.07.12	8.04.13	F	*1911:*	323	*1912:*	366	*1913:*	99	
Ventotene	135	. .	. .13	. .14	S	*1912:*	34	*1913:*	67	*1914:*	34	

Table F.13 (continued)

	Displacement (tons)	Construction dates: laid down	launched	completed	Source[a]	Estimated construction (years, tons/year)						Ship notes
For export:												
Lynce	200	. .	.	.11	. .	M	*1910:*	50	*1911:*	100	*1912:*	50	(b)

Ship notes:
(a) wood-built.
(b) to Portugal; displacement estimated: see text.

[a]A: *Annuario 1878*, *1884*; F: Fraccaroli (1970); M: *Marina mercantile 1911*; N: *Annuario navale 1897*; S: *Almanacco navale*.

Sources: see text.

Table F.14
Naval Vessels Built in Italy, 1861-1913: Bulk Transports

	Displacement (tons)	Construction dates: laid down	launched	completed	Source[a]	Estimated construction (years, tons/year)						Ship notes
Adda	281	1.02.13	17.10.13	8.01.14	F	*1913:*	269	*1914:*	12			
Adige	78	. .	. .85	. .86	S	*1884:*	19	*1885:*	40	*1886:*	19	
Anapo	76	. .08	. .09	. .11	S	*1908:*	13	*1909-10:*	25	*1911:*	13	
Aniene	281	1.02.13	21.11.13	20.06.14	F	*1913:*	182	*1914:*	99			
Arno	78	. .	. .90	. .90	S	*1888:*	19	*1889:*	40	*1890:*	19	
Aterno	281	1.03.13	20.01.14	21.01.14	F	*1913:*	269	*1914:*	12			
Betta N.2	580	. .	. .	. .94	N	*1892:*	145	*1893:*	290	*1894:*	145	
Betta N.3	580	. .	. .	. .93	N	*1891:*	145	*1892:*	290	*1893:*	145	
Betta N.4	444	. .	. .	. .89	N	*1887:*	111	*1888:*	222	*1889:*	111	
Betta N.5	570	. .	. .	. .94	N	*1892:*	142	*1893:*	285	*1894:*	143	
Betta N.7	444	. .	. .	. .90	N	*1888:*	111	*1889:*	222	*1890:*	111	
Betta N.10	470	. .	. .	. .	N	*1884:*	117	*1885:*	235	*1886:*	118	
Betta N.11	470	. .	. .	. .86	N	*1884:*	117	*1885:*	235	*1886:*	118	
Betta N.12	470	. .	. .	. .	A	*1884:*	117	*1885:*	235	*1886:*	118	
Bisagno	78	. .	. .85	. .86	S	*1884:*	19	*1885:*	40	*1886:*	19	
Bormida	86	. .	. .98	. .99	S	*1897:*	21	*1898:*	43	*1899:*	22	
Brembo	281	1.03.13	31.01.14	1.03.14	F	*1913:*	238	*1914:*	43			
Brenta	175	. .	. .	11.08.93	F	*1891:*	34	*1892:*	87	*1893:*	54	
Bronte	9,490	1.10.03	11.09.04	1.02.06	F	*1903:*	949	*1904-05:*	4,113	*1906:*	315	
Crati	171	. .04	. .04	. .05	S	*1904:*	86	*1905:*	85			
Dora	175	. .	. 5.94	24.12.95	F	*1894:*	88	*1895:*	87			
Eridano	1,260	1.02.10	28.05.11	29.09.11	F	*1910:*	630	*1911:*	630			
Foce	281	1.02.13	19.12.13	17.02.14	F	*1913:*	250	*1914:*	31			
Liri	175	. .	. 5.94	14.10.94	F	*1892:*	17	*1893:*	87	*1894:*	71	
Magra	78	. .	. .85	. .86	S	*1884:*	19	*1885:*	40	*1886:*	19	
Malaussena	444	. .	. .	. .	N	*1888:*	111	*1889:*	222	*1890:*	111	
Mincio	120	. .89	. .90	. .90	S	*1889:*	60	*1890:*	60			
Nera	281	1.03.13	14.03.14	9.08.14	F	*1913:*	163	*1914:*	118			
Ofanto	281	1.03.13	14.03.14	2.06.14	F	*1913:*	187	*1914:*	94			
Oristano	281	1.02.13	17.10.13	16.04.14	F	*1913:*	218	*1914:*	63			
Pagano	390	.05.76	12.07.77	15.04.78	F,A,N	*1876:*	127	*1877:*	207	*1878:*	56	
Piave	77	. .08	. .08	. .10	S	*1908:*	19	*1909:*	39	*1910:*	19	

Table F.14 (continued)

	Displacement (tons)	Construction dates: laid down	launched	completed	Source[a]	Estimated construction (years, tons/year)						Ship notes
Po	175	. .	7.10.94	11.11.94	F	*1892:*	10	*1893:*	88	*1894:*	77	
Polcevera	175	. .	. .	. .95	S	*1893:*	44	*1894:*	87	*1895:*	44	
Sarno	78	. .	. .88	. .89	S	*1887:*	19	*1888:*	40	*1889:*	19	
Sebeto	78	. .	. .87	. .88	S	*1886:*	19	*1887:*	40	*1888:*	19	
Sile	175	. .	. .94	22.01.95	F	*1893:*	84	*1894:*	87	*1895:*	4	
Simeto	171	. .	. .04	. .05	S	*1904:*	86	*1905:*	85			
Sterope	9,500	. .04	15.01.05	18.11.06	F	*1904:*	1,992	*1905:*	3,984	*1906:*	3,524	
Tanaro	78	. .	. .87	. .89	S	*1887:*	19	*1888:*	40	*1889:*	19	
Tevere	960	. .	23.08.97	6.02.98	F	*1896:*	443	*1897:*	480	*1898:*	37	
Ticino	120	. .89	. .89	. .90	S	*1889:*	60	*1890:*	60			
Tronto	120	. .89	. .89	. .90	S	*1889:*	60	*1890:*	60			
Velino	171	. .	. .00	. .01	S	*1899:*	43	*1900:*	85	*1901:*	43	
Verde	390	.05.76	12.07.77	21.03.79	F,A	*1876:*	85	*1877-78:*	139	*1879:*	27	
Viterbo	470	. .	. .	. .86	N	*1884:*	117	*1885:*	235	*1886:*	118	

Ship notes: (none)

[a]A: *Annuario 1881*, *1884*, *1895*; F: Fraccaroli (1970); N: *Annuario navale 1897*, *1914*; S: *Almanacco navale*.

Sources: see text.

Table F.15
Naval Vessels Built in Italy, 1861-1913: Other Auxiliaries

	Displacement (tons)	Construction dates: laid down	launched	completed	Source[a]	Estimated construction (years, tons/year)						Ship notes
Ammiraglio Magnaghi	1,506	28.05.13	10.08.14	16.11.14	F	*1913:*	594	*1914:*	912			
Castore	530	12.06.88	. .88	23.12.89	F	*1888:*	186	*1889:*	344			
Chioggia	533	.09.76	6.11.77	. .78	A,N	*1876:*	81	*1877:*	301	*1878:*	151	(a)
Città di Genova	3,740	1.10.63	3.05.65	. .66	A,S	*1863:*	316	*1864-65:*	1,370	*1866:*	684	(a)
Città di Napoli	3,733	.10.63	11.04.65	. .66	A,S	*1863:*	266	*1864-65:*	1,387	*1866:*	693	(a)
Diligente	30	. .82	. .83	. .83	S	*1882:*	15	*1883:*	15			(a)
Gorgona	196	1.10.64	8.06.67	. .68	A,N	*1864:*	12	*1865-67:*	53	*1868:*	25	(a)
Ischia	196	1.10.64	.01.67	. .68	A,S	*1864:*	12	*1865-67:*	53	*1868:*	25	(a)
Marittimo	196	1.10.64	.01.67	. .68	A,N	*1864:*	12	*1865-67:*	53	*1868:*	25	(a)
Miseno	554	. .	3.07.86	16.06.87	F	*1884:*	17	*1885-86:*	218	*1887:*	101	
Palinuro	554	. .86	7.09.87	21.01.89	F,S	*1886:*	109	*1887-88:*	218	*1889:*	9	
Polluce	530	. .	. .88	. .91	S	*1888:*	88	*1889-90:*	177	*1891:*	88	
Tino	196	1.10.64	31.07.67	. .68	A,N	*1864:*	12	*1865-67:*	53	*1868:*	25	(a)
Tremiti	196	1.10.64	11.07.67	. .69	A,N	*1864:*	11	*1865-68:*	41	*1869:*	21	(a)
Vigilante	30	. .83	. .83	. .84	S	*1882:*	8	*1883:*	15	*1884:*	7	(a)
Vulcano	276	.09.76	.06.77	. .	A	*1876:*	37	*1877:*	138	*1878:*	101	
For export:												
Ceara	3,800	. .13	. .	. .15	B	*1913:*	950	*1914:*	1,900	*1915:*	950	(b)

Ship notes:
(a) wood-built.
(b) submarine tender; to Brazil.

[a]A: *Annuario 1878*, *1881*, *1884*; B: *Brassey's 1913*, *1915*; F: Fraccaroli (1970); N: *Annuario navale 1897;* S: *Almanacco navale*.

Sources: see text.

Table F.16
Estimated Construction of Seagoing Naval Vessels, 1861-1913 (displacement tons)

Year	(1) Armored frigates 1861-1913	(2) Frigates, corvettes 1861-1913	(3) Battle-ships 1861-1913	(4) Armored cruisers 1861-1913	(5) Colonial, protected, and scout cruisers 1861-1913	(6) Despatch boats, scouts, torpedo cruisers 1861-1913	(7) Destroyers 1861-1913
1861	2,136	2,887	0	0	0	0	0
1862	2,679	2,472	0	0	0	61	0
1863	4,292	2,066	0	0	0	122	0
1864	3,555	1,197	0	0	0	122	0
1865	3,657	851	0	0	0	122	0
1866	3,999	458	0	0	0	122	0
1867	3,659	645	0	0	0	122	0
1868	2,825	833	0	0	0	122	0
1869	2,243	833	0	0	0	35	0
1870	2,243	681	0	0	0	0	0
1871	2,224	146	0	0	0	0	0
1872	1,796	0	0	0	0	0	0
1873	1,367	0	1,844	0	507	204	0
1874	1,197	0	2,926	0	579	823	0
1875	276	0	2,926	0	579	908	0
1876	0	0	3,878	0	508	1,027	0
1877	0	0	5,712	0	0	1,100	0
1878	0	0	5,712	0	0	598	0
1879	0	0	5,712	0	410	480	0
1880	0	0	4,041	0	1,644	130	0
1881	0	0	4,804	0	1,940	0	0
1882	0	0	7,332	0	1,940	0	0
1883	0	0	7,018	0	2,266	0	40
1884	0	0	8,694	0	2,759	209	146
1885	0	0	9,629	0	2,606	1,029	212
1886	0	0	9,685	0	3,360	2,263	212
1887	0	0	9,204	0	3,300	1,817	118
1888	0	0	8,274	0	1,525	1,464	12
1889	0	0	5,799	0	2,320	1,890	0
1890	0	0	5,355	1,008	2,468	1,653	0
1891	0	0	4,761	1,008	2,909	1,235	0
1892	0	0	4,170	1,113	3,312	1,348	0
1893	0	0	3,801	3,505	3,191	830	0
1894	0	0	4,617	4,937	2,910	378	0
1895	0	0	3,320	8,893	1,728	356	0
1896	0	0	2,736	11,597	1,284	171	0
1897	0	0	2,736	11,690	827	775	41
1898	0	0	3,045	9,167	333	933	91
1899	0	0	7,083	8,250	333	849	224
1900	0	0	7,255	7,804	333	572	460
1901	0	0	10,490	3,241	138	0	433
1902	0	0	11,294	7,147	0	0	481
1903	0	0	10,060	9,636	0	0	312
1904	0	0	11,629	1,568	0	0	188
1905	0	0	10,225	4,813	0	0	491
1906	0	0	8,866	6,582	0	0	1,340
1907	0	0	8,293	10,431	330	0	959
1908	0	0	5,168	11,660	661	0	545
1909	0	0	3,138	10,143	826	0	545
1910	0	0	12,991	6,096	1,973	0	545
1911	0	0	22,352	1,449	2,320	0	1,225
1912	0	0	32,592	0	3,927	0	2,790
1913	0	0	30,065	0	3,486	839	3,306

Table F.16 (continued)

Year	(8) Submarines 1861-1913	(9) Torpedo boats 1861-1913	(10) Gunboats 1861-1913	(11) Tugs 1861-1913	(12) Bulk transports 1861-1913	(13) Other auxiliary vessels 1861-1913
1861	0	0	0	0	0	0
1862	0	0	0	0	0	0
1863	0	0	0	0	0	582
1864	0	0	333	71	0	2,816
1865	0	0	666	132	0	3,010
1866	0	0	666	74	0	1,630
1867	0	0	752	58	0	253
1868	0	0	909	58	0	141
1869	0	0	833	54	0	21
1870	0	0	600	37	0	0
1871	0	0	257	169	0	0
1872	0	0	92	380	0	0
1873	0	0	149	697	0	0
1874	0	0	149	657	0	0
1875	0	0	107	547	0	0
1876	0	0	33	273	212	118
1877	0	0	0	0	346	439
1878	0	0	0	0	195	252
1879	0	0	0	0	27	0
1880	0	0	0	0	0	0
1881	0	5	0	0	0	0
1882	0	29	216	0	0	23
1883	0	83	432	0	0	30
1884	0	200	432	44	525	24
1885	0	288	348	96	1,060	218
1886	0	710	434	106	548	327
1887	0	1,226	610	150	189	319
1888	0	826	610	158	562	492
1889	6	608	434	380	813	530
1890	38	944	130	620	421	177
1891	38	917	204	694	179	88
1892	13	618	407	362	691	0
1893	0	363	407	150	1,077	0
1894	0	236	204	30	698	0
1895	0	26	0	0	135	0
1896	0	23	20	0	443	0
1897	0	63	40	0	501	0
1898	0	86	153	0	80	0
1899	0	122	265	31	65	0
1900	0	131	152	267	85	0
1901	0	36	40	361	43	0
1902	0	82	40	403	0	0
1903	28	166	640	207	949	0
1904	153	548	1,620	40	6,277	0
1905	223	1,900	1,400	40	8,267	0
1906	188	2,320	390	106	3,839	0
1907	268	875	0	186	0	0
1908	293	261	132	139	32	0
1909	120	159	98	141	64	0
1910	379	462	0	274	674	0
1911	1,080	1,738	429	747	643	0
1912	1,305	1,531	448	1,019	0	0
1913	1,191	763	0	1,032	1,776	1,544

Sources: see text.

Table F.17
Estimated Value Added in the Construction of a Sample of Naval Vessels, ca. 1911

(1) Vessel	(2) Type of vessel and builder[a]	(3) Displacement (tons) vessel normal	(4) Displacement (tons) vessel empty	(5) Displacement (tons) components engines	(6) Displacement (tons) components weapons	(7) Displacement (tons) components hull	(8) Values (thousand lire) hull and engines materials	(9) Values (thousand lire) hull and engines total	(10) Values (thousand lire) weapons[b], munitions	(11) Values (thousand lire) value added total	(12) Values (thousand lire) value added per ton	(13) Ratio of value added to value
Dante Alighieri	3-R	19,500	17,535	1,760	2,600	13,175	16,258	36,604	18,674	23,147	1.19	.42
(*Cavour*-class)	3-P	23,088	20,680	1,705	2,820	16,155	18,802	39,140	11,351	22,041	.95	.44
San Marco	4-R	10,700	9,400	1,100	1,265	7,035	9,082	18,087	9,560	10,439	.98	.38
Quarto	5-R	3,281	2,581	900	181	1,500	3,600	7,797	1,372	4,403	1.34	.48
Indomito	7-P	672	500	304	30	166	909	2,224	228	1,349	2.01	.55
Argo	8-P	250	200	65	-	135	284	1,272	19	986	3.94	.76
(*Nautilus*-class)	8-R	225	180	60	_	120	258	793	4	535	2.38	.67
(first *PN* series)	9-P	120	103	61	7	35	184	510	54	334	2.78	.59
Sebastiano Caboto	10-P	877	600	36	29	535	411	1,007	222	629	.72	.51
Titano	11-P	788	600	99	9	492	427	979	71	563	.71	.54
Adda	12-P	281	140	8	-	132	68	126	3	58	.21	.45
Bronte	12-P	9,490	2,500	200	17	2,283	1,333	2,629	127	1,315	.14	.48
Eridano	12-P	1,260	660	60	5	595	367	932	38	571	.45	.59

[a]vessel types are indicated by numbers corresponding to the columns of Table F.16 and rows of Table F.18; builder types are indicated by *P* (private yard) and *R* (Royal yard).

[b]includes electrical and underwater equipment.

Sources: see text.

Table F.18
Estimated Value Added in the Construction of Naval Vessels in 1911

Row	Type of vessel	(1) Total accrued displacement (thousand tons)	(2) Value added per displacement ton (thousand lire)	(3) Aggregate value added (million lire)
(1)	Armored frigates	-	1.00	-
(2)	Frigates and corvettes	-	1.35	-
(3)	Battleships	22.352	1.00	22.4
(4)	Armored cruisers	1.449	1.00	1.4
(5)	Colonial, etc., cruisers	2.320	1.35	3.1
(6)	Despatch boats, etc.	-	1.55	-
(7)	Destroyers	1.225	2.00	2.5
(8)	Submarines	1.080	3.80	4.1
(9)	Torpedo boats	1.738	2.80	4.9
(10)	Gunboats	.429	.70	.3
(11)	Tugs	.747	.70	.5
(12)	Bulk transports	.643	.20	.1
(13)	Other auxiliary vessels	-	.45	-
Total				39.3

Sources: col. 1: Table F.16.
col. 2: see text.
col. 3: col. 1 times col. 2.

Table F.19
Estimated Consumption of Semi-finished Metal in the Construction of Naval Vessels, per Unit (tons per normal displacement ton)

Row	Type of vessel	(1) Weight of hull	(2) Weight of armor	(3) Semi-finished metal consumed
(1)	Armored frigates	.80	.19	.2
(2)	Frigates and corvettes	.70	.00	.0
(3)	Battleships	.69	.22	.6
(4)	Armored cruisers	.66	.20	.6
(5)	Colonial, etc., cruisers	.46	.10	.4
(6)	Despatch boats, etc.	.35	.00	.3
(7)	Destroyers	.25	.00	.2
(8)	Submarines	.54	.00	.4
(9)	Torpedo boats	.29	.00	.2
(10)	Gunboats	.61	.00	.5
(11)	Tugs	.62	.00	.6
(12)	Bulk transports	.32	.00	.3
(13)	Other auxiliary vessels	.47	.00	.4

Sources: see text.

Table F.20
Estimated Consumption of Materials in the Construction and Maintenance of Seagoing Vessels, 1861-1913 (thousand tons)

	(1)	(2)	(3)	(4)	(5)
	Semi-finished metal				
	Construction		Maintenance		
Year	Naval 1861-1913	Merchant 1861-1913	Naval 1861-1913	Merchant 1861-1913	Total 1861-1913
1861	.427	.000	.015	.004	.446
1862	.554	.000	.016	.010	.580
1863	.895	.000	.016	.016	.927
1864	.831	.000	.017	.022	.870
1865	.935	.000	.019	.024	.978
1866	1.003	.000	.021	.025	1.049
1867	.999	.000	.025	.025	1.049
1868	.914	.171	.032	.026	1.143
1869	.881	.171	.043	.027	1.122
1870	.899	.000	.056	.033	.988
1871	.638	.005	.065	.039	.747
1872	.405	.033	.069	.043	.550
1873	1.516	1.207	.069	.049	2.841
1874	2.316	1.628	.070	.057	4.071
1875	2.137	.449	.070	.061	2.717
1876	2.730	.005	.070	.065	2.870
1877	3.916	.005	.070	.065	4.056
1878	3.706	.203	.071	.065	4.045
1879	3.743	.203	.071	.071	4.088
1880	3.121	.007	.073	.077	3.278
1881	3.659	.630	.076	.087	4.452
1882	5.289	.745	.079	.102	6.215
1883	5.358	.968	.085	.114	6.525
1884	6.859	1.057	.093	.128	8.137
1885	7.865	.299	.105	.137	8.406
1886	8.594	.155	.117	.145	9.011
1887	8.236	.590	.132	.165	9.123
1888	6.946	1.656	.161	.182	8.945
1889	5.999	4.224	.195	.193	10.611
1890	6.139	7.339	.230	.198	13.906
1891	5.801	5.982	.266	.216	12.265
1892	5.656	2.615	.308	.221	8.800
1893	6.598	1.857	.351	.229	9.035
1894	7.386	1.849	.383	.234	9.852
1895	8.172	2.417	.404	.243	11.236
1896	9.312	4.463	.424	.261	14.460
1897	9.410	8.123	.448	.284	18.265
1898	7.876	15.075	.478	.304	23.733
1899	9.828	25.060	.504	.334	35.726
1900	9.720	28.844	.518	.386	39.468
1901	8.637	21.348	.523	.444	30.952
1902	11.439	17.224	.521	.480	29.664
1903	12.653	14.314	.514	.495	27.976
1904	10.844	15.474	.503	.502	27.323
1905	12.794	17.482	.494	.508	31.278
1906	11.486	19.533	.485	.552	32.056
1907	11.952	19.122	.474	.600	32.148
1908	10.799	13.234	.473	.643	25.149
1909	8.641	12.130	.481	.706	21.958
1910	12.961	9.481	.496	.758	23.696
1911	17.089	9.981	.527	.789	28.386
1912	23.348	17.322	.579	.842	42.091
1913	22.745	20.028	.652	.944	44.369

Table F.20 (continued)

Year	(6) Lumber Construction Naval 1861-1913	(7) Lumber Construction Merchant 1861-1913	(8) Lumber Maintenance Naval 1861-1913	(9) Lumber Maintenance Merchant 1861-1913	(10) Total 1861-1913
1861	3.303	14.996	.537	1.534	20.370
1862	3.338	19.424	.530	1.564	24.856
1863	4.429	23.142	.520	1.649	29.740
1864	5.225	29.210	.503	1.666	36.604
1865	5.456	35.177	.480	1.781	42.894
1866	4.379	38.785	.474	1.942	45.580
1867	3.331	46.701	.494	2.066	52.592
1868	2.934	53.520	.540	2.236	59.230
1869	2.265	54.917	.603	2.401	60.186
1870	1.848	47.199	.601	2.554	52.202
1871	1.555	39.009	.533	2.652	43.749
1872	1.344	37.913	.446	2.665	42.368
1873	1.663	43.004	.405	2.665	47.737
1874	1.583	50.604	.425	2.678	55.290
1875	.954	48.616	.431	2.750	52.751
1876	.603	34.094	.429	2.843	37.969
1877	.211	21.409	.426	2.865	24.911
1878	.106	15.510	.435	2.856	18.907
1879	.000	10.973	.461	2.792	14.226
1880	.000	8.244	.484	2.716	11.444
1881	.000	8.595	.500	2.665	11.760
1882	.016	9.628	.506	2.618	12.768
1883	.021	8.836	.506	2.571	11.934
1884	.005	7.133	.506	2.525	10.169
1885	.000	6.451	.503	2.469	9.423
1886	.000	5.112	.495	2.393	8.000
1887	.000	3.075	.484	2.244	5.803
1888	.000	3.799	.472	2.100	6.371
1889	.000	6.833	.454	1.972	9.259
1890	.000	9.064	.400	1.862	11.326
1891	.000	8.114	.318	1.845	10.277
1892	.000	7.397	.247	1.794	9.438
1893	.000	5.323	.216	1.743	7.282
1894	.000	3.017	.209	1.675	4.901
1895	.000	2.776	.177	1.632	4.585
1896	.000	2.182	.125	1.568	3.875
1897	.000	2.763	.077	1.522	4.362
1898	.000	4.079	.053	1.539	5.671
1899	.000	5.468	.046	1.585	7.099
1900	.000	5.525	.038	1.632	7.195
1901	.000	6.848	.033	1.653	8.534
1902	.000	8.987	.028	1.658	10.673
1903	.000	7.269	.021	1.666	8.956
1904	.000	5.188	.013	1.666	6.867
1905	.000	5.007	.009	1.607	6.623
1906	.000	5.593	.008	1.534	7.135
1907	.000	5.679	.008	1.471	7.158
1908	.000	4.767	.007	1.420	6.194
1909	.000	4.177	.006	1.390	5.573
1910	.000	3.917	.005	1.364	5.286
1911	.000	3.512	.005	1.322	4.839
1912	.000	5.429	.005	1.228	6.662
1913	.000	6.763	.005	1.148	7.916

Sources: cols. 1 - 4, 6 - 9: see text.
col. 5: sum of cols. 1 - 4.
col. 10: sum of cols. 6 - 9.

Table F.21
Estimated Construction of Seagoing Merchant Vessels, 1861-1913
(thousand register tons)

Year	(1) Sail-powered vessels: Reported net tonnage launched[a] 1861-1914	(2) Sail-powered vessels: Reported gross tonnage launched: Total 1861-1914	(3) Sail-powered vessels: Reported gross tonnage launched: Metal-hulled 1861-1914	(4) Sail-powered vessels: Estimated gross tons constructed 1861-1913	(5) Engine-powered vessels: Reported net tonnage launched 1861-1914	(6) Engine-powered vessels: Reported gross tonnage launched: Total 1861-1914	(7) Engine-powered vessels: Reported gross tonnage launched: Metal-hulled[b] 1861-1914	(8) Engine-powered vessels: Estimated gross tons constructed 1861-1913
1861	23.224			25.0				.0
1862	26.155			32.4				.0
1863	38.165			38.4				.2
1864	38.277			48.5		.437		.2
1865	60.056			58.2				.4
1866	59.444			63.9		.830		.7
1867	71.537			77.5		.720		.4
1868	86.895			88.8		.059		.7
1869	94.514			89.9		1.496	.748	2.0
1870	89.079			77.3	1.614			1.4
1871	69.017			64.8	.111			.2
1872	63.813			63.0	.150		.022	.2
1873	65.424			71.6	.120		.123	2.6
1874	76.378			84.3		4.913	4.913	3.5
1875	85.681			80.7		2.010	1.870	1.2
1876	69.589			56.6		.433		.2
1877	39.264			35.5		.023	.019	.2
1878	28.986			25.6		.379		.7
1879	20.226			18.0		.987	.846	.7
1880	14.333	14.999		13.2	.193	.400		.5
1881	10.994			13.9	.362		.029	1.7
1882	15.770	16.360		16.0	2.039	2.802	2.594	1.6
1883	14.946	15.593	.387	15.1	.134	.441	.122	1.6
1884	14.122	14.672	.955	12.3	1.659	2.782	2.571	1.8
1885	9.526	9.948	.160	10.9	.419	.780	.719	.5
1886	11.331	11.791	.252	8.5	.090	.229	.114	.3
1887	5.034	5.270		5.2	.157	.393	.278	1.2
1888	4.934	5.126	.458	8.2	1.026	1.921	1.723	1.6
1889	10.934	11.328	3.739	19.3	.681	1.190	.981	.9
1890	26.413	27.259	12.368	25.9	.361	.601	.514	4.5
1891	23.700	24.472	10.584	20.0	6.084	8.459	7.113	6.0
1892	15.123	15.595	3.801	15.4	2.476	3.445	3.428	2.4
1893	14.797	15.235	2.480	10.9	.704	1.277	1.187	1.9
1894	6.276	6.471	2.190	5.7	1.659	2.587	1.970	3.2
1895	4.431	4.869	.058	4.4	2.319	4.642	3.576	5.2
1896	3.841	3.991		3.5	2.765	6.539	6.438	9.4
1897	2.857	2.985		4.3	8.601	14.445	14.249	17.2
1898	5.411	5.665		6.5	14.067	22.056	21.691	31.7
1899	7.034	7.299		8.8	26.768	41.388	41.122	52.5
1900	9.852	10.262		8.8	41.624	63.695	63.294	60.5
1901	6.953	7.292		15.4	37.590	57.350	56.890	40.5
1902	22.584	23.491	8.764	26.4	15.243	23.643	23.297	24.5
1903	28.116	29.223	14.865	19.1	16.337	25.366	24.842	22.8
1904	8.615	8.993		8.2	13.091	20.292	19.936	32.6
1905	7.133	7.499		7.8	28.569	44.982	44.538	36.9
1906	6.671	8.102		8.9	17.100	28.097	27.534	41.1
1907	7.763	9.577	.669	9.1	28.670	51.930	51.037	40.2
1908	6.883	8.476	.844	7.8	16.912	26.452	25.150	27.7
1909	5.689	6.950	.527	6.7	15.089	27.625	27.254	25.5
1910	4.952	6.312		6.0	7.987	22.080	21.394	20.2
1911	4.383	6.367	.631	5.2	10.538	17.729	16.832	21.4
1912	3.804	4.726		6.9	13.498	25.506	24.580	38.3
1913	7.967	8.917	1.765	9.1	28.934	50.998	45.967	43.9
1914	7.707	9.109			22.540	35.915	34.961	

Table F.21 (continued)

[a]in 1861, estimated: see text.
[b]in 1861-81, estimated: see text.

Sources: cols. 1 - 3, 5 - 7: *Navigazione marittima*, *Marina mercantile.*

cols. 4, 8: see text.

Table F.22
Estimated Naval Vessels Maintained, 1861-1913
(thousand displacement tons)

Year	(1) Armored vessels added 1861-1913	(2) Armored vessels deleted 1861-1913	(3) Protected vessels added 1861-1913	(4) Protected vessels deleted 1861-1913	(5) Bulk transports added 1861-1913	(6) Bulk transports deleted 1861-1913	(7) Other vessels added 1861-1913	(8) Other vessels deleted 1861-1913	(9) Total displacement[a] added 1861-1913	(10) Total displacement[a] deleted 1861-1913	(11) Mid-year stock[a] 1861-1913
1861	.000	.000	.000	.000	4.572	.000	58.320	.000	60.149	.000	60.1
1862	.000	.000	.000	.000	.000	.000	.000	.762	.000	.762	59.5
1863	.000	.000	.000	.000	.000	.000	.755	2.164	.755	2.164	58.7
1864	.000	.000	.000	.000	.000	.000	4.921	5.811	4.921	5.811	57.2
1865	.000	.000	.000	.000	.000	.000	8.737	12.257	8.737	12.257	55.7
1866	5.530	.000	.000	.000	.000	.000	3.080	6.096	7.504	6.096	56.0
1867	3.501	.000	.000	.000	.000	.000	6.077	1.935	8.878	1.935	59.8
1868	14.236	.000	.000	.000	.000	.000	.000	1.626	11.389	1.626	67.3
1869	7.725	.000	.000	.000	.000	.000	3.680	.000	9.860	.000	78.2
1870	10.600	.000	.000	.000	.000	.000	10.592	.000	19.072	.000	83.4
1871	3.930	12.702	.000	.000	.000	.000	.000	29.345	3.144	39.507	80.2
1872	5.814	.000	.000	.000	.000	.000	.760	.000	5.411	.000	73.1
1873	.000	.000	.000	.000	.285	.000	1.172	.661	1.286	.661	69.3
1874	.000	.000	.000	.000	.000	.000	1.578	.000	1.578	.000	71.6
1875	3.930	.000	.000	.000	.000	.000	1.962	1.150	5.106	1.150	72.3
1876	.000	7.860	.000	.000	.000	.000	.000	1.372	.000	7.660	72.1
1877	5.814	.000	.000	.000	.000	.000	.117	.000	4.768	.000	71.8
1878	5.854	.000	.000	.000	.000	.000	.269	4.870	4.952	4.870	72.8
1879	5.854	.000	.000	.000	.000	.000	.787	1.730	5.470	1.730	75.5
1880	.000	.000	.000	.000	.000	.000	4.412	.354	4.412	.354	78.6
1881	.000	.000	.000	.000	.000	.000	3.485	.981	3.485	.981	81.5
1882	.000	.000	.000	.000	.780	.000	.533	.000	.845	.000	83.4
1883	.000	.000	.000	.000	.000	.000	.787	.000	.787	.000	86.0
1884	11.138	.000	.000	.000	.000	.000	.782	.244	9.692	.244	89.4
1885	.000	.000	.000	.000	.000	.285	.132	.800	.132	.914	93.8
1886	11.138	.000	.000	.000	.000	1.524	.148	.244	9.058	.854	98.0
1887	.000	2.000	.000	.000	1.050	.000	4.491	2.312	4.911	3.912	103.4
1888	.000	.000	.000	.000	.990	.000	14.658	.270	15.054	.270	114.0
1889	13.898	.000	3.128	.000	.000	.000	12.297	2.536	26.230	2.536	126.3

Table F.22 (continued)

Year	(1) Armored vessels added 1861-1913	(2) Armored vessels deleted 1861-1913	(3) Protected vessels added 1861-1913	(4) Protected vessels deleted 1861-1913	(5) Bulk transports added 1861-1913	(6) Bulk transports deleted 1861-1913	(7) Other vessels added 1861-1913	(8) Other vessels deleted 1861-1913	(9) Total displacement[a] added 1861-1913	(10) Total displacement[a] deleted 1861-1913	(11) Mid-year stock[a] 1861-1913
1890	.000	.000	.000	.000	.704	3.048	1.710	5.150	1.991	6.369	135.4
1891	13.898	17.482	5.618	.000	.000	1.038	4.203	4.711	20.378	19.112	142.1
1892	11.204	.000	6.877	.000	.078	.000	7.709	.027	22.893	.027	152.5
1893	11.204	.000	6.234	.000	.596	.000	3.989	.000	18.801	.000	167.2
1894	.000	.000	.000	.000	.438	.000	3.762	.376	3.937	.376	179.8
1895	11.204	.000	.000	.000	.580	.000	2.546	3.804	11.741	3.804	185.7
1896	.000	5.854	.000	.000	.175	.000	5.342	6.969	5.412	11.652	188.6
1897	13.300	.000	2.389	.000	.440	.000	1.606	4.193	14.572	4.193	193.9
1898	4.580	.000	6.843	.000	1.095	.000	5.228	.000	15.489	.000	203.8
1899	27.260	11.257	2.732	.000	.350	.000	1.116	2.699	25.523	11.705	214.1
1900	.000	7.033	.000	.000	.000	.000	1.547	3.103	1.547	8.729	219.1
1901	.000	.000	2.492	.000	.000	.000	.124	1.024	2.367	1.024	220.7
1902	13.552	.000	.000	.000	1.137	.000	.064	4.321	11.360	4.321	219.1
1903	.000	4.376	.000	3.450	.086	.078	.000	12.138	.034	18.775	215.5
1904	.000	.000	.000	2.088	.000	.000	3.614	1.506	3.614	3.385	210.2
1905	34.300	33.546	2.538	5.876	.171	.000	1.280	.525	31.073	32.650	206.0
1906	.000	4.224	.000	.000	.000	.000	.980	1.451	.980	4.830	202.1
1907	.000	11.204	.000	3.427	.000	.000	1.986	2.654	1.986	14.702	197.5
1908	13.427	.000	.000	.000	.000	.000	.268	4.240	11.010	4.240	197.1
1909	20.777	.000	.000	.000	.342	.000	1.890	5.351	18.648	5.351	200.5
1910	.000	13.898	.000	.000	20.500	.000	1.850	5.870	10.050	16.988	206.7
1911	12.691	.000	.000	.000	.000	.078	8.246	.560	18.399	.591	219.4
1912	38.659	.000	.000	.000	.000	.000	10.356	.160	41.283	.160	241.1
1913	19.664	.000	.000	.000	.000	.000	3.872	.000	19.603	.000	271.2

[a]equivalent displacement tons.

Sources: see text.

Table F.23
Estimated Metal-Hulled Naval Vessels Maintained, 1861-1913
(thousand displacement tons)

Year	(1) Armored vessels added 1861-1913	(2) Armored vessels deleted 1861-1913	(3) Protected vessels added 1861-1913	(4) Protected vessels deleted 1861-1913	(5) Bulk transports added 1861-1913	(6) Bulk transports deleted 1861-1913	(7) Other vessels added 1861-1913	(8) Other vessels deleted 1861-1913	(9) Total displacement[a] added 1861-1913	(10) Total displacement[a] deleted 1861-1913	(11) Mid-year stock[a] 1861-1913
1861	.000	.000	.000	.000	.000	.000	6.363	.000	6.363	.000	6.4
1862	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	6.5
1863	.000	.000	.000	.000	.000	.000	.564	.000	.564	.000	6.7
1864	.000	.000	.000	.000	.000	.000	.528	.000	.528	.000	6.9
1865	.000	.000	.000	.000	.000	.000	.198	1.100	.198	1.100	7.7
1866	5.530	.000	.000	.000	.000	.000	.000	.000	4.424	.000	8.6
1867	.000	.000	.000	.000	.000	.000	.000	1.935	.000	1.935	10.4
1868	8.536	.000	.000	.000	.000	.000	.000	.000	6.829	.000	13.3
1869	4.224	.000	.000	.000	.000	.000	.000	.000	3.379	.000	17.9
1870	10.600	.000	.000	.000	.000	.000	.680	.000	9.160	.000	23.3
1871	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	26.9
1872	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	28.5
1873	.000	.000	.000	.000	.000	.000	.828	.000	.828	.000	28.8
1874	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	29.1
1875	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	29.2
1876	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	29.2
1877	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	29.2
1878	.000	.000	.000	.000	.000	.000	.000	.100	.000	.100	29.3
1879	.000	.000	.000	.000	.000	.000	.518	.000	.518	.000	29.4
1880	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	30.2
1881	.000	.000	.000	.000	.000	.000	3.485	.000	3.485	.000	31.5
1882	.000	.000	.000	.000	.780	.000	.000	.000	.312	.000	32.8
1883	.000	.000	.000	.000	.000	.000	.787	.000	.787	.000	35.4
1884	11.138	.000	.000	.000	.000	.000	.782	.000	9.692	.000	38.8
1885	.000	.000	.000	.000	.000	.000	.132	.800	.132	.800	43.5
1886	11.138	.000	.000	.000	.000	.000	.148	.000	9.058	.000	48.5
1887	.000	2.000	.000	.000	1.050	.000	4.461	.000	4.881	1.600	55.0
1888	.000	.000	.000	.000	.960	.000	14.628	.000	15.012	.000	66.8
1889	13.898	.000	3.128	.000	.000	.000	12.061	.574	25.994	.574	80.9

Table F.23 (continued)

Year	(1) Armored vessels added 1861-1913	(2) Armored vessels deleted 1861-1913	(3) Protected vessels added 1861-1913	(4) Protected vessels deleted 1861-1913	(5) Bulk transports added 1861-1913	(6) Bulk transports deleted 1861-1913	(7) Other vessels added 1861-1913	(8) Other vessels deleted 1861-1913	(9) Total displacement[a] added 1861-1913	(10) Total displacement[a] deleted 1861-1913	(11) Mid-year stock[a] 1861-1913
1890	.000	.000	.000	.000	.704	.000	1.710	1.470	1.991	1.470	95.4
1891	13.898	.000	5.618	.000	.000	1.038	4.203	.000	20.378	.415	110.3
1892	11.204	.000	6.877	.000	.078	.000	7.709	.027	22.893	.027	127.8
1893	11.204	.000	6.234	.000	.596	.000	3.989	.000	18.801	.000	145.6
1894	.000	.000	.000	.000	.438	.000	3.762	.186	3.937	.186	158.9
1895	11.204	.000	.000	.000	.580	.000	2.546	.014	11.741	.014	168.0
1896	.000	.000	.000	.000	.175	.000	5.342	.384	5.412	.384	176.1
1897	13.300	.000	2.389	.000	.440	.000	1.606	3.143	14.572	3.143	186.2
1898	4.580	.000	6.843	.000	1.095	.000	5.228	.000	15.489	.000	198.5
1899	27.260	11.257	2.732	.000	.350	.000	1.116	1.477	25.523	10.483	209.5
1900	.000	7.033	.000	.000	.000	.000	1.547	2.053	1.547	7.679	215.3
1901	.000	.000	2.492	.000	.000	.000	.124	1.024	2.367	1.024	217.4
1902	13.552	.000	.000	.000	1.137	.000	.064	4.321	11.360	4.321	216.3
1903	.000	4.376	.000	3.450	.086	.078	.000	10.365	.034	17.002	213.4
1904	.000	.000	.000	2.088	.000	.000	3.614	.973	3.614	2.852	208.9
1905	34.300	33.546	2.538	5.876	.171	.000	1.280	.525	31.073	32.650	205.1
1906	.000	4.224	.000	.000	.000	.000	.980	1.451	.980	4.830	201.3
1907	.000	11.204	.000	3.427	.000	.000	1.986	2.654	1.986	14.702	196.7
1908	13.427	.000	.000	.000	.000	.000	.268	3.971	11.010	3.971	196.4
1909	20.777	.000	.000	.000	.342	.000	1.890	5.351	18.648	5.351	199.9
1910	.000	13.898	.000	.000	20.500	.000	1.850	5.870	10.050	16.988	206.2
1911	12.691	.000	.000	.000	.000	.078	8.246	.560	18.399	.591	218.9
1912	38.659	.000	.000	.000	.000	.000	10.356	.160	41.283	.160	240.6
1913	19.664	.000	.000	.000	.000	.000	3.872	.000	19.603	.000	270.7

[a]equivalent displacement tons.

Sources: see text.

Table F.24
Seagoing Merchant Fleet, 1861-1913

Year	(1) Reported year-end fleet: Sail-powered: thousand vessels 1862-1913	(2) Reported year-end fleet: Sail-powered: thousand net tons 1862-1913	(3) Reported year-end fleet: Engine-powered: thousand vessels 1862-1913	(4) Reported year-end fleet: Engine-powered: thousand net tons 1862-1913	(5) Reported year-end fleet: Engine-powered: thousand gross t. 1882-1913	(6) Estimated mid-year fleet: Sail-pow.: thousand net tons 1861-1913	(7) Estimated mid-year fleet: Engine-powered: thousand net tons 1861-1913	(8) Estimated mid-year fleet: Engine-powered: thousand gross t. 1861-1913
1861						517	3	
1862	10.792	634	.057	10		531	8	
1863	12.186	642	.080	18		545	14	
1864	13.809	573	.090	20		559	19	
1865	15.707	656	.095	22		605	21	
1866	17.621	741	.099	22		660	22	
1867	17.685	794	.098	23		704	23	
1868	17.858	860	.101	23		759	23	
1869	17.699	928	.105	25		816	24	
1870	18.083	980	.118	32		867	29	
1871	11.270	994	.121	38		902	35	
1872	10.951	993	.118	38		913	38	
1873	10.712	998	.133	49		910	44	
1874	10.791	980	.138	52		913	51	
1875	10.828	987	.141	57		931	55	
1876	10.903	1,020	.142	58		963	58	
1877	10.742	1,010	.151	58		976	58	
1878	8.438	966	.152	63		967	59	
1879	7.910	933	.151	73		948	63	
1880	7.822	922	.158	77		928	68	
1881	7.639	895	.176	94		909	78	
1882	7.528	885	.192	105	156	890	91	
1883	7.270	866	.201	107	175	876	102	166
1884	7.072	849	.215	122	198	858	115	187
1885	7.111	829	.225	125	201	839	124	200
1886	6.992	801	.237	144	231	815	135	216
1887	6.717	732	.254	163	262	767	154	247
1888	6.544	698	.266	175	280	715	169	271
1889	6.442	642	.279	186	291	670	181	286
1890	6.442	634	.290	187	298	638	187	295
1891	6.312	626	.305	200	319	630	194	309
1892	6.308	610	.316	201	321	618	201	320
1893	6.341	588	.327	208	331	599	205	326
1894	6.231	572	.328	208	329	580	208	330
1895	6.166	556	.345	221	350	564	215	340
1896	6.002	528	.351	238	380	542	230	365
1897	5.872	527	.366	260	415	528	249	398
1898	5.764	538	.384	278	445	533	269	430
1899	5.665	558	.409	315	507	548	297	476
1900	5.511	568	.446	377	597	563	346	552
1901	5.337	575	.471	425	671	572	401	634
1902	5.205	570	.485	448	708	573	437	690
1903	5.153	584	.501	461	726	577	455	717
1904	5.083	570	.513	462	728	577	462	727
1905	5.020	541	.514	484	758	556	473	743
1906	4.981	503	.548	498	815	532	499	802
1907	4.874	469	.589	527	864	512	531	872
1908	4.701	453	.626	567	934	496	569	935
1909	4.723	440	.680	631	1,044	485	622	1,026
1910	4.741	433	.718	674	1,122	477	676	1,114
1911	4.713	411	.757	697	1,159	462	709	1,164
1912	4.693	375	.839	762	1,269	433	754	1,236
1913	4.696	356	.931	877	1,452	406	844	1,383

Sources: cols. 1 - 5: *Navigazione marittima*, *Marina mercantile*.
cols. 6 - 8: see text.

Table F.25
Beaching-slip and Dry-dock Throughput, 1885-1913

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Reported throughput, private establishments				Reported throughput, Royal yards				Estimated throughput (thousand net tons)	
	Sail-powered		Engine-powered		Sail-powered		Engine-powered			
Year	thousand vessels 1885-1913	thousand net tons 1885-1913	thousand vessels 1885-1913	thousand net tons 1885-1913	thousand vessels 1899-1905	thousand net tons 1899-1905	thousand vessels 1899-1905	thousand net tons[a] 1899-1905	Sail-powered 1885-1913	Engine-powered 1885-1913
1885	.505	136	.311	301					136	351
1886	.426	119	.318	259					119	309
1887	.399	97	.366	264					97	314
1888	.496	134	.372	327					134	377
1889	.530	105	.408	371					105	421
1890	.505	114	.373	359					114	409
1891	.435	104	.493	643					104	693
1892	.413	97	.557	594					97	644
1893	.458	107	.589	738					107	788
1894	.407	83	.688	812					83	862
1895	.456	107	.643	902					107	952
1896	.437	99	.655	967					99	1,017
1897	.447	91	.693	1,069					91	1,119
1898	.448	91	.709	1,060					91	1,110
1899	.458	111	.712	1,087	.004	3	.047	50	114	1,137
1900	.371	125	.721	1,220	.002	1	.034	48	126	1,268
1901	.312	107	.701	1,408	.013	10	.031	57	117	1,465
1902	.320	99	.698	1,454	.001	1	.032	59	100	1,513
1903	.380	121	.706	1,440	.001	0	.007	15	121	1,455
1904	.376	110	.775	1,417	.001	1	.028	50	111	1,467
1905	.417	108	.676	1,328	.000	0	.007	13	108	1,341
1906	.389	96	.692	1,548					96	1,548
1907	.272	103	.759	1,687					103	1,687
1908	.290	114	.746	1,809					114	1,809
1909	.271	81	.716	1,982					81	1,982
1910	.294	104	.717	1,893					104	1,893
1911	.425	86	.741	1,875					86	1,875
1912	.499	106	.795	2,108					106	2,108
1913	.408	88	.912	2,450					88	2,450

[a]in 1899, allows 1,002 net tons in lieu of 1,503 reported gross tons.

Sources: cols. 1 - 8: *Marina mercantile.*
cols. 9 - 10: see text.

Table F.26
Port Movements, 1861-1913

Year	(1) Reported foreign-flag arrivals: Sail-powered: thousand vessels 1861-1913	(2) Reported foreign-flag arrivals: Sail-powered: thousand net tons 1861-1913	(3) Reported foreign-flag arrivals: Engine-powered: thousand vessels 1861-1913	(4) Reported foreign-flag arrivals: Engine-powered: thousand net tons 1861-1913	(5) Reported Italian-flag arrivals: Sail-powered: thousand vessels 1861-1913	(6) Reported Italian-flag arrivals: Sail-powered: thousand net tons 1861-1913	(7) Reported Italian-flag arrivals: Engine-powered: thousand vessels 1861-1913	(8) Reported Italian-flag arrivals: Engine-powered: thousand net tons 1861-1913
1861	7.1	966	3.1	1,215	82.8	3,429	4.9	901
1862	7.6	993	4.3	1,551	89.4	3,425	6.8	1,194
1863	7.9	1,251	4.2	1,596	97.3	3,374	10.2	2,164
1864	8.1	1,234	3.5	1,398	93.4	3,235	11.4	2,461
1865	6.5	995	3.1	1,272	96.8	3,342	11.4	2,524
1866	5.9	966	3.2	1,503	88.2	3,235	11.3	2,473
1867	5.9	931	3.7	1,555	86.7	3,269	10.8	2,537
1868	6.2	946	4.0	1,654	95.3	3,513	12.4	2,944
1869	5.6	902	4.2	1,954	100.2	3,892	12.0	2,917
1870	5.1	857	3.9	1,883	96.8	3,712	13.0	3,258
1871	4.7	853	4.5	2,236	102.5	3,945	13.4	3,500
1872	5.0	889	4.8	2,519	101.0	4,002	13.3	3,646
1873	4.6	770	4.5	2,749	99.9	3,956	11.9	3,403
1874	5.1	805	5.1	3,361	94.9	3,759	13.4	4,128
1875	4.6	767	5.2	3,576	93.9	3,651	14.3	4,641
1876	4.0	690	5.3	3,703	77.1	2,970	14.3	4,998
1877	3.6	618	5.4	3,944	79.5	3,158	12.2	4,778
1878	3.5	666	5.2	3,793	72.1	2,752	13.5	5,421
1879	3.6	650	5.9	4,421	54.9	2,423	11.8	5,398
1880	3.1	500	6.4	5,055	56.9	2,557	12.9	6,111
1881	3.2	531	6.8	5,444	82.0	3,053	18.2	7,086
1882	3.0	493	7.2	6,256	80.7	2,955	19.1	7,855
1883	3.0	444	8.4	7,358	82.2	2,991	17.7	7,671
1884	2.8	423	7.4	6,573	77.5	2,807	16.6	6,915
1885	3.0	509	8.4	7,315	83.0	3,041	18.7	7,576
1886	2.5	429	7.8	7,238	79.3	3,059	18.9	7,936
1887	2.5	390	8.3	7,836	79.4	3,109	20.7	8,977
1888	2.3	333	7.3	6,996	79.6	3,086	22.0	9,633
1889	2.5	346	7.1	7,249	84.2	3,184	22.9	10,128
1890	2.5	372	7.6	7,477	87.3	3,313	24.3	11,298
1891	2.0	305	7.2	7,196	90.1	3,242	26.5	12,742
1892	2.0	257	7.5	7,201	86.1	3,155	25.6	12,430
1893	1.6	209	8.2	8,762	80.8	2,975	25.8	14,012
1894	1.4	173	9.2	9,468	74.5	2,935	30.1	16,462
1895	1.5	201	9.2	9,909	68.6	2,859	27.9	14,889
1896	1.6	195	9.3	10,313	65.1	2,783	24.7	13,504
1897	1.6	160	9.6	10,908	66.7	2,789	27.0	14,718
1898	1.5	148	9.8	11,330	65.1	2,730	27.9	15,531
1899	1.5	154	9.6	10,974	66.4	2,787	28.4	16,391
1900	1.4	155	9.1	10,707	64.9	2,782	28.1	16,463
1901	1.2	137	9.4	11,622	61.6	2,642	27.0	16,961
1902	1.2	120	9.8	12,868	64.1	2,749	30.0	18,734
1903	1.4	106	10.2	13,711	66.6	2,894	31.1	19,814
1904	1.5	112	10.3	14,829	65.9	2,896	31.2	20,669
1905	1.4	125	10.6	15,672	61.5	2,782	30.9	21,844
1906	1.4	145	11.4	17,496	63.0	2,784	30.2	21,399
1907	1.3	117	11.4	18,006	63.7	2,535	30.2	21,898
1908	1.5	112	11.6	18,558	87.8	2,735	39.3	23,687
1909	1.2	135	12.5	19,925	84.8	2,666	38.3	24,216
1910	1.2	119	12.6	19,717	91.7	2,918	50.8	28,460
1911	1.1	123	12.7	20,009	93.1	2,934	66.5	32,991
1912	1.0	87	13.3	21,335	93.5	3,121	68.8	32,294
1913	.9	80	12.5	20,665	91.5	3,169	72.2	33,024

Table F.26 (continued)

Year	(9) Reported Ital.-flag international arrivals: Sail-powered: thousand vessels 1861-1913	(10) Reported Ital.-flag international arrivals: Sail-powered: thousand net tons 1861-1913	(11) Reported Ital.-flag international arrivals: Engine-powered: thousand vessels 1861-1913	(12) Reported Ital.-flag international arrivals: Engine-powered: thousand net tons 1861-1913	(13) Italian-flag arrivals: reported net tons arrived per net ton in the reported fleet[a]: Sail-powered: Total 1861-1913	(14) Italian-flag arrivals: reported net tons arrived per net ton in the reported fleet[a]: Sail-powered: Internat. 1861-1913	(15) Italian-flag arrivals: reported net tons arrived per net ton in the reported fleet[a]: Engine-powered: Total 1861-1913	(16) Italian-flag arrivals: reported net tons arrived per net ton in the reported fleet[a]: Engine-powered: Internat. 1861-1913
1861	9.3	734	.4	84				
1862	10.5	813	.7	143				
1863	9.4	756	1.1	208	5.29	1.18	154.57	14.86
1864	9.8	858	1.4	291	5.33	1.41	129.53	15.32
1865	9.7	868	1.4	303	5.44	1.41	120.19	14.43
1866	9.2	869	1.4	281	4.63	1.24	112.41	12.77
1867	11.3	972	1.3	280	4.26	1.27	112.76	12.44
1868	10.8	934	1.7	321	4.25	1.13	128.00	13.96
1869	10.9	929	1.7	339	4.35	1.04	121.54	14.13
1870	9.7	945	1.8	394	3.89	.99	114.32	13.82
1871	9.5	964	1.8	471	4.00	.98	100.00	13.46
1872	10.6	1,107	1.6	458	4.03	1.11	95.95	12.05
1873	10.9	984	1.3	496	3.97	.99	78.23	11.40
1874	10.9	989	.7	345	3.80	1.00	81.74	6.83
1875	9.7	863	.8	410	3.71	.88	85.16	7.52
1876	9.4	838	.9	468	2.96	.84	86.92	8.14
1877	9.4	882	.9	537	3.11	.87	82.38	9.26
1878	8.9	821	1.2	774	2.79	.83	89.60	12.79
1879	9.1	838	1.1	775	2.55	.88	79.38	11.40
1880	9.5	854	1.2	847	2.76	.92	81.48	11.29
1881	9.0	800	1.0	664	3.36	.88	82.88	7.77
1882	9.1	735	1.0	789	3.32	.83	78.94	7.93
1883	9.7	735	.9	732	3.42	.84	72.37	6.91
1884	8.6	661	.9	751	3.27	.77	60.39	6.56
1885	8.9	712	.9	741	3.62	.85	61.34	6.00
1886	8.3	697	1.0	800	3.75	.86	59.00	5.95
1887	8.8	694	1.2	987	4.06	.91	58.48	6.43
1888	7.9	559	1.5	1,159	4.32	.78	57.00	6.86
1889	7.4	549	1.6	1,286	4.75	.82	56.11	7.12
1890	7.8	628	1.4	1,233	5.19	.98	60.58	6.61
1891	7.6	548	1.4	1,280	5.15	.87	65.85	6.61
1892	7.9	585	1.4	1,266	5.11	.95	62.00	6.31
1893	7.3	526	1.5	1,533	4.97	.88	68.52	7.50
1894	8.0	558	1.6	1,451	5.06	.96	79.14	6.98
1895	7.6	541	1.5	1,444	5.07	.96	69.41	6.73
1896	7.3	536	1.5	1,540	5.13	.99	58.84	6.71
1897					5.29		59.11	
1898					5.13		57.74	
1899					5.09		55.28	
1900					4.94		47.58	
1901	7.7	522	2.2	2,365	4.62	.91	42.30	5.90
1902	7.8	505	2.5	2,573	4.80	.88	42.92	5.89
1903	8.1	545	2.5	2,741	5.02	.94	43.60	6.03
1904	8.2	543	2.4	2,655	5.02	.94	44.79	5.75
1905	7.5	529	2.1	2,611	5.01	.95	46.18	5.52
1906	7.5	501	2.1	2,710	5.33	.96	43.58	5.52
1907	8.0	484	2.3	2,800	5.22	1.00	42.73	5.46
1908	8.1	487	2.5	3,155	5.93	1.06	43.30	5.77
1909	7.4	463	2.6	3,420	5.97	1.04	40.43	5.71
1910	7.8	485	2.4	3,284	6.68	1.11	43.62	5.03
1911	7.9	459	2.7	3,586	6.95	1.09	48.13	5.23
1912	8.0	473	3.3	4,291	7.94	1.20	44.27	5.88
1913	8.3	481	3.7	4,837	8.67	1.32	40.30	5.90

Table F.26 (continued)

[a]average of the reported year-end fleet, current and preceding year.

Sources: cols. 1 - 12: *Navigazione marittima*.
col. 13: col. 6/(Table F.24, col. 2, shifted forward half a year).
col. 14: col. 10/(Table F.24, col. 2, shifted forward half a year).
col. 15: col. 8/(Table F.24, col. 4, shifted forward half a year).
col. 16: col. 12/(Table F.24, col. 4, shifted forward half a year).

Table F.27
Estimated Value Added in the Maintenance of Seagoing Merchant Vessels, 1861-1913
(million lire at 1911 prices)

	(1)	(2)	(3)	(4)	(5)	(6)
	Total maintenance, Italian-flag vessels		Engine-powered Dry-dock maintenance performed			
Year	Dry-dock 1861-1913	Other 1861-1913	in Italy, all ships 1861-1913	abroad, It. ships 1861-1884	in Italy, for. ships 1861-1884	Total maint. in Italy 1861-1913
1861	.02	.04	.17	.00	.15	.21
1862	.05	.11	.23	.01	.19	.34
1863	.09	.19	.26	.02	.19	.45
1864	.13	.26	.28	.02	.17	.54
1865	.14	.29	.27	.02	.15	.56
1866	.15	.30	.30	.03	.18	.60
1867	.15	.31	.29	.03	.17	.60
1868	.15	.31	.30	.03	.18	.61
1869	.16	.33	.35	.03	.22	.68
1870	.19	.40	.37	.03	.21	.77
1871	.23	.48	.42	.04	.23	.90
1872	.26	.52	.48	.04	.26	1.00
1873	.30	.60	.54	.05	.29	1.14
1874	.34	.70	.63	.06	.35	1.33
1875	.37	.75	.68	.06	.37	1.43
1876	.39	.79	.70	.07	.38	1.49
1877	.39	.79	.73	.07	.41	1.52
1878	.40	.80	.72	.07	.39	1.52
1879	.42	.86	.81	.07	.46	1.67
1880	.46	.93	.91	.08	.53	1.84
1881	.52	1.06	1.00	.09	.57	2.06
1882	.61	1.24	1.16	.10	.65	2.40
1883	.68	1.39	1.33	.11	.76	2.72
1884	.77	1.57	1.32	.13	.68	2.89
1885	.83	1.68	1.45			3.13
1886	.89	1.81	1.27			3.08
1887	1.02	2.07	1.30			3.37
1888	1.12	2.27	1.56			3.83
1889	1.18	2.40	1.74			4.14
1890	1.22	2.47	1.69			4.16
1891	1.27	2.59	2.86			5.45
1892	1.32	2.68	2.66			5.34
1893	1.34	2.73	3.25			5.98
1894	1.36	2.76	3.56			6.32
1895	1.40	2.85	3.93			6.78
1896	1.51	3.06	4.20			7.26
1897	1.64	3.33	4.62			7.95
1898	1.77	3.60	4.58			8.18
1899	1.96	3.99	4.69			8.68
1900	2.28	4.62	5.23			9.85
1901	2.62	5.31	6.04			11.35
1902	2.85	5.78	6.24			12.02
1903	2.96	6.00	6.00			12.00
1904	3.00	6.09	6.05			12.14
1905	3.06	6.22	5.53			11.75
1906	3.31	6.72	6.39			13.11
1907	3.60	7.30	6.96			14.26
1908	3.86	7.83	7.46			15.29
1909	4.23	8.59	8.18			16.77
1910	4.60	9.33	7.81			17.14
1911	4.80	9.75	7.73			17.48
1912	5.10	10.35	8.70			19.05
1913	5.70	11.58	10.11			21.69

Table F.27 (continued)

Year	(7) Total maint., It. ships 1861-1913	(8) Sail-powered: Maint. performed abroad, It. ships 1861-1913	(9) Sail-powered: Maint. performed in Italy, for. ships 1861-1913	(10) Total maint. in Italy 1861-1913
1861	3.67	.33	.27	3.61
1862	3.77	.37	.28	3.68
1863	3.87	.34	.35	3.88
1864	3.97	.39	.34	3.92
1865	4.30	.39	.28	4.19
1866	4.69	.39	.27	4.57
1867	5.00	.38	.24	4.86
1868	5.39	.37	.24	5.26
1869	5.79	.37	.23	5.65
1870	6.16	.37	.22	6.01
1871	6.40	.37	.21	6.24
1872	6.48	.43	.22	6.27
1873	6.46	.38	.19	6.27
1874	6.48	.38	.20	6.30
1875	6.61	.33	.19	6.47
1876	6.84	.32	.17	6.69
1877	6.93	.34	.15	6.74
1878	6.87	.32	.17	6.72
1879	6.73	.32	.16	6.57
1880	6.59	.33	.13	6.39
1881	6.45	.31	.13	6.27
1882	6.32	.28	.12	6.16
1883	6.22	.28	.11	6.05
1884	6.09	.26	.11	5.94
1885	5.96	.28	.13	5.81
1886	5.79	.27	.11	5.63
1887	5.45	.27	.10	5.28
1888	5.08	.22	.08	4.94
1889	4.76	.21	.09	4.64
1890	4.53	.24	.09	4.38
1891	4.47	.21	.08	4.34
1892	4.39	.23	.06	4.22
1893	4.25	.20	.05	4.10
1894	4.12	.22	.04	3.94
1895	4.00	.21	.05	3.84
1896	3.85	.21	.05	3.69
1897	3.75	.21	.04	3.58
1898	3.78	.20	.04	3.62
1899	3.89	.20	.04	3.73
1900	4.00	.20	.04	3.84
1901	4.06	.20	.03	3.89
1902	4.07	.20	.03	3.90
1903	4.10	.21	.03	3.92
1904	4.10	.21	.03	3.92
1905	3.95	.20	.03	3.78
1906	3.78	.21	.04	3.61
1907	3.64	.21	.03	3.46
1908	3.52	.21	.03	3.34
1909	3.44	.20	.03	3.27
1910	3.39	.21	.03	3.21
1911	3.28	.20	.03	3.11
1912	3.07	.20	.02	2.89
1913	2.88	.20	.02	2.70

Table F.27 (continued)

Sources: col. 1: 1861-1882, (Table F.24, col. 7)((166/102) gross tons/net ton)(4.125 lire/gross ton);
1883-1913, (Table F.24, col. 8)(4.125 lire/gross ton).

col. 2: 1861-1882, (Table F.24, col. 7)((166/102) gross tons/net ton)(8.375 lire/gross ton);
1883-1913, (Table F.24, col. 8)(8.375 lire/gross ton).

col. 3: 1861-1884, col. 1 - col. 4 + col. 5;
1885-1913, (Table F.25, col. 10)(4.125 lire/net ton).

col. 4: (col. 1)/6.

col. 5: 1861-1870, see text;
1871-1884, (Table F.26, col. 4)((.76/7,315) lire/net ton).

col. 6: col. 2 + col. 3.

col. 7: (Table F.24, col. 6)(7.1 lire/net ton).

col. 8: see text.

col. 9: 1861-1870, see text;
1871-1913, (Table F.26, col. 2)(.25 lire/net ton).

col. 10: col. 7 - col. 8 + col. 9.

Table F.28
Estimated Acquisitions of New Rail-guided Vehicles, 1861-1914: Units

Year	(1) Locomotives and rail-cars: Major lines[a] 1861-1914	(2) Locomotives and rail-cars: Minor lines[b] 1861-1914	(3) Locomotives and rail-cars: Machine tramways 1861-1914	(4) Locomotives and rail-cars: Other concerns[c] 1861-1914	(5) Passenger cars: Major lines 1861-1914	(6) Passenger cars: Minor lines 1861-1914	(7) Passenger cars: Machine tramways 1861-1914	(8) Passenger cars: Other concerns 1861-1914
1861	50				191			
1862	25				279			
1863	59				606			
1864	94				181			
1865	83				109			
1866	55				200			
1867	43				194			
1868	52	3			130	21		
1869	34	2			244	9		
1870	46				64			
1871	61	7			137	28		
1872	73	7			63	29		
1873	101	4			138	6		
1874	89				115	2		
1875	50	2	2		176	8	5	
1876	22	5			55	29	1	
1877	42	10	1		16	51	2	
1878	24	4	5		22	8	15	
1879	26	13	36		15	74	109	
1880	29	18	61		87	75	181	
1881	56	13	79		53	50	237	
1882	114	5	71		279	13	215	
1883	157	30	49		387	99	146	
1884	81	36	37		118	131	111	
1885	87	21	12		234	78	36	
1886	105	28	45		202	55	133	
1887	86	18	5		307	63	14	
1888	137	67	13		485	173	41	
1889	194	10	22		645	78	65	
1890	95	8	65		258	12	130	26
1891	38	2	8		151	16	23	26
1892	25	11	9		83	7	29	26
1893	7	17	40		45	42	88	26
1894	15	5	12		14	1	36	26
1895	31	19	54		32	50	15	26
1896	12	8	25		170		10	26
1897	24	3	133		106	13	57	26
1898	39	7	334		60	6	110	26
1899	53	19	224		41	45	61	26
1900	102	8	278		217	64	113	12
1901	141	5	282	3	265	20	71	158
1902	72	6	47	6	222	22	141	
1903	113	21	51	5	102	21		19
1904	203	16	78		396	53	45	2
1905	117	31	108		668	33	133	1
1906	423	32	225		266	89	110	1
1907	511	20	252		532	40	98	1
1908	468	21	223		773	78	93	26
1909	375	41	70		716	87	476	27
1910	233	59	84		238	119	93	11
1911	223	32	454		368	75	191	24
1912	244	25	456		422	51	192	11
1913	205	70	426		266	168	177	1
1914	187	76	425		381	171	176	1

Table F.28 (continued)

Year	(9) Freight, baggage, and service cars: Major lines 1861-1914	(10) Freight, baggage, and service cars: Minor lines 1861-1914	(11) Freight, baggage, and service cars: Machine tramways 1861-1914	(12) Freight, baggage, and service cars: Other concerns 1861-1914	(13) Horse-tramway cars 1861-1914
1861	246				
1862	1,128				
1863	1,952				
1864	824				
1865	698				
1866	1,737				
1867	510				
1868	357	34			
1869	1,142				
1870	511				
1871	1,416	27			
1872	1,186	81			6
1873	3,052	10			12
1874	1,022	39			39
1875	344	26	8		60
1876	340	55	2		99
1877	574	74	3		120
1878	405	4	27		51
1879	49	131	188		15
1880	365	203	314		42
1881	2,167	145	409		75
1882	1,991	50	372	5	75
1883	1,548	263	252	5	78
1884	1,113	206	192	5	75
1885	554	170	63	5	75
1886	1,126	272	230	5	75
1887	3,432	234	25	5	75
1888	3,495	611	71	5	75
1889	4,357	48	111	5	75
1890	2,148	50	219	5	75
1891	250		39	5	75
1892	268	62	50	29	75
1893	129	155	149	29	63
1894	513	46	62	13	69
1895	421	269	9	13	21
1896	486	72	11	13	39
1897	568	76	58	13	
1898	957	158	90	15	
1899	2,366	99	36	13	
1900	3,452	237	113	59	
1901	3,341	88	260	54	
1902	2,718	308	102	61	
1903	3,241	179	75	20	
1904	2,490	147	71	71	
1905	457	233	194	55	
1906	3,478	346	215	45	
1907	10,403	295	355	128	
1908	8,724	450	47	182	
1909	5,959	321	469	234	
1910	4,494	499	62	382	
1911	4,540	324	292	385	
1912	6,786	283	293	193	
1913	5,371	684	271	80	
1914	3,649	701	269	111	

Table F.28 (continued)

[a]of which: electric locomotives, 2 in 1904, 3 in 1905, 1 in 1906, 3 in 1907, 8 in 1908, 7 in 1909, 25 in 1910, 5 in 1912, 32 in 1913, and 40 in 1914;
rail-cars, 2 in 1899, 20 in 1901, 18 in 1903, 15 in 1904, 1 in 1905, 7 in 1906, and 93 in 1907.

[b]of which: electric locomotives, 2 in 1903, 8 in 1904, 2 in 1905, 6 in 1907, 2 in 1908;
rail-cars, 3 in 1904, 21 in 1905, and 8 in 1906.

[c]rail-cars.

Sources: see text.

Table F.29
Estimated Acquisitions of New Rail-guided Vehicles, 1899-1906:
Units, by Major Railway Company

Year	Company	(1) Loco-motives[a]	(2) Rail-cars	(3) Passenger cars[b]	(4) Baggage cars	(5) Freight cars	(6) Service cars
1899	*Rete Adriatica*	36		2	6	1,556	
	Rete Mediterranea	15	2	41		775	4
	Rete Sicula					25	
1900	*Rete Adriatica*	41		22		375	
	id., ex l. 56/1900					1,924	
	Rete Mediterranea	61		195	61	1,090	2
	Rete Sicula						
1901	*Rete Adriatica*	10		25	1		
	id., ex l. 56/1900	6		32		912	
	Rete Mediterranea	105	20	228		2,305	
	Rete Sicula				3	120	
1902	*Rete Adriatica*	2		33	20	137	
	id., ex l. 56/1900	20		32		1,367	
	Rete Mediterranea	50		157	110	1,054	
	Rete Sicula					30	
1903	*Rete Adriatica*	18		80		87	
	id., ex l. 56/1900	50			34	1,165	
	Rete Mediterranea	19	18	40	19	1,735	
	Rete Sicula	8				195	6
1904	*Rete Adriatica*	35	10	60		200	
	id., ex l. 56/1900	76		291	13	382	
	Rete Mediterranea	77	5	60	40	1,825	
	Rete Sicula					30	
1905 (1st sem.)	*Rete Adriatica*	8		215	6		
	id., ex l. 56/1900	21		90		45	4
	Rete Mediterranea	19			10	32	
	Rete Sicula	6	1	28		220	
1905 (2nd sem.)	*Ferrovie dello Stato*	62		326	110	28	2
	Rete Adriatica			10			
1906	*Ferrovie dello Stato*	416	7	273	121	3,338	19

[a]includes electric locomotives: for the *Rete Adriatica*, 2 in 1904 and 3 in 1905, 1st sem., none of them ex law 56/1900; for the *Ferrovie dello Stato*, 1 in 1906.

[b]includes the rail-cars separately counted in col. 2.

Sources: see text.

Table F.30
Reported Year-end Stock of Rail-guided Vehicles, 1861-1914: Minor Railway Companies (units)[a]

Year	(1) Loco-motives[b] 1861-1914	(2) Passenger cars[c] 1861-1914	(3) Freight cars[d] 1861-1914	Year	(1) Loco-motives[b] 1861-1914	(2) Passenger cars[c] 1861-1914	(3) Freight cars[d] 1861-1914
				1890	311	1,092	2,733
1861				1891	267	965	2,446
1862				1892	324	1,115	2,757
1863				1893	341	1,157	2,912
1864				1894	346	1,158	2,958
1865				1895	365	1,208	3,227
1866				1896	373	1,205	3,299
1867				1897	376	1,218	3,375
1868	17	45	140	1898	383	1,224	3,533
1869				1899	402	1,269	3,632
1870				1900	410	1,333	3,869
1871	12	58	61	1901	415	1,353	3,957
1872	14	57	108	1902	421	1,375	4,265
1873	23	93	152	1903	442	1,396	4,444
1874	23	95	191	1904	458	1,452	4,591
1875	25	103	217	1905	489	1,506	4,752
1876	26	102	267	1906	469	1,417	4,740
1877	36	151	341	1907	465	1,399	4,817
1878	40	158	344	1908	506	1,533	5,366
1879	53	232	475	1909	547	1,620	5,687
1880	75	340	684	1910	588	1,715	6,081
1881	88	390	829	1911	620	1,762	6,401
1882	93	403	879	1912	640	1,803	6,607
1883	123	502	1,142	1913	703	1,962	7,251
1884	156	622	1,346	1914	771	2,133	7,952
1885	177	700	1,516				
1886	205	755	1,788				
1887	223	818	2,022				
1888	293	1,002	2,635				
1889	303	1,080	2,683				

[a]in 1911-14, estimated year-end fleet excluding the narrow-gauge Sicilian State railways: see text.

[b]of which: electric locomotives, 2 in 1903, 10 in 1904, 12 in 1905, 11 in 1906, 17 in 1907, and 19 in 1908-18; rail-cars, 3 in 1904, 24 in 1905, and 32 in 1906-10.

[c]of which: rail-cars, 3 in 1904, 24 in 1905, and 28 in 1906-10.

[d]of which: rail-cars, 4 in 1906-10. Includes baggage cars and service cars.

Sources: 1861-1910, *Relazione S.F.I.*, *Relazione S.F.C.*; 1911-14, see text.

Table F.31
Estimated Year-end Stock of Rail-guided Vehicles, 1861-1914:
Machine-powered Tramways[a] (units)

	(1)	(2)	(3)	(4)	(5)
	Steam tramways				
	Reported track length[b]	Reported route length[c]	Estimated year-end stock		
Year	1861-1909	1900-1914	Locomotives 1861-1914	Passenger cars[d] 1861-1914	Freight cars[e] 1861-1914
1875	8		2	5	8
1876	10		2	6	10
1877	13		3	8	13
1878	40		8	23	40
1879	225		44	132	228
1880	535		105	313	542
1881	940		184	550	951
1882	1,307		255	765	1,323
1883	1,556		304	911	1,575
1884	1,746		341	1,022	1,767
1885	1,808		353	1,058	1,830
1886	2,035		398	1,191	2,060
1887	2,060		403	1,205	2,085
1888	2,130		416	1,246	2,156
1889	2,240		438	1,311	2,267
1890	2,453		479	1,435	2,483
1891	2,492		487	1,458	2,522
1892	2,541		496	1,487	2,572
1893	2,687		525	1,572	2,720
1894	2,748		537	1,608	2,782
1895	2,751		538	1,610	2,785
1896	2,760		539	1,615	2,794
1897	2,804		548	1,641	2,838
1898	2,858		558	1,672	2,893
1899	2,870		561	1,679	2,905
1900	2,953	3,056	577	1,728	2,989
1901	3,043	3,155	585	1,753	3,228
1902	3,067	3,183	579	1,825	3,299
1903	3,089	3,203	574	1,755	3,344
1904	3,077	3,190	572	1,744	3,390
1905	3,103	3,217	587	1,804	3,551
1906	3,100	3,215	597	1,822	3,725
1907	3,108	3,211	595	1,808	4,029
1908	2,992	3,195	611	2,671	4,422
1909	2,950	3,202	602	3,147	4,891
1910		3,209	625	3,240	4,953
1911		3,216	626	3,431	5,245
1912		3,223	628	3,623	5,538
1913		3,226	628	3,800	5,809
1914		3,228	629	3,976	6,078

Table F.31 (continued)

	(6)	(7)	(8)	(9)	(10)	(11)
	Electric tramways					
	Reported track length[b]	Reported route length[c]	Estimated year-end stock			
			Loco-motives[f]	Passenger cars		Freight cars[i]
				Rail-cars[g]	Trailers[h]	
Year	1861-1909	1900-1914	1861-1910	1861-1914	1861-1907	1861-1907
1875						
1876						
1877						
1878						
1879						
1880						
1881						
1882						
1883						
1884						
1885						
1886						
1887						
1888						
1889						
1890	8			24	6	3
1891	8			24	6	3
1892	8			24	6	3
1893	12			35	9	4
1894	12			35	9	4
1895	30			88	22	10
1896	38			112	27	12
1897	80			236	58	26
1898	190			560	137	61
1899	265			781	191	85
1900	354	444		1,043	255	114
1901	434	532		1,317	301	135
1902	474	607	4	1,360	370	166
1903	506	655	4	1,411	437	196
1904	578	765	4	1,489	493	221
1905	604	801	4	1,582	566	254
1906	742	1,001	9	1,792	658	295
1907	844	1,110	10	2,043	770	346
1908	998	1,208	9	2,250		
1909	1,077	1,271	40	2,289		
1910		1,397	43	2,347		
1911		1,662		2,843		
1912		1,927		3,297		
1913		2,176		3,723		
1914		2,424		4,147		

Table F.31 (continued)

[a]none appear to have been in service before 1875.

[b]kilometers at year-end.

[c]kilometers at year-end. In 1909-11 and 1913-14, estimated: see text.

[d]from 1908, includes passenger (and mixed passenger-freight) cars of electric tramways.

[e]from 1908, includes freight cars of electric tramways.

[f]from 1911, included in col. 9.

[g]from 1911, includes electric locomotives.

[h]from 1908, included in col. 4.

[i]from 1908, included in col. 5.

Sources: see text.

Table F.32
Reported Average Number of Leased and Privately-owned Rail-guided Vehicles in Service on Major Railway Lines, 1891-1914: Units

Year	(1) Locomotives[a] 1891-1914	(2) Rail-cars[b] 1891-1914	(3) Sleeping cars 1891-1914	(4) Mail and cell cars 1891-1914	(5) Total passenger cars[a] 1891-1914
1891			1		1
1892					
1893			1		12
1894			1		13
1895			1		13
1896			1		13
1897			1		13
1898			1		13
1899	3		47	211	264
1900	6		50	220	276
1901		3	35	378	425
1902	11	9	32	355	417
1903	17	14	51	346	413
1904	124	7	52	347	618
1905					8
1906	10			303	303
1907	10			301	301
1908	10			326	326
1909	12			352	352
1910	12			362	362
1911	12			385	385
1912	12			395	395
1913	6			389	389
1914				380	380

Year	(6) Baggage cars 1891-1914	(7) Tank cars[c] 1891-1914	(8) Total freight cars 1891-1914	(9) Service cars 1891-1914
1891		55	126	
1892				
1893		119	144	
1894		97	161	
1895		97	171	
1896		97	174	
1897		94	174	
1898		99	180	
1899	5	183	2,676	
1900	6	249	5,435	1
1901	7	309	4,598	2
1902	10	331	4,291	2
1903	26	351	4,468	2
1904	57	522	10,188	2
1905		577	4,281	
1906		622	748	
1907		750	864	
1908		932	1,057	
1909		1,166	1,304	
1910		1,548	1,722	
1911		1,933	2,162	
1912		2,126	2,414	
1913		2,206	2,528	
1914		2,317	2,620	

Table F.32 (continued)

[a]includes rail-cars

[b]in 1901, reported in the *Rete Adriatica*.

[c]through 1901, includes other cars other than box cars, flat card, and gondolas; in 1901, includes 39 such cars.

Sources: 1891-1903: *Relazione S.F.I.*
1904: *Rete Adriatica*, *Rete Mediterranea*, *Rete Sicula*.
1905: *Rete Adriatica* (2d semester), *Statistica F.S.* (2d semester).
1906-1913: *Statistica F.S.*

Table F.33
Estimated Acquisitions of New Rail-guided Vehicles, 1861-1914: Weight (thousand tons)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Locomotives and rail-cars				Passenger cars			
Year	Major lines 1861-1914	Minor lines 1861-1914	Machine tramways 1861-1914	Other concerns 1861-1914	Major lines 1861-1914	Minor lines 1861-1914	Machine tramways 1861-1914	Other concerns 1861-1914
1861	1.50				1.34			
1862	.77				1.95			
1863	1.86				4.24			
1864	3.05				1.27			
1865	2.76				.76			
1866	1.87				1.40			
1867	1.47				1.40			
1868	1.79	.08			.96	.12		
1869	1.18	.06			1.85	.05		
1870	1.60				.50			
1871	2.14	.20			1.10	.18		
1872	2.60	.20			.52	.19		
1873	3.66	.12			1.16	.04		
1874	3.28				.99	.01		
1875	1.87	.06	.02		1.55	.06	.02	
1876	.84	.15			.50	.21		
1877	1.60	.30	.01		.15	.38	.01	
1878	.91	.12	.04		.21	.06	.05	
1879	.99	.40	.29		.14	.57	.33	
1880	1.10	.55	.49		.85	.59	.54	
1881	2.13	.40	.63		.53	.40	.71	
1882	4.38	.15	.57		2.85	.11	.65	
1883	6.09	.93	.39		4.02	.82	.44	
1884	3.18	1.13	.30		1.25	1.11	.33	
1885	3.45	.67	.10		2.53	.67	.11	
1886	4.20	.90	.36		2.22	.48	.41	
1887	3.46	.58	.04		3.44	.56	.04	
1888	5.53	2.17	.11		5.53	1.58	.14	
1889	7.88	.32	.18		7.48	.72	.22	
1890	3.88	.26	.55		3.04	.11	.46	.31
1891	1.56	.07	.07		1.81	.15	.08	.31
1892	1.04	.37	.08		1.01	.07	.11	.32
1893	.30	.57	.35		.56	.42	.33	.32
1894	.64	.17	.11		.18	.01	.14	.33
1895	1.35	.66	.49		.41	.51	.06	.33
1896	.53	.28	.23		2.21		.04	.34
1897	1.07	.11	1.22		1.46	.14	.24	.36
1898	1.75	.25	3.11		.88	.07	.47	.38
1899	2.40	.69	2.11		.63	.55	.27	.40
1900	4.65	.29	2.64		3.52	.83	.51	.19
1901	6.49	.18	2.71	.14	4.51	.27	.33	2.69
1902	3.31	.22	.46	.28	3.95	.31	.66	
1903	5.20	.77	.50	.23	1.90	.31		.35
1904	9.34	.59	.77		7.68	.82	.22	.04
1905	5.38	1.14	1.08		13.49	.53	.67	.02
1906	19.46	1.18	2.25		5.59	1.50	.57	.02
1907	24.02	.75	2.52		11.28	.68	.53	.02
1908	22.46	.81	2.23		16.54	1.34	.52	.56
1909	18.38	1.61	.70		15.47	1.50	2.76	.58
1910	11.65	2.36	.84		5.19	2.08	.56	.24
1911	11.37	1.31	4.54		8.10	1.32	1.18	.53
1912	12.69	1.04	4.56		9.37	.91	1.23	.24
1913	10.87	2.97	4.26		5.96	3.01	1.17	.02
1914	10.10	3.28	4.25		8.61	3.09	1.20	.02

Table F.33 (continued)

Year	(9) Freight, baggage, and service cars: Major lines 1861-1914	(10) Freight, baggage, and service cars: Minor lines 1861-1914	(11) Freight, baggage, and service cars: Machine tramways 1861-1914	(12) Freight, baggage, and service cars: Other concerns 1861-1914	(13) Horse-tramway cars 1861-1914	(14) Tenders: Major lines 1861-1914	(15) Tenders: Minor lines 1861-1914
1861	1.35					.65	
1862	6.29					.32	
1863	11.07					.72	
1864	4.75					1.11	
1865	4.08					.95	
1866	10.32					.61	
1867	3.08					.48	
1868	2.18	.17				.59	.03
1869	7.09					.39	.02
1870	3.22					.54	
1871	8.99	.14				.73	.07
1872	7.59	.41			.02	.88	.07
1873	19.69	.05			.03	1.21	.04
1874	6.64	.20			.10	1.07	
1875	2.25	.14	.02		.15	.60	.02
1876	2.24	.29			.25	.26	.05
1877	3.82	.39	.01		.30	.50	.10
1878	2.71	.02	.05		.13	.29	.04
1879	.33	.71	.38		.04	.31	.13
1880	2.48	1.10	.63		.11	.35	.18
1881	15.10	.81	.85		.19	.67	.13
1882	14.22	.29	.79	.04	.19	1.35	.05
1883	11.32	1.54	.55	.04	.20	1.82	.30
1884	8.33	1.23	.44	.04	.19	.92	.36
1885	4.24	1.04	.15	.04	.19	.97	.21
1886	8.81	1.70	.55	.04	.19	1.16	.28
1887	27.42	1.50	.06	.04	.19	.98	.18
1888	28.52	3.99	.18	.04	.19	1.62	.67
1889	36.29	.32	.29	.04	.19	2.37	.10
1890	18.26	.34	.58	.04	.19	1.20	.08
1891	2.15		.11	.04	.19	.49	.02
1892	2.33	.43	.14	.25	.19	.33	.11
1893	1.14	1.09	.43	.26	.16	.09	.17
1894	4.57	.33	.18	.12	.17	.20	.05
1895	3.79	1.94	.03	.12	.05	.43	.19
1896	4.42	.52	.03	.12	.10	.17	.08
1897	5.23	.56	.18	.12		.32	.03
1898	8.90	1.18	.29	.14		.50	.07
1899	22.24	.74	.12	.12		.62	.19
1900	32.79	1.80	.38	.56		1.18	.08
1901	31.91	.67	.88	.52		1.33	.05
1902	26.09	2.37	.35	.59		.78	.06
1903	31.28	1.38	.27	.19		1.01	.19
1904	24.15	1.14	.26	.69		1.93	.05
1905	4.46	1.82	.71	.54		1.15	.08
1906	34.08	2.71	.80	.44		4.15	.24
1907	102.47	2.32	1.35	1.26		4.15	.14
1908	86.37	3.56	.18	1.80		4.60	.19
1909	59.29	2.56	1.84	2.33		3.68	.41
1910	44.94	3.99	.25	3.82		2.08	.59
1911	45.63	2.60	1.19	3.87		2.23	.32
1912	68.54	2.29	1.21	1.95		2.39	.25
1913	54.52	5.55	1.14	.81		1.73	.70
1914	37.22	5.72	1.15	1.13		1.47	.76

Sources: see text.

Table F.34
Estimated New Rail-guided Vehicles Delivered, 1861-1914: Weight (thousand tons)

	(1)	(2)	(3)	(4)	(5)	(6)
		Locomotives[a]			Passenger cars	
Year	Total 1861-1914	Imported 1861-1914	Domestic 1861-1914	Total 1861-1914	Imported 1861-1914	Domestic 1861-1914
1861	1.50	1.38	.12	1.34	.95	.39
1862	.77	.65	.12	1.95	.87	1.08
1863	1.86	1.48	.38	4.24	1.49	2.75
1864	3.05	2.95	.10	1.27	.91	.36
1865	2.76	2.76	.00	.76	-.02	.78
1866	1.87	1.80	.07	1.40	.55	.85
1867	1.47	1.20	.27	1.40	.49	.91
1868	1.87	1.39	.48	1.08	.69	.39
1869	1.24	.72	.52	1.90	1.03	.87
1870	1.60	1.32	.28	.50	.02	.48
1871	2.34	1.99	.35	1.28	1.17	.11
1872	2.80	2.41	.39	.73	.62	.11
1873	3.78	3.35	.43	1.23	1.18	.05
1874	3.28	2.88	.40	1.10	.60	.50
1875	1.95	1.31	.64	1.78	.11	1.67
1876	.99	.99	.00	.96	.23	.73
1877	1.91	1.30	.61	.84	.34	.50
1878	1.07	0.61	.46	.45	.17	.28
1879	1.68	1.15	.53	1.08	.08	1.00
1880	2.14	1.80	.34	2.09	.39	1.70
1881	3.16	2.32	.84	1.83	.30	1.53
1882	5.10	4.18	.92	3.80	1.07	2.73
1883	7.41	6.44	.97	5.48	.32	5.16
1884	4.61	3.47	1.14	2.88	.66	2.22
1885	4.22	2.68	1.54	3.50	.18	3.32
1886	5.46	2.92	2.54	3.30	.58	2.72
1887	4.08	4.39	-.31	4.23	.84	3.39
1888	7.81	4.96	2.85	7.44	1.36	6.08
1889	8.38	4.79	3.59	8.61	1.02	7.59
1890	4.69	2.02	2.67	4.11	.41	3.70
1891	1.70	.20	1.50	2.54	.05	2.49
1892	1.49	.15	1.34	1.70	.12	1.58
1893	1.22	.13	1.09	1.79	.08	1.71
1894	.92	.26	.66	.83	.01	.82
1895	2.50	.23	2.27	1.36	.14	1.22
1896	1.04	-.05	1.09	2.69	.00	2.69
1897	2.40	-.41	2.81	2.20	.00	2.20
1898	5.11	-.25	5.36	1.80	.03	1.77
1899	5.20	-1.47	6.67	1.85	-.61	2.46
1900	7.58	.12	7.46	5.05	.32	4.73
1901	9.52	.59	8.93	7.80	2.12	5.68
1902	4.27	-.27	4.54	4.92	2.31	2.61
1903	6.70	.95	5.75	2.56	.70	1.86
1904	10.70	2.33	8.37	8.76	2.46	6.30
1905	7.60	1.31	6.29	14.71	2.71	12.00
1906	22.89	8.46	14.43	7.68	2.26	5.42
1907	27.29	13.49	13.80	12.51	9.29	3.22
1908	25.50	10.15	15.35	18.96	12.65	6.31
1909	20.69	8.90	11.79	20.31	5.63	14.68
1910	14.85	2.62	12.23	8.07	1.41	6.66
1911	17.22	3.00	14.22	11.13	1.10	10.03
1912	18.29	2.03	16.26	11.75	1.11	10.64
1913	18.10	1.94	16.16	10.16	.17	9.99
1914	17.63	1.41	16.22	12.92	-.07	12.99

Table F.34 (continued)

Year	(7)	(8) Freight cars[b]	(9)
	Total 1861-1914	Imported 1861-1914	Domestic 1861-1914
1861	2.00	1.16	.84
1862	6.61	4.58	2.03
1863	11.79	6.74	5.05
1864	5.86	2.86	3.00
1865	5.03	2.16	2.87
1866	10.93	2.64	8.29
1867	3.56	2.13	1.43
1868	2.97	1.41	1.56
1869	7.50	2.97	4.53
1870	3.76	2.43	1.33
1871	9.93	5.52	4.41
1872	8.95	7.47	1.48
1873	20.99	14.62	6.37
1874	7.91	6.07	1.84
1875	3.03	1.15	1.88
1876	2.84	.46	2.38
1877	4.82	1.25	3.57
1878	3.11	.02	3.09
1879	1.86	.58	1.28
1880	4.74	1.60	3.14
1881	17.56	1.07	16.49
1882	16.74	1.80	14.94
1883	15.57	3.19	12.38
1884	11.32	1.71	9.61
1885	6.65	1.01	5.64
1886	12.54	1.56	10.98
1887	30.18	8.74	21.44
1888	35.02	7.51	27.51
1889	39.41	16.82	22.59
1890	20.50	5.02	15.48
1891	2.81	-.56	3.37
1892	3.59	-.26	3.85
1893	3.18	-.16	3.34
1894	5.45	.47	4.98
1895	6.50	.11	6.39
1896	5.34	.62	4.72
1897	6.44	.43	6.01
1898	11.08	.09	10.99
1899	24.03	6.12	17.91
1900	36.79	18.04	18.75
1901	35.36	17.18	18.18
1902	30.24	2.08	28.16
1903	34.32	7.40	26.92
1904	28.22	8.94	19.28
1905	8.76	1.75	7.01
1906	42.42	17.75	24.67
1907	111.69	47.25	64.44
1908	96.70	14.33	82.37
1909	70.11	6.63	63.48
1910	55.67	5.96	49.71
1911	55.84	6.12	49.72
1912	76.63	.81	75.82
1913	64.45	-3.10	67.55
1914	47.45	-1.22	48.67

Table F.34 (continued)

[a]includes rail-cars.

[b]includes baggage cars, service cars, and tenders.

Sources: col. 1: sum of Table F.33, cols. 1 - 4.
col. 2: 1886-1914, *Movimento commerciale*; 1861-85, col. 1 - col. 3.
col. 3: 1886-1914, col. 1 - col. 2; 1861-1885, see text.
col. 4: sum of Table F.33, cols. 5 - 8 and 13.
col. 5: 1878-1914, *Movimento commerciale*; 1861-77, col. 4 - col. 6.
col. 6: 1878-1914, col. 4 - col. 5; 1861-77, see text.
col. 7: sum of Table F.33, cols. 9 - 12 and 14 - 15.
col. 8: 1878-1914, *Movimento commerciale*; 1861-77, col. 7 - col. 9.
col. 9: 1878-1914, col. 7 - col. 8; 1861-77, see text.

Table F.35
Estimated Acquisitions of New Major-Railway Locomotives, 1861-1885: Units

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Rete Mediterranea				*Rete Adriatica*			
Year	Italian 1861-1885	Other 1861-1885	Total 1861-1885	Error[a] 1861-1884	Italian 1861-1885	Other 1861-1885	Total 1861-1885	Error[a] 1861-1884
1861	2	23	25		2	23	25	
1862	4	16	20			5	5	
1863	8	39	47		4	8	12	
1864	3	25	28			66	66	
1865		20	20			63	63	
1866	2	4	6			46	46	
1867		17	17		8	13	21	
1868	6	36	42	4	8	6	14	
1869	4	17	21		11	2	13	
1870		19	19		8	4	12	
1871		34	34	-4	10	10	20	
1872	4	50	54		7	12	19	
1873		56	56	-7	12	22	34	
1874	8	67	75	7		11	11	
1875	10	14	24		4	6	10	
1876				-10		6	6	
1877		16	16		16	8	24	
1878	5	22	27	10				
1879	10		10		2	12	14	
1880	9	2	11			12	12	
1881	16	17	33			19	19	2
1882		31	31		24	57	81	-2
1883	15	46	61	-2	10	60	70	
1884	20	25	45		9	27	36	
1885	39	17	56			12	12	

	(9)	(10)	(11)	(12)	(13)	(14)
		Rete Sicula			Total	
Year	Italian 1861-1885	Other 1861-1885	Total 1861-1885	Error[a] 1861-1884	Italian 1861-1885	Other 1861-1885
1861					4	46
1862					4	21
1863					12	47
1864					3	91
1865						83
1866		2	2	-1	2	52
1867		6	6	1	8	36
1868					14	42
1869					15	19
1870		15	15		8	38
1871		3	3		10	47
1872					11	62
1873		4	4		12	82
1874	3	7	10		11	85
1875	3	13	16		17	33
1876		4	4	-2		10
1877		4	4	2	16	28
1878	4		4	-3	9	22
1879	5		5	3	17	12
1880		6	6		9	20
1881	6		6		22	36
1882					24	88
1883		24	24		25	130
1884					29	52
1885					39	29

Table F.35 (continued)

[a]Total in preceding column less the corresponding total in *Relazione ferroviaria 1900*, part I, vol. 2, p. 149.

Sources: cols. 1 - 2: *Locomotive Mediterranea 1888*.

col. 3: col. 1 + col. 2.

cols. 4, 8, and 12: see note *a*.

cols. 5 - 6: *Locomotice Adriatica 1887*.

col. 7: col. 5 + col. 6.

cols. 9 - 10: *Locomotive Sicula c.1902*.

col. 11: col. 7 + col. 8.

col. 13: col. 1 + col. 5 + col. 9.

col. 14: col. 2 + col. 6 + col. 10.

Table F.36
Estimated Acquisitions of New Major-Railway Passenger, Mail, and Cell Cars, 1861-1877: Units

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Rete Mediterranea				*Rete Adriatica*			
Year	Italian 1861-1877	Other 1861-1877	Total 1861-1877	Error[a] 1861-1877	Italian 1861-1877	Other 1861-1877	Total 1861-1877	Error[a] 1861-1877
1861	36	43	79		19	82	101	-11
1862	131	2	133		23	133	156	10
1863	177	72	249		180	182	362	44
1864	11		11		41	106	147	-23
1865	44		44		67		67	2
1866	19		19		103	72	175	-6
1867	50		50		77	28	105	10
1868	3	50	53		41	26	67	-9
1869	47	47	94		63	40	103	2
1870	47		47		14	1	15	-2
1871		134	134		3		3	
1872		57	57			6	6	
1873	1	137	138					
1874	1	65	66		19		19	1
1875					84		84	
1876	1		1		32		32	
1877					16		16	

	(9)	(10)	(11)	(12)	(13)	(14)
	Rete Sicula				Total	
Year	Italian 1861-1877	Other 1861-1877	Total 1861-1877	Error[a] 1861-1877	Italian 1861-1877	Other 1861-1877
1861					55	125
1862					154	135
1863	36	3	39		393	257
1864					52	106
1865					111	
1866					122	72
1867		51	51	2	127	79
1868				-1	44	76
1869		47	47	-2	110	134
1870					61	1
1871					3	134
1872						63
1873					1	137
1874	31		31		51	65
1875	92		92		176	
1876	22		22		55	
1877					16	

[a]Total in preceding column less the corresponding total in *Relazione ferroviaria 1900*, parte I, vol. 2, p. 149.

Sources: cols. 1 - 2: *Carrozze Mediterranea 1888*.
col. 3: col. 1 + col. 2.
cols. 4, 8, and 12: see note *a*.
cols. 5 - 6: *Carrozze Adriatica 1887*.
col. 7: col. 5 + col. 6.
cols. 9 - 10: *Locomotive Sicula c.1902*.
col. 11: col. 7 + col. 8.
col. 13: col. 1 + col. 5 + col. 9.
col. 14: col. 2 + col. 6 + col. 10.

Table F.37
Estimated Acquisitions of New Major-Railway Freight, Baggage, and Service Cars, 1861-1877: Units

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Rete Mediterranea				*Rete Adriatica*			
Year	Italian 1861-1877	Other 1861-1877	Total 1861-1877	Error[a] 1861-1877	Italian 1861-1877	Other 1861-1877	Total 1861-1885	Error[a] 1861-1877
1861	97	2	99		47	100	147	
1862	292	6	298		62	784	846	16
1863	483	535	1,018	1	377	551	928	-3
1864	335	2	337	-2	179	309	488	3
1865	19	2	21	20	472	224	696	-1
1866	1,128	71	1,199		264	275	539	1
1867					220	170	390	2
1868	70	7	77	7	142	88	230	2
1869	329	216	545	1	371	100	471	-2
1870	125	280	405		70	2	72	2
1871	30	397	427		633	302	935	-15
1872	3	372	375	10	174	658	832	3
1873	219	2,095	2,314	-2	553	29	582	31
1874		778	778		186		186	-3
1875		60	60		143	7	150	-30
1876					270		270	
1877	5		5		345	96	441	-2

	(9)	(10)	(11)	(12)	(13)	(14)
	Rete Sicula[a]				Total	
Year	Italian 1861-1877	Other 1861-1877	Total 1861-1877	Error[a] 1861-1877	Italian 1861-1877	Other 1861-1877
1861					144	102
1862					354	790
1863	4		4		864	1,086
1864					514	311
1865					491	226
1866					1,392	346
1867		113	113	-9	220	283
1868		63	63	4	212	158
1869		125	125		700	441
1870		38	38	2	195	320
1871		39	39		663	738
1872					177	1,030
1873	188		188	3	960	2,124
1874	61		61	6	247	778
1875	99		99	-5	242	67
1876	68		68	-2	338	
1877	127	3	130	4	477	99

[a]Total in preceding column less the corresponding total in *Relazione ferroviaria 1900*, parte I, vol. 2, p. 149.

Sources: cols. 1 - 2: *Carri Mediterranea 1888*.
col. 3: col. 1 + col. 2.
cols. 4, 8, and 12: see note *a*.
cols. 5 - 6: *Carri Adriatica 1887*.
col. 7: col. 5 + col. 6.
cols. 9 - 10: *Locomotive Sicula c.1902*, *Carri Sicuola c.1902*.
col. 11: col. 7 + col. 8.
col. 13: col. 1 + col. 5 + col. 9.
col. 14: col. 2 + col. 6 + col. 10.

Table F.38
Estimated New Production of Rail-guided Vehicles and Related Materials Consumption, 1861-1913 (thousand tons)

	(1)	(2)	(3)	(4)	(5)
	New production			Materials consumption	
Year	Loco-motives[a] 1861-1913	Passenger cars 1861-1913	Freight cars[b] 1861-1913	Semi-f. metal 1861-1913	Wood 1861-1913
1861	.12	.74	1.44	.59	2.11
1862	.25	1.92	3.54	1.59	5.10
1863	.24	1.56	4.03	1.89	4.94
1864	.05	.57	2.94	1.30	2.87
1865	.04	.82	5.58	2.63	4.90
1866	.17	.88	4.86	2.72	4.19
1867	.38	.65	1.50	1.36	1.59
1868	.50	.63	3.05	2.47	2.40
1869	.40	.68	2.93	2.44	2.23
1870	.32	.30	2.87	2.37	1.69
1871	.37	.11	2.95	2.57	1.41
1872	.41	.08	3.93	3.32	1.81
1873	.42	.28	4.11	3.51	2.07
1874	.52	1.09	1.86	2.24	1.79
1875	.32	1.20	2.13	2.25	2.00
1876	.31	.62	2.98	2.69	1.86
1877	.54	.39	3.33	3.14	1.81
1878	.50	.64	2.19	2.36	1.51
1879	.44	1.35	2.21	2.56	2.09
1880	.59	1.62	9.82	8.32	5.66
1881	.88	2.13	15.72	13.11	8.66
1882	.95	3.95	13.66	12.39	9.20
1883	1.06	3.69	11.00	10.51	7.81
1884	1.34	2.77	7.63	8.06	5.59
1885	2.04	3.02	8.31	9.45	6.09
1886	1.12	3.06	16.21	14.09	9.62
1887	1.27	4.74	24.48	20.83	14.62
1888	3.22	6.84	25.05	24.27	16.55
1889	3.13	5.65	19.04	19.40	12.94
1890	2.09	3.10	9.43	10.34	6.65
1891	1.42	2.04	3.61	4.99	3.23
1892	1.22	1.65	3.60	4.61	2.91
1893	.88	1.27	4.16	4.48	2.86
1894	1.47	1.02	5.69	6.16	3.33
1895	1.68	1.96	5.56	6.66	4.03
1896	1.95	2.45	5.37	7.02	4.33
1897	4.09	1.99	8.50	11.56	5.35
1898	6.02	2.12	14.45	18.11	8.09
1899	7.07	3.60	18.33	22.66	10.99
1900	8.20	5.21	18.47	24.66	12.33
1901	6.74	4.15	23.17	25.96	13.57
1902	5.15	2.24	27.54	26.56	13.99
1903	7.06	4.08	23.10	26.25	13.49
1904	7.33	9.15	13.15	21.31	13.12
1905	10.36	8.71	15.84	26.56	13.96
1906	14.12	4.32	44.56	49.89	23.18
1907	14.58	4.77	73.41	71.33	36.32
1908	13.57	10.50	72.93	71.97	40.68
1909	12.01	10.67	56.60	58.50	33.58
1910	13.23	8.35	49.72	54.09	28.68
1911	15.24	10.34	62.77	66.52	36.05
1912	16.21	10.32	71.69	74.05	39.98
1913	16.19	11.49	58.11	64.70	34.90

Table F.38 (continued)

[a]includes rail-cars.

[b]includes baggage cars, service cars, and tenders.

Sources: col. 1: Table F.34, col. 3, shifted half a year backward.
col. 2: Table F.34, col. 6, shifted half a year backward.
col. 3: Table F.34, col. 9, shifted half a year backward.
cols. 4 - 5: see text.

Table F.39
Vehicle Mileage, All Railways, 1861-1913

Year	(1) Locomotives (million vehicle-kilometers) 1861-1913	(2) Passenger cars (million vehicle-kilometers) 1867-1903	(3) Passenger cars (million axle-kilometers) 1861-1913	(4) Freight cars (million vehicle-kilometers) 1861-1913	(5) Freight cars (million axle-kilometers) 1881-1890
1861	10		70	62	
1862	12		80	71	
1863	14		97	86	
1864	16		109	97	
1865	18		119	107	
1866	21		139	124	
1867	21	71	142	127	
1868	22	81	162	144	
1869	24		177	164	
1870	26		196	191	
1871	28		213	217	
1872	31	119	238	253	
1873	34	128	256	294	
1874	36	131	262	294	
1875	37	140	281	304	
1876	39	143	289	341	
1877	41	147	298	346	
1878	41	152	310	339	
1879	43	159	326	359	
1880	48	163	336	406	
1881	52	170	352	417	836
1882	55	173	357	443	885
1883	58	184	378	488	979
1884	63	201	407	517	1,034
1885	64	211	424	517	1,034
1886	69	225	450	528	1,057
1887	74	235	476	551	1,103
1888	83	254	512	604	1,209
1889	86	263	532	622	1,245
1890	86	265	536	624	1,249
1891	85	266	537	603	
1892	85	268	541	607	
1893	87	274	553	635	
1894	87	276	558	651	
1895	88	281	568	644	
1896	90	288	582	672	
1897	94	293	592	715	
1898	97	297	600	733	
1899	102	303	612	775	
1900	106	319	644	784	
1901	109	318	661	798	
1902	114	328	689	849	
1903	118	336	709	887	
1904	125		749	936	
1905	130		785	922	
1906	138		906	979	
1907	142		897	977	
1908	155		993	1,025	
1909	161		1,031	1,088	
1910	166		1,176	1,112	
1911	169		1,232	1,164	
1912	173		1,283	1,222	
1913	177		1,378	1,278	

Sources: *Relazione S.F.I.*, save col. 1, 1861-66, 1869-71 and 1904-13, col. 2, 1867, col. 3, 1861-80 and 1891-1913, col. 4, 1861-67, 1869-71, 1898 and 1904-13, estimated: see text.

Table F.40
Vehicle Mileage, Major and Minor Railways, 1904-1913

	(1)	(2)	(3)	(4)	(5)
	Major railways				
	Locomotives	Passenger cars		Freight cars	
Year	(million vehicle-kilometers) 1904-1913	(million vehicle-kilometers) 1904-1909	(million axle-kilometers) 1904-1913	(million vehicle-kilometers) 1904-1913	(million axle-kilometers) 1910-1913
1904	112	317	675	897	
1905	117	329	707	869	
1906	125	385	828	934	
1907	129	368	817	934	
1908	140	381	903	978	
1909	145	377	939	1,039	
1910	149	424	1,073	1,059	2,140
1911	151	433	1,125	1,108	2,239
1912	154	446	1,174	1,164	2,351
1913	157	469	1,258	1,215	2,455

	(6)	(7)	(8)
	Minor railways		
	Locomotives	Passenger cars	Freight cars
Year	(million vehicle-kilometers) 1904-1913	(million vehicle-kilometers) 1904-1913	(million vehicle-kilometers) 1904-1913
1904	13	35	39
1905	13	37	53
1906	13	37	45
1907	13	38	43
1908	15	43	47
1909	16	44	49
1910	17	49	53
1911	18	51	56
1912	19	52	58
1913	20	57	63

Sources: cols. 1 - 5: *Statistica Adriatica*, *Statistica Mediterranea*, *Statistica Sicula*, *Statistica F. S.*, save col. 3, 1904-09, col. 4, 1910-13, estimated: see text.
cols. 6 - 8: 1904-10, *Relazione S.F.C.*; 1911-13, estimated: see text.

Table F.41
Estimated Value Added and Materials Consumption in Railway-Vehicle Maintenance, 1861-1913

Year	(1) Vehicle ton-mileage (million ton-kilometers) Loco-motives[a] 1861-1913	(2) Passenger cars 1861-1913	(3) Freight cars[b] 1861-1913	(4) Value added in main-tenance[c] 1861-1913	(5) Materials consumed (thousand tons) Semi-f. metal 1861-1913	(6) Wood 1861-1913
1861	260	231	329	2.00	.73	1.46
1862	318	265	379	2.37	.89	1.66
1863	378	323	463	2.86	1.08	1.99
1864	440	365	526	3.28	1.27	2.22
1865	504	400	584	3.69	1.46	2.42
1866	599	469	682	4.35	1.75	2.78
1867	609	481	704	4.45	1.81	2.82
1868	649	552	804	4.92	2.00	3.16
1869	720	605	922	5.49	2.28	3.52
1870	793	673	1,081	6.18	2.60	4.00
1871	868	735	1,237	6.86	2.93	4.44
1872	967	825	1,452	7.79	3.37	5.08
1873	1,068	892	1,699	8.74	3.85	5.75
1874	1,138	917	1,711	9.07	4.06	5.72
1875	1,177	989	1,781	9.48	4.26	5.90
1876	1,248	1,022	2,012	10.23	4.69	6.42
1877	1,320	1,059	2,055	10.64	4.95	6.46
1878	1,328	1,107	2,027	10.71	5.00	6.35
1879	1,402	1,170	2,161	11.35	5.36	6.63
1880	1,574	1,212	2,460	12.61	6.11	7.25
1881	1,716	1,275	2,544	13.41	6.58	7.39
1882	1,837	1,324	2,742	14.32	7.13	7.76
1883	1,960	1,434	3,065	15.57	7.84	8.46
1884	2,155	1,579	3,293	16.98	8.62	8.98
1885	2,214	1,682	3,340	17.48	8.90	9.05
1886	2,415	1,824	3,458	18.71	9.57	9.30
1887	2,620	1,970	3,659	20.11	10.37	9.71
1888	2,971	2,163	4,065	22.52	11.74	10.56
1889	3,113	2,293	4,242	23.62	12.40	10.85
1890	3,148	2,356	4,312	23.99	12.68	10.84
1891	3,145	2,407	4,221	23.91	12.69	10.50
1892	3,162	2,468	4,304	24.24	12.90	10.64
1893	3,254	2,568	4,559	25.23	13.50	11.12
1894	3,271	2,636	4,733	25.74	13.83	11.41
1895	3,326	2,729	4,740	26.13	14.03	11.43
1896	3,420	2,843	5,006	27.18	14.67	11.92
1897	3,591	2,940	5,391	28.70	15.63	12.58
1898	3,725	3,028	5,593	29.73	16.27	12.91
1899	3,937	3,138	5,983	31.43	17.34	13.57
1900	4,113	3,354	6,123	32.75	18.03	13.92
1901	4,251	3,495	6,304	33.86	18.68	14.25
1902	4,503	3,711	6,817	36.13	19.98	15.33
1903	4,720	3,889	7,238	38.04	21.08	16.21
1904	5,063	4,182	7,759	40.82	22.61	17.39
1905	5,330	4,461	7,763	42.34	23.25	17.71
1906	5,727	5,238	8,370	46.38	25.15	19.57
1907	5,964	5,275	8,480	47.53	25.81	19.78
1908	6,588	5,937	9,030	52.10	28.07	21.42
1909	6,923	6,266	9,727	55.23	29.84	22.92
1910	7,221	7,263	10,086	58.85	31.25	24.62
1911	7,436	7,731	10,709	61.66	32.71	26.15
1912	7,699	8,139	11,365	64.60	34.29	27.68
1913	7,965	8,836	12,013	68.07	35.95	29.52

Table F.41 (continued)

[a]includes rail-cars.

[b]includes baggage cars and service cars.

[c]million lire at 1911 prices.

Sources: see text.

Table F.42
Estimated Value Added and Materials Consumption in Machine-Tramway-Vehicle Maintenance, 1861-1913

	(1)	(2)	(3)	(4)	(5)	(6)
	Estimated weight of the vehicles in service (thousand tons)					
	Steam lines			Electric lines		
	Loco-motives[a] 1861-1913	Passenger cars 1861-1913	Freight cars 1861-1913	Loco-motives[a] 1861-1913	Passenger cars 1861-1913	Freight cars 1861-1913
1861	.00	.00	.00	.00	.00	.00
1862	.00	.00	.00	.00	.00	.00
1863	.00	.00	.00	.00	.00	.00
1864	.00	.00	.00	.00	.00	.00
1865	.00	.00	.00	.00	.00	.00
1866	.00	.00	.00	.00	.00	.00
1867	.00	.00	.00	.00	.00	.00
1868	.00	.00	.00	.00	.00	.00
1869	.00	.00	.00	.00	.00	.00
1870	.00	.00	.00	.00	.00	.00
1871	.00	.00	.00	.00	.00	.00
1872	.00	.00	.00	.00	.00	.00
1873	.00	.00	.00	.00	.00	.00
1874	.00	.00	.00	.00	.00	.00
1875	.01	.01	.01	.00	.00	.00
1876	.02	.02	.02	.00	.00	.00
1877	.02	.02	.02	.00	.00	.00
1878	.04	.05	.05	.00	.00	.00
1879	.21	.23	.27	.00	.00	.00
1880	.60	.67	.77	.00	.00	.00
1881	1.16	1.29	1.51	.00	.00	.00
1882	1.76	1.97	2.33	.00	.00	.00
1883	2.24	2.51	3.00	.00	.00	.00
1884	2.58	2.90	3.49	.00	.00	.00
1885	2.78	3.12	3.79	.00	.00	.00
1886	3.01	3.38	4.14	.00	.00	.00
1887	3.21	3.61	4.44	.00	.00	.00
1888	3.28	3.70	4.56	.00	.00	.00
1889	3.43	3.88	4.80	.00	.00	.00
1890	3.70	4.20	5.23	.10	.01	.00
1891	3.91	4.46	5.57	.20	.02	.01
1892	3.98	4.56	5.69	.20	.02	.01
1893	4.15	4.77	5.98	.25	.03	.01
1894	4.33	5.00	6.28	.30	.03	.01
1895	4.38	5.08	6.37	.54	.06	.02
1896	4.39	5.09	6.39	.89	.09	.03
1897	4.44	5.16	6.48	1.57	.17	.06
1898	4.53	5.28	6.63	3.64	.40	.13
1899	4.59	5.36	6.74	6.19	.69	.23
1900	4.68	5.49	6.90	8.47	.96	.32
1901	4.79	5.65	7.45	11.03	1.21	.40
1902	4.81	5.88	7.98	12.57	1.47	.49
1903	4.76	5.88	8.18	13.05	1.80	.60
1904	4.73	5.69	8.34	13.69	2.10	.70
1905	4.80	5.81	8.72	14.54	2.41	.80
1906	4.93	6.01	9.34	16.08	2.84	.94
1907	4.97	6.02	10.24	18.41	3.38	1.11
1908	5.04	6.02	10.84	20.70	3.90	1.28
1909	5.08	7.37	11.76	22.08	4.19	1.37
1910	5.16	8.89	12.77	22.74	4.33	1.41
1911	5.28	9.16	13.31	25.31	4.93	1.59
1912	5.30	9.30	14.20	29.84	6.00	1.90
1913	5.31	9.42	15.06	34.24	7.07	2.21

Table F.42 (continued)

Year	(7) Value added in maintenance[c] 1861-1913	(8) Materials consumed (thousand tons) Semi-f. metal 1861-1913	(9) Materials consumed (thousand tons) Wood 1861-1913
1861	.00	.00	.00
1862	.00	.00	.00
1863	.00	.00	.00
1864	.00	.00	.00
1865	.00	.00	.00
1866	.00	.00	.00
1867	.00	.00	.00
1868	.00	.00	.00
1869	.00	.00	.00
1870	.00	.00	.00
1871	.00	.00	.00
1872	.00	.00	.00
1873	.00	.00	.00
1874	.00	.00	.00
1875	.00	.00	.00
1876	.00	.00	.00
1877	.00	.00	.00
1878	.01	.00	.00
1879	.05	.02	.02
1880	.15	.07	.05
1881	.29	.13	.10
1882	.45	.19	.15
1883	.57	.25	.19
1884	.66	.28	.22
1885	.71	.31	.24
1886	.77	.33	.26
1887	.82	.36	.27
1888	.84	.36	.28
1889	.88	.38	.29
1890	.96	.42	.32
1891	1.03	.45	.34
1892	1.05	.46	.35
1893	1.11	.48	.37
1894	1.16	.51	.38
1895	1.21	.53	.39
1896	1.26	.56	.39
1897	1.36	.61	.41
1898	1.66	.77	.43
1899	2.02	.95	.46
1900	2.35	1.12	.48
1901	2.73	1.32	.52
1902	2.98	1.45	.56
1903	3.07	1.49	.59
1904	3.16	1.54	.60
1905	3.32	1.61	.64
1906	3.60	1.75	.69
1907	3.97	1.94	.74
1908	4.33	2.12	.79
1909	4.66	2.26	.90
1910	4.92	2.35	1.00
1911	5.35	2.56	1.07
1912	6.04	2.90	1.16
1913	6.72	3.24	1.26

Table F.42 (continued)

[a]includes rail-cars.

Sources: see text.

Table F.43
Physical Product per Engineering-industry Worker, ca. 1913: Firm-specific Evidence

(1) Source page	(2) Firm	(3) Activity or product	(4) Workers (blue-collar)	(5) Output (tons)	(6) Sales (thousand lire)	(7) Output/ worker (tons)	(8) Horse-power/ worker
A. Fabricated metal							
152	Ghidini	small brassware	12	10		.83	.21
151	Gnutti	swords	100	100	200	1.00	.35
133	Cooperativa	hand-forged nails	500	600		1.20	.03
161	Grasselli	non-ferrous hardware	32	40	60	1.25	.05
238	Marcellino	copperware	10	13.5		1.35	
52	Toccafondi	hardware (cans)	15	26	30	1.73	.20
51	Piccinini	hardware	110	200	200	1.82	.05
32	Filosa	hardware	30	60	60	2.00	.33
153	Leali	hardware	5	10		2.00	2.00
158	Carissimo	copperware	5	10		2.00	
122	Scacchini	medals	15	40	80	2.67	.67
133	Cagnola	hardware	185	500	300	2.70	.27
158	Meroni	hardware	70	200	200	2.86	.44
138	Perego	kitchenware	120	353	600	2.94	.20
158	Monti	copperware	14	50		3.57	2.14
258	Pacini	hardware, machinery	100	391	450	3.91	1.24
188	Fornara	hardware	500	2,000	2,000	4.00	.40
310	Bellieni	hardware	25	100		4.00	.12
113	Guglieri	metal furniture	45	200	200	4.44	.07
209	Ruffoni	hardware	30	140		4.67	.50
213	Netro	tools, parts	850	4,000	4,000	4.71	.88
146	Rusconi	hardware	500	2,467	850	4.93	1.22
193	Rigaldo	tools	35	200	200	5.71	.57
194	Cooperativa	files	80	500	300	6.25	.50
271	Giorgetti	metal furniture	4	25	25	6.25	
153	Oliva	agric. tools	12	80		6.67	.42
282	Antinucci	copperware	6	40		6.67	3.33
310	Sandri	copperware	5	35		7.00	1.60
120	Pozzi	hardware	450	4,000		8.89	.67
312	FOM	hardware	30	275	275	9.17	.35
144	Mazzoleni	hardware	100	1,000	1,000	10.00	
151	Gnutti	hardware	30	300		10.00	1.67
154	Gnutti	agric. tools	14	150		10.71	1.07
258	Benti	crude tool parts	12	130		10.83	
277	Bertini	tools, machinery	50	570		11.40	1.24
213	Cremonesi	hardware	125	1,500		12.00	.80
154	Bosio	forged hardware	40	500		12.50	.88
153	Damioli	cutting tools	19	280		14.74	5.42
156	Borghi	hardware	50	750		15.00	1.00
158	Bolis	hardware	120	2,000		16.67	.92
158	Bonaiti	hardware	100	1,800		18.00	.50
63	Bolis	hardware	80	1,500		18.75	1.75
37	TPN	hardware	100	2,250		22.50	1.60
156	Panzera	hardware	40	1,000		25.00	
209	Tocco	sheet-metal prod.	12	400		33.33	.25

Table F.43 (continued)

(1) Source page	(2) Firm	(3) Activity or product	(4) Workers (blue-collar)	(5) Output (tons)	(6) Sales (thousand lire)	(7) Output/ worker (tons)	(8) Horse-power/ worker
B. Heavy engineering, structures							
37	Zeno	gates, stairs	50	130	130	2.60	.14
161	Carabelli	gates, stairs	15	40		2.67	.03
72	Fulconis	structures, mach.	120	391	450	3.26	.42
36	Robecchi	structures	150	750		5.00	.18
38	Cattori	structures	500	2,500		5.00	1.20
93	Migliardi	structures, mach.	110	700		6.36	.82
53	Maccaferri	structures, h'ware	300	2,800		9.33	.33
147	Togni	structures	800	8,000		10.00	.63
156	Paganoni	structures	30	300		10.00	.83
93	Marcenaro	structures, mach.	60	1,000		16.67	1.00
89	SIFGCM	pressure pipelines	350	10,000		28.57	
128	SICG	structures	150	5,000		33.33	
195	Savigliano	structures	450	18,000		40.00	
C. Heavy engineering, machinery							
110	Fornara	machinery	15	19	25	1.27	.33
266	Martelli	machinery	60	77	100	1.28	.40
112	Guerinoni	precision parts	25	39	77.5	1.56	.48
117	Monis	machinery	70	115	150	1.64	
36	SOMF	machinery, struct.	700	1,304	1,500	1.86	.29
52	Tartarini	blinds	20	38	50	1.90	.08
188	Galantini	machinery	20	38	50	1.90	.30
259	Baroncelli	machinery	12	23	30	1.92	
215	Fumagalli	machinery	80	154	200	1.93	.19
311	Gregori	machinery	40	77	100	1.93	.25
188	Frè	machinery	16	31	40	1.94	.31
208	Lizzoli	machinery	140	308	400	2.20	.29
229	BGGM	machinery	280	615	800	2.20	.29
300	Del Favero	machinery	28	62	80	2.21	1.25
30	Carrino	machinery, etc.	200	458	550	2.29	1.25
143	Paredi	machinery	16	38	50	2.38	.31
195	SMIG	precision parts	280	667	1,000	2.38	.71
197	Zanelli	machinery	150	385	500	2.57	.27
238	Tutone	machinery	60	154	200	2.57	.33
191	Mure	machinery	35	92	120	2.63	.43
106	Columbo	machinery (electric)	50	150	300	3.00	.25
292	Bedeschi	machinery	15	46	60	3.07	.25
131	Guenzani	heavy equipment	75	231	300	3.08	
167	Casali	machinery	250	769	1,000	3.08	.60
30	Carnevali	machinery (food)	65	204	265	3.14	.55
134	SAML	machinery	700	2,308	3,000	3.30	.46
124	SIIP	precision parts	75	250	500	3.33	.93
49	Calzoni	machinery	225	769	1,000	3.42	.53
192	Pistorio	safes	50	192	250	3.84	.40
215	Fumagalli	machinery	40	154	200	3.85	.25

Table F.43 (continued)

(1) Source page	(2) Firm	(3) Activity or product	(4) Workers (blue-collar)	(5) Output (tons)	(6) Sales (thousand lire)	(7) Output/ worker (tons)	(8) Horse-power/ worker
C. Heavy engineering, machinery (continued)							
298	SVCMF	machinery	250	962	1,250	3.85	.25
106	Clerici	machinery (electric)	150	600	1,200	4.00	.33
147	Riunite	machinery	300	1,250		4.17	.33
58	Ferrari	machinery, struct.	30	130	150	4.33	.33
195	Savigliano	machinery	450	2,000		4.44	
186	Cigala	machinery	40	192	250	4.80	.20
110	FMA	machine parts	1,100	5,500		5.00	.82
183	Audoli	machinery	50	250		5.00	.60
183	Friulane	machinery	50	250		5.00	.24
129	Comerio	machinery	75	385	500	5.13	.53
191	Dubosc	machinery	300	1,538	2,000	5.13	.33
298	Ronfini	machinery	30	154	200	5.13	.12
128	Fregati	forged parts	20	13	90	5.65	.15
205	Cuneese	machinery, struct.	150	900		6.00	.17
51	Parenti	machinery (agric.)	300	2,000		6.67	.43
168	Moncalvi	foundry, machinery	150	1,000		6.67	
197	Westinghouse	air brakes, mach.	250	1,667	2,500	6.67	.80
251	Cacialli	machinery, struct.	37.5	250	250	6.67	.53
60	Callegari	railway equipment	90	750	750	8.33	.44
251	Bartolazzi	foundry, mach. parts	35	300		8.57	.29
93	Fossati	mach. parts (naval)	300	3,000		10.00	1.00
153	Gottardi	foundry, machinery	84	1,200		14.29	.27
168	Anelli	foundry, machinery	56	800		14.29	.20
195	Savigliano	(total)	1,800	32,500		18.06	.61
178	Trezza	foundry, machinery	176	5,000		28.41	.40
D. Heavy engineering, road vehicles							
220	Favale	bicycles, repairs	10	3		.30	1.00
137	Mona	bicycles	15	5		.33	.10
56	Ranieri	bicycles	4	2		.50	.63
103	Bianchi	bicycles, cars	1,200	650		.54	.83
113	Isotta Fras.	cars	700	600		.86	.57
202	Maina	bicycles, motorbikes	15	13.25		.88	.07
198	Bertoldo	cars, etc.	450	417	2,500	.93	.67
59	Valsit	bicycles	37	60		1.62	
305	Colli	bicycles, repairs	4	8		2.00	.50
161	Frera	bicycles	250	700		2.80	.60
132	Wolsit	cars	300	1,000	2,000	3.33	.27
131	Rejna	car parts	350	1,333	1,200	3.81	.57
131	Sessa	car parts	50	222	200	4.44	1.00
140	Silva	car parts	8	39	35	4.88	
258	Palandri	axles	20	250		12.50	

Table F.43 (continued)

(1) Source page	(2) Firm	(3) Activity or product	(4) Workers (blue-collar)	(5) Output (tons)	(6) Sales (thousand lire)	(7) Output/ worker (tons)	(8) Horse-power/ worker
E. Light engineering							
161	Balzaretti	watches	40	.6		.02	.13
113	Koristka	precision optics	60	4	150	.07	.50
288	Junghans	watches	300	30		.10	
150	Gardoncini	rifles	37.5	4		.11	.31
150	Cavagna	rifles	70	9.6		.14	
104	Borletti	clocks and watches	700	117.1		.17	
150	Beretta	rifles	200	48		.24	2.00
255	Verità	electrical equip.	20	13	50	.65	.15
110	Fossati	precision equip.	25	25	100	1.00	.12
140	OEB	electrical equip.	150	150	600	1.00	.11
54	Santini	electrical equip.	350	375	1,500	1.07	.17
185	Brugnoli	light equipment	12	13	50	1.08	.25
114	Larghi	electrical equip.	35	38	150	1.09	.09
114	Lesmo	precision equip.	20	25	100	1.25	.30
121	Rejna	electric lights	225	300	1,500	1.33	.53
111	Gerra	machinery (sanitary)	300	500	1,000	1.67	
266	OEL	elec. equip., etc.	150	300	600	2.00	.37
106	Comi	machinery (sanitary)	180	438	875	2.43	.22
112	Greco	electrical, artistic	115	400	800	3.48	.61
136	Cusano	kitchen stoves	25	100	100	4.00	.24

Source: Grioni (1914).

Table F.44
Estimated Production of Fabricated Metal and Equipment:
Metal Consumption, 1861-1913 (thousand tons)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Semi-finished ferrous metal, net of rails and railway chairs							
	Gross consumption		processed	consumed as final product			Processed scrap	Net consumption,
	cast iron	w. iron, steel	by other sectors	as rebars	as beams	other	ferrous metal	ferrous metal
	1861-1913	1861-1913	1861-1913	1861-1913	1861-1913	1861-1913	1861-1913	1861-1913
1861	25	89	2	0	0	13	0	99
1862	24	87	3	0	0	13	0	95
1863	25	85	4	0	0	13	0	93
1864	23	81	3	0	0	12	0	89
1865	22	80	5	0	0	12	0	85
1866	21	75	6	0	0	11	0	79
1867	24	90	4	0	0	13	0	97
1868	23	87	6	0	0	13	0	91
1869	27	103	6	0	0	15	0	109
1870	26	101	6	0	0	15	0	106
1871	25	97	6	0	0	14	0	102
1872	27	107	7	0	0	16	0	111
1873	25	98	10	0	0	14	0	99
1874	30	123	10	0	0	18	0	125
1875	29	119	9	0	0	17	0	122
1876	28	118	10	0	0	17	0	119
1877	29	122	12	0	0	18	0	121
1878	24	107	11	0	0	15	0	105
1879	31	138	12	0	0	20	0	137
1880	34	152	18	0	1	21	0	146
1881	44	195	24	0	1	27	0	187
1882	46	204	26	0	2	28	0	194
1883	53	245	25	0	3	35	0	235
1884	54	252	25	0	4	36	0	241
1885	58	275	27	0	5	39	0	262
1886	67	328	33	0	5	46	0	311
1887	83	404	41	0	5	57	0	384
1888	72	361	45	0	4	50	0	334
1889	71	360	43	0	5	50	0	333
1890	58	297	37	0	7	41	0	270
1891	48	253	30	1	8	35	0	227
1892	41	218	27	3	8	29	0	192
1893	44	237	27	4	9	32	0	209
1894	44	241	30	6	9	32	0	208
1895	48	266	32	8	10	35	1	230
1896	46	257	37	10	10	33	3	216
1897	48	269	46	12	10	33	7	223
1898	53	301	59	15	11	36	7	240
1899	64	362	77	18	12	43	12	288
1900	68	379	83	22	13	45	11	295
1901	62	343	77	24	15	39	11	261
1902	64	353	78	26	18	40	11	266
1903	70	387	77	36	22	44	11	289
1904	77	440	73	42	25	52	12	337
1905	90	525	83	47	29	63	12	405
1906	120	675	109	57	30	83	12	528
1907	137	747	131	69	33	90	12	573
1908	155	848	127	73	38	106	12	671
1909	162	916	113	88	47	116	13	727
1910	173	976	111	97	57	124	13	773
1911	175	993	130	112	62	121	13	756
1912	190	1,090	153	121	65	133	13	821
1913	176	1,008	148	129	65	119	13	736

Table F.44 (continued)

	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Semi-finished non-ferrous metal						
	Gross consumption				Net consump-	Net con- sumption,	Residual consump.,
	aluminum	copper, c. alloys	nickel	zinc	tion	all metal, shifted	new fab., gen. eq.
	1861-1913	1861-1913	1861-1913	1861-1913	1861-1913	1861-1913	1861-1913
1861	0	3	0	1	3	102	95.37
1862	0	2	0	1	3	100	93.07
1863	0	2	0	1	3	97	89.89
1864	0	3	0	1	3	94	86.98
1865	0	2	0	1	3	90	82.93
1866	0	2	0	1	3	85	78.34
1867	0	3	0	1	3	91	84.70
1868	0	3	0	1	3	97	90.64
1869	0	3	0	1	3	103	96.72
1870	0	3	0	1	3	111	104.50
1871	0	3	0	1	3	107	98.64
1872	0	3	0	1	3	110	99.40
1873	0	3	0	1	3	108	94.21
1874	0	3	0	2	4	116	101.73
1875	0	4	0	1	4	128	114.82
1876	0	5	0	1	5	125	111.91
1877	0	5	0	2	6	126	113.07
1878	0	4	0	2	5	119	105.86
1879	0	5	0	2	6	127	113.21
1880	0	5	0	2	6	148	132.83
1881	0	5	0	3	7	173	155.91
1882	0	6	0	3	8	198	178.08
1883	0	7	0	3	9	223	201.30
1884	0	7	0	3	9	247	225.78
1885	0	7	0	3	9	261	238.98
1886	0	9	0	4	11	297	276.04
1887	0	9	0	4	11	359	325.79
1888	0	9	0	4	11	370	347.32
1889	0	11	0	4	13	346	336.49
1890	0	11	0	4	13	315	294.89
1891	0	8	0	4	10	260	241.25
1892	0	7	0	4	10	220	201.37
1893	0	8	0	4	10	211	194.26
1894	0	10	0	4	12	220	201.79
1895	0	8	0	4	10	230	213.38
1896	0	10	0	4	12	234	217.44
1897	0	12	0	5	14	233	209.95
1898	0	12	0	5	14	246	224.55
1899	0	13	0	5	15	279	258.07
1900	0	13	0	6	16	307	286.81
1901	0	12	0	7	16	294	271.99
1902	0	14	0	7	18	281	254.22
1903	0	14	0	8	19	296	263.85
1904	0	16	0	8	20	333	305.08
1905	0	21	0	9	24	393	363.95
1906	0	22	0	8	24	491	449.98
1907	1	25	0	10	29	577	531.27
1908	0	27	1	10	30	652	605.24
1909	1	28	0	10	31	730	679.92
1910	1	32	1	11	35	783	723.47
1911	1	34	1	12	38	801	739.96
1912	1	38	0	11	38	827	764.87
1913	1	36	0	12	38	817	754.54

Sources: see text.

Table F.45
Net Imports of Engineering-Related Goods, 1861-1913 (thousand tons)

	(1)	(2)	(3)	(4)	(5)	(6)
		Semi-finished non-ferrous metal				
	Cement 1883-1913	Aluminum 1905-1913	Copper, c. alloys 1861-1913	Nickel 1861-1913	Zinc 1861-1913	Sheet-metal hardware 1861-1913
1861			.839	.019	.658	.186
1862			.839	.019	.658	.186
1863			1.084	.022	.836	.264
1864			1.187	.026	.956	.211
1865			1.084	.020	1.025	.201
1866			.979	.016	.722	.141
1867			1.102	.005	1.036	.149
1868			1.369	.019	.901	.180
1869			1.362	.024	1.170	.185
1870			1.303	.024	1.130	.143
1871			1.402	.031	1.304	.130
1872			1.466	.028	1.223	.224
1873			1.363	.031	1.487	.191
1874			1.575	.043	1.555	.135
1875			2.220	.047	1.213	.165
1876			2.829	.061	1.305	.186
1877			2.811	.046	1.544	.200
1878			2.202	.037	1.686	.128
1879			3.215	.055	1.698	.172
1880			3.041	.057	2.112	.039
1881			3.411	.055	2.300	.091
1882			3.467	.064	2.401	-.020
1883	30.576		4.371	.065	2.712	.103
1884	30.747		3.830	.060	2.574	-.076
1885	34.792		4.019	.060	2.820	-.264
1886	42.691		5.929	.069	3.213	-.437
1887	59.423		5.394	.070	3.194	-.314
1888	39.285		3.322	.072	2.848	-.675
1889	35.224		3.618	.078	3.240	.061
1890	31.230		4.715	.072	2.831	-.990
1891	23.280		2.371	.077	2.956	-1.009
1892	19.218		1.467	.078	2.928	-1.274
1893	18.629		1.351	.193	2.842	-.850
1894	12.067		1.532	.262	3.083	-1.422
1895	10.933		1.119	.164	2.976	-1.338
1896	9.232		1.177	.270	3.279	-1.354
1897	11.722		1.700	.321	3.328	-1.370
1898	7.061		1.373	.149	3.005	-1.618
1899	9.222		1.134	.118	3.018	-1.610
1900	8.726		1.805	.125	3.319	-2.296
1901	7.281		1.284	.221	3.855	-2.204
1902	7.579		2.281	.216	3.912	-2.516
1903	10.010		1.699	.209	4.198	-3.228
1904	7.461		1.740	.295	3.903	-6.454
1905	7.627	.000	2.530	.310	4.419	-8.187
1906	11.997	.059	3.108	.275	4.089	-7.881
1907	24.366	.127	3.604	.251	4.983	-7.169
1908	16.798	-.094	4.850	.607	4.718	-6.156
1909	14.793	-.192	4.733	.272	4.228	-5.969
1910	13.983	-.009	5.090	.520	4.824	-7.895
1911	13.095	.248	6.045	.553	5.513	-9.226
1912	-24.339	.332	5.877	.456	5.488	-14.394
1913	-32.516	.302	5.117	.230	5.701	-12.551

Table F.45 (continued)

	(7) Other hardware 1861-1913	(8) Fab. ferr. metal n.e.c.[a] 1861-1913	(9) Non-ferrous hardware 1861-1913	(10) Machine parts 1888-1913	(11) Metal road vehicles 1896-1913	(12) Prime movers[b] 1861-1913
1861	2.246	3.816	.178			-.650
1862	2.246	3.816	.178			-.650
1863	2.302	8.384	.280			-1.480
1864	3.018	6.935	.401			-2.950
1865	3.355	4.972	.337			-2.760
1866	2.569	5.475	.313			-.793
1867	3.537	4.713	.333			1.018
1868	3.035	4.618	.332			2.234
1869	4.172	6.713	.564			2.103
1870	3.849	6.568	.487			1.322
1871	3.489	7.998	.528			2.671
1872	4.883	6.104	.866			2.242
1873	5.287	6.291	.812			4.900
1874	4.736	6.395	.719			4.692
1875	5.595	6.726	.794			2.945
1876	5.511	4.578	.771			3.375
1877	6.619	5.061	.977			3.942
1878	5.872	3.055	.674			3.945
1879	4.947	5.620	.341			1.959
1880	5.698	6.859	.381			2.949
1881	6.806	12.863	.376			5.251
1882	7.278	15.949	.386			3.611
1883	6.753	16.101	.453			2.945
1884	7.152	16.181	.593			4.623
1885	7.802	15.519	.804			5.431
1886	8.144	16.106	.790			4.225
1887	9.913	24.306	.812			5.071
1888	3.532	19.063	.889	8.107		4.714
1889	2.837	21.456	.900	7.242		4.871
1890	2.387	16.583	.827	5.334		4.315
1891	2.217	13.307	.670	3.640		3.273
1892	2.258	11.802	.579	2.848		3.120
1893	1.992	9.838	.605	2.606		2.071
1894	1.819	9.665	.822	2.939		1.414
1895	2.102	7.016	.532	2.864		1.935
1896	2.101	8.182	.690	2.455	.038	2.124
1897	2.369	7.614	.497	2.221	.027	1.783
1898	2.502	12.012	.539	1.734	.024	2.167
1899	2.526	15.330	.581	2.992	.001	5.256
1900	3.044	21.052	.665	5.404	.140	6.846
1901	3.404	19.516	.754	4.215	.268	6.477
1902	3.802	24.217	.749	4.238	.263	4.311
1903	3.947	25.154	.751	4.047	.253	3.913
1904	4.372	21.552	1.117	5.821	.286	7.208
1905	4.048	23.262	1.345	5.897	.339	8.757
1906	6.056	43.737	1.646	8.717	.023	11.083
1907	8.840	68.827	2.447	11.264	-.515	15.797
1908	8.514	77.481	2.708	16.667	-1.182	16.558
1909	8.317	60.965	2.246	11.056	-1.657	13.439
1910	8.745	67.511	3.090	12.323	-1.619	12.029
1911	9.531	63.616	3.290	14.176	-2.189	11.335
1912	8.469	69.900	3.240	11.650	-2.881	9.064
1913	8.360	64.903	2.824	11.068	-2.140	4.619

Table F.45 (continued)

	(13) Other machinery[c] 1861-1913	(14) Firearm parts 1861-1913	(15) Firearms 1861-1913	(16) Gas meters, electrical equipment 1905-1913	(17) Carding wire, pr. instr. 1861-1913	(18) Musical instrument parts 1888-1913
1861	4.077	.055	.948		.133	
1862	4.077	.055	.948		.133	
1863	3.509	.099	1.253		.142	
1864	4.454	.098	.500		.239	
1865	8.540	.063	.392		.175	
1866	4.332	.035	.032		.142	
1867	4.909	.016	-.002		.200	
1868	3.011	.052	.016		.180	
1869	6.619	.053	.005		.221	
1870	4.762	.042	-.451		.160	
1871	3.879	.049	-.043		.186	
1872	8.347	.047	.003		.271	
1873	9.672	.047	-.174		.285	
1874	9.515	.041	-.019		.270	
1875	9.461	.041	-.007		.303	
1876	9.945	.030	.004		.282	
1877	9.737	.044	.004		.313	
1878	8.128	.056	.013		.232	
1879	8.856	.007	.028		.182	
1880	13.931	.004	.028		.228	
1881	16.398	.005	-.067		.238	
1882	23.434	-.003	-.188		.284	
1883	23.351	.003	.053		.277	
1884	25.005	-.135	.013		.358	
1885	28.407	-.016	-.540		.376	
1886	25.481	.001	.063		.492	
1887	33.952	-.003	.074		1.353	
1888	17.615	-.016	.029		.612	.013
1889	18.875	-.015	.035		.648	.012
1890	18.791	.006	.013		.560	.007
1891	14.737	.004	.003		.394	.008
1892	15.125	-.005	.052		.378	.009
1893	15.002	-.030	.068		.394	.007
1894	16.778	.007	.050		.299	.009
1895	22.400	.008	.046		.343	.012
1896	23.403	.009	.058		.455	.015
1897	20.329	-.034	.039		.618	.014
1898	21.930	.011	.051		.902	.015
1899	31.180	-.029	.064		.943	.012
1900	43.592	.010	.044		1.049	.012
1901	34.053	-.045	.057		1.105	.012
1902	34.043	.004	.077		1.123	.014
1903	40.000	.005	.076		1.249	.015
1904	45.748	-.012	.088		1.385	.005
1905	54.196	-.055	-.021	.252	1.449	-.003
1906	82.414	-.123	-.593	.404	2.210	.013
1907	103.068	.002	.126	.491	2.351	-.001
1908	109.832	.001	.227	.688	2.525	.020
1909	78.686	.002	.225	.798	2.067	.000
1910	74.820	.003	.178	1.071	2.304	.016
1911	66.910	.002	.188	1.338	2.219	.000
1912	63.028	-.004	.159	1.383	2.500	.034
1913	53.710	.001	.194	1.441	2.458	.017

Table F.45 (continued)

	(19) Musical instru-ments 1861-1913	(20) Clock, watch parts 1861-1913	(21) Clocks and watches 1861-1913	(22) Total eng'g net imports 1861-1913	(23) Total precision instr. 1861-1913	(24) Assembled general machinery 1861-1913
1861	.011	.004	.036	11.040	.184	4.43
1862	.011	.004	.036	11.040	.184	4.43
1863	.015	.006	.052	14.826	.197	3.46
1864	.016	.011	.067	13.000	.295	2.23
1865	.014	.006	.047	15.342	.229	6.02
1866	.011	.006	.030	12.293	.193	3.62
1867	.011	.011	.040	14.935	.221	5.57
1868	.012	.010	.034	13.714	.202	4.97
1869	.018	.015	.047	20.715	.249	7.86
1870	.006	.016	.033	16.937	.176	5.08
1871	.011	.016	.034	18.948	.197	5.72
1872	.012	.020	.039	23.058	.283	9.00
1873	.010	.018	.017	27.356	.295	12.21
1874	.007	.017	.038	26.546	.277	12.06
1875	.008	.021	.033	26.085	.311	10.91
1876	.010	.030	.030	24.752	.292	11.73
1877	.010	.031	.035	26.973	.323	12.04
1878	.008	.030	.030	22.171	.240	10.64
1879	.011	.046	.026	22.195	.193	9.55
1880	.009	.037	.028	30.191	.237	14.38
1881	.020	.062	.028	42.071	.258	17.69
1882	.016	.062	.027	50.836	.300	21.18
1883	.024	.083	.032	50.178	.301	20.04
1884	.029	.081	.058	53.882	.387	21.64
1885	.034	.092	.070	57.715	.410	24.16
1886	.033	.113	.076	55.087	.525	21.75
1887	.040	.154	.085	75.443	1.143	26.34
1888	.025	.068	.072	54.048	.900	24.59
1889	.022	.072	.056	57.072	.682	23.78
1890	.012	.087	.052	47.984	.579	23.12
1891	.014	.091	.053	37.402	.416	18.01
1892	.021	.092	.057	35.062	.408	18.30
1893	.017	.110	.057	31.887	.418	17.14
1894	.013	.082	.047	32.522	.321	18.24
1895	.010	.088	.051	36.069	.365	24.38
1896	.010	.077	.046	38.309	.480	25.62
1897	.003	.086	.047	34.243	.635	22.18
1898	.006	.084	.059	40.418	.923	24.17
1899	.004	.106	.057	57.413	.959	36.50
1900	.002	.120	.065	79.749	1.063	50.62
1901	-.004	.085	.060	67.753	1.113	40.86
1902	-.003	.131	.065	70.518	1.134	38.69
1903	.000	.122	.091	76.395	1.264	44.24
1904	.002	.143	.084	81.345	1.392	53.33
1905	.001	.143	.061	91.484	1.699	63.27
1906	-.006	.128	.089	147.917	2.621	92.93
1907	-.009	.139	.094	205.752	2.832	118.48
1908	-.010	.146	.102	228.121	3.223	125.44
1909	-.016	.131	.075	170.365	2.849	90.69
1910	-.017	.160	.094	172.813	3.374	85.41
1911	-.018	.160	.090	161.422	3.539	76.24
1912	-.017	.175	.094	152.400	3.900	69.37
1913	-.019	.160	.084	135.128	3.897	56.38

Table F.45 (continued)

	(25) Diagnostic series: General equipment 1861-1913	(26) Diagnostic series: Fabric'd metal 1861-1913	(27) Net tariff (lire/ton): General machinery 1861-1913	(28) Net tariff (lire/ton): Fabric'd metal 1861-1913	(29) Ratio of net tariffs 1861-1913	(30) Cumulative demand index (1861 = 1) 1861-1913
1861	4.83	7.026	-42.5	22.5	-1.889	1.000
1862	4.83	7.026	-42.5	22.5	-1.889	1.000
1863	3.78	11.830	-42.5	22.5	-1.889	.903
1864	2.50	11.165	-42.5	22.5	-1.889	.794
1865	6.64	9.465	-41.3	26.4	-1.564	.896
1866	4.01	9.098	-40.0	30.3	-1.320	.956
1867	6.14	9.132	-40.0	30.3	-1.320	.949
1868	5.51	8.565	-40.0	30.3	-1.320	.989
1869	8.98	12.034	-40.0	30.3	-1.320	1.006
1870	5.88	11.447	-40.0	30.3	-1.320	.980
1871	6.56	12.145	-27.8	41.6	-.668	.936
1872	10.64	12.077	-27.8	41.6	-.668	1.008
1873	14.44	12.581	-27.8	41.6	-.668	1.103
1874	14.23	11.985	-27.8	41.6	-.668	1.141
1875	12.44	13.280	-27.8	41.6	-.668	1.113
1876	13.36	11.046	-27.8	41.6	-.668	1.114
1877	13.73	12.857	-27.8	41.6	-.668	1.133
1878	12.14	9.729	-12.8	44.1	-.290	1.136
1879	10.85	11.080	2.3	46.6	.049	1.126
1880	16.92	12.977	2.3	46.6	.049	1.138
1881	21.59	20.136	2.3	46.6	.049	1.140
1882	26.86	23.617	2.3	46.6	.049	1.127
1883	26.35	23.286	2.3	46.6	.049	1.133
1884	29.50	23.941	2.3	46.6	.049	1.145
1885	33.28	24.178	2.3	46.6	.049	1.174
1886	29.77	25.127	2.3	46.6	.049	1.168
1887	36.05	29.961	2.3	46.6	.049	1.148
1888	33.49	28.752	17.5	35.5	.493	1.146
1889	31.01	25.181	17.5	35.5	.493	1.148
1890	28.46	19.995	17.5	35.5	.493	1.176
1891	21.65	16.396	17.5	35.5	.493	1.190
1892	21.14	14.894	17.5	35.5	.493	1.188
1893	19.72	12.605	17.5	35.5	.493	1.213
1894	21.19	12.590	17.5	35.5	.493	1.240
1895	27.25	9.918	17.5	35.5	.493	1.330
1896	28.08	11.244	17.5	35.5	.493	1.397
1897	24.37	10.754	17.5	35.5	.493	1.365
1898	25.92	15.377	17.5	35.5	.493	1.294
1899	39.46	18.759	17.5	35.5	.493	1.292
1900	56.03	25.220	17.5	35.5	.493	1.333
1901	45.03	24.115	17.5	35.5	.493	1.314
1902	42.93	29.271	17.5	35.5	.493	1.244
1903	48.29	30.498	17.5	35.5	.493	1.221
1904	59.14	28.332	17.5	35.5	.493	1.277
1905	69.11	30.292	17.5	35.5	.493	1.336
1906	101.52	53.015	17.5	35.5	.493	1.314
1907	129.75	81.548	17.5	35.5	.493	1.257
1908	142.11	89.934	17.5	35.5	.493	1.232
1909	101.75	72.722	17.5	35.5	.493	1.215
1910	97.74	80.925	17.5	35.5	.493	1.172
1911	90.42	78.282	17.5	35.5	.493	1.145
1912	81.02	84.488	17.5	35.5	.493	1.113
1913	67.45	78.597	17.5	35.5	.493	1.073

[a]includes structural components.
[b]excludes locomotives.
[c]excludes ships and rail-guided vehicles.

Sources: see text.

Table F.46
The Structure of the Engineering Industry in 1911

row	component	(1) value added (million lire)	(2) output (thous. tons)	(3) metal cons. (thous. tons)	(4) total workers (thou-sands)	(5) value added (lire) per ton of output	(6) value added (lire) per worker	(7) metal consump-tion (tons) per ton of output	(8) metal consump-tion (tons) per worker
	A. Fabricated metal								
	new production								
1.	total	152.62	367.76	496.48	90.46	415	1,687	1.35	5.49
	maintenance								
2.	blacksmiths	132.68		5.24	102.69		1,292		.05
3.	other smiths	53.72		.42	41.23		1,303		.01
4.	other	8.65		.34	6.57		1,317		.05
5.	total	195.05		6.00	150.49		1,296		.04
	total								
6.	total	347.67		502.48	240.95		1,443		2.09
	B. General equipment								
	new production								
7.	mere assembly	4.25	14.18	.00	3.06	300	1,387	.00	.00
8.	truss-s. comp.	14.62	41.77	50.12	5.51	350	2,651	1.20	9.09
9.	other	175.30	194.78	243.48	80.34	900	2,182	1.25	3.03
10.	total	194.17		293.60	88.91		2,184		3.30
	maintenance								
11.	total	32.86		3.79	24.69		1,331		.15
	total								
12.	total	227.03		297.39	113.60		1,999		2.62
	C. Precision equipment: instruments								
	new production								
13.	total	4.57	.277	.69	1.99	16,500	2,296	2.50	.35
	maintenance								
14.	total	1.36		.01	.96		1,416		.01
	total								
15.	total	5.93		.70	2.95		2,010		.24
	D. Precision equipment: clocks and watches								
	new production								
16.	mere assembly	1.28	.160	.00	.83	8,000	1,535	.00	.00
17.	from metal	2.31	.154	.39	1.04	15,000	2,221	2.50	.38
18.	total	3.59	.314	.39	1.87		1,920		.21
	maintenance								
19.	total	10.63		.04	6.93		1,535		.01
	total								
20.	total	14.22		.43	8.80		1,616		.05
	Total								
21.	new production	354.95		791.16	183.23		1,937		4.32
22.	maintenance	239.90		9.84	183.07		1,310		.05
23.	total	594.85		801.00	366.30		1,624		2.19

Sources: see text.

Table F.47
The Structure of the Engineering Industry in 1900

row	component	(1) value added (million lire)	(2) output (thous. tons)	(3) metal cons. (thous. tons)	(4) total workers (thou-sands)	(5) value added (lire) per ton of output	(6) value added (lire) per worker	(7) metal consump-tion (tons) per ton of output	(8) metal consump-tion (tons) per worker
	A. Fabricated metal								
	new production								
1.	total	55.14	132.87	179.37	79.44	415	694	1.35	2.26
	maintenance								
2.	blacksmiths	123.69		4.88	95.73		1,292		.05
3.	other smiths	44.71		.35	34.31		1,303		.01
4.	other	7.20		.28	5.47		1,317		.05
5.	total	175.76		5.51	135.51		1,296		.04
	total								
6.	total	230.74		184.88	214.95		1,073		.86
	B. General equipment								
	new production								
7.	mere assembly	1.62	5.41	.00	1.17	300	1,387	.00	.00
8.	truss-s. comp.	3.65	10.43	12.51	1.83	350	1,995	1.20	6.82
9.	other	77.36	85.95	107.44	46.31	900	1,670	1.25	2.32
10.	total	82.63		119.95	49.31		1,676		2.43
	maintenance								
11.	total	14.49		1.67	10.89		1,331		.15
	total								
12.	total	97.12		121.62	60.20		1,613		2.02
	C. Precision equipment: instruments								
	new production								
13.	total	2.11	.128	.32	1.17	16,500	1,803	2.50	.27
	maintenance								
14.	total	.54		.00	.38		1,416		.01
	total								
15.	total	2.65		.32	1.55		1,710		.21
	D. Precision equipment: clocks and watches								
	new production								
16.	mere assembly	.96	.120	.00	.63	8,000	1,535	.00	.00
17.	from metal	.86	.057	.14	.45	15,000	1,911	2.50	.31
18.	total	1.82	.177	.14	1.08		1,685		.13
	maintenance								
19.	total	11.77		.04	7.67		1,535		.01
	total								
20.	total	13.59		.18	8.75		1,553		.02
	Total								
21.	new production	141.70		299.78	131.00		1,082		2.29
22.	maintenance	202.40		7.22	154.45		1,310		.05
23.	total	344.10		307.00	285.45		1,205		1.08

Sources: see text.

Table F.48
The Structure of the Engineering Industry in 1881

row	component	(1) value added (million lire)	(2) output (thous. tons)	(3) metal cons. (thous. tons)	(4) total workers (thou-sands)	(5) value added (lire) per ton of output	(6) value added (lire) per worker	(7) metal consump-tion (tons) per ton of output	(8) metal consump-tion (tons) per worker
	A. Fabricated metal								
	new production								
1.	total	45.13	108.74	146.80	81.07	415	557	1.35	1.81
	maintenance								
2.	blacksmiths	109.57		4.33	84.80		1,292		.05
3.	other smiths	36.00		.28	27.63		1,303		.01
4.	other	5.80		.23	4.40		1,317		.05
5.	total	151.37		4.84	116.83		1,296		.04
	total								
6.	total	196.50		151.64	197.90		993		.77
	B. General equipment								
	new production								
7.	mere assembly	1.17	3.90	.00	.84	300	1,387	.00	.00
8.	truss-s. comp.	3.28	9.37	11.24	2.70	350	1,215	1.20	4.16
9.	other	6.56	7.29	9.11	6.20	900	1,058	1.25	1.47
10.	total	11.01		20.35	9.74		1,130		2.09
	maintenance								
11.	total	6.67		.77	5.01		1,331		.15
	total								
12.	total	17.68		21.12	14.75		1,199		1.43
	C. Precision equipment: instruments								
	new production								
13.	total	.89	.054	.14	.80	16,500	1,113	2.50	.17
	maintenance								
14.	total	.28		.00	.20		1,416		.01
	total								
15.	total	1.17		.14	1.00		1,170		.14
	D. Precision equipment: clocks and watches								
	new production								
16.	mere assembly	.50	.062	.00	.33	8,000	1,535	.00	.00
17.	from metal	.41	.027	.07	.25	15,000	1,640	2.50	.28
18.	total	.91	.089	.07	.58		1,569		.12
	maintenance								
19.	total	8.24		.03	5.37		1,535		.01
	total								
20.	total	9.15		.10	5.95		1,538		.02
	Total								
21.	new production	57.94		167.36	92.19		628		1.82
22.	maintenance	166.56		5.64	127.41		1,307		.04
23.	total	224.50		173.00	219.60		1,022		.79

Sources: see text.

Table F.49
The Structure of the Engineering Industry in 1871

row	component	(1) value added (million lire)	(2) output (thous. tons)	(3) metal cons. (thous. tons)	(4) total workers (thou-sands)	(5) value added (lire) per ton of output	(6) value added (lire) per worker	(7) metal consump-tion (tons) per ton of output	(8) metal consump-tion (tons) per worker
	A. Fabricated metal								
	new production								
1.	total	28.90	69.64	94.01	77.66	415	372	1.35	1.21
	maintenance								
2.	blacksmiths	102.80		4.06	79.56		1,292		.05
3.	other smiths	32.62		.26	25.04		1,303		.01
4.	other	5.25		.21	3.99		1,317		.05
5.	total	140.67		4.53	108.59		1,295		.04
	total								
6.	total	169.57		98.54	186.25		910		.53
	B. General equipment								
	new production								
7.	mere assembly	.25	.84	.00	.18	300	1,387	.00	.00
8.	truss-s. comp.	.97	2.77	3.32	1.03	350	942	1.20	3.21
9.	other	3.33	3.70	4.63	3.99	900	835	1.25	1.16
10.	total	4.55		7.95	5.20		875		1.53
	maintenance								
11.	total	3.12		.36	2.35		1,331		.15
	total								
12.	total	7.67		8.31	7.55		1,016		1.10
	C. Precision equipment: instruments								
	new production								
13.	total	.46	.028	.07	.53	16,500	868	2.50	.13
	maintenance								
14.	total	.24		.00	.17		1,416		.01
	total								
15.	total	.70		.07	.70		1,000		.10
	D. Precision equipment: clocks and watches								
	new production								
16.	mere assembly	.13	.016	.00	.08	8,000	1,535	.00	.00
17.	from metal	.33	.022	.06	.21	15,000	1,571	2.50	.28
18.	total	.46	.038	.06	.29		1,586		.21
	maintenance								
19.	total	6.09		.02	3.96		1,535		.01
	total								
20.	total	6.55		.09	4.25		1,541		.02
	Total								
21.	new production	34.37		102.09	83.68		411		1.22
22.	maintenance	150.12		4.91	115.07		1,305		.04
23.	total	184.49		107.00	198.75		928		.54

Sources: see text.

Table F.50
Ancillary Estimates: Clocks and Watches, Truss-structure Components, 1861-1913

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Clocks, watches (thousand tons)							
	Output of the Borletti works 1861-1913	Other output 1861-1913	Actual mid-year stock 1861-1913	Weighted construc-tion (Mil-lion 1911 lire) 1861-1913	Net exp. of compo-nents of bridges, canopies 1861-1913	Bridge, canopy metal consump. (thou. t.) 1861-1913	Hydro-electric power added (thou. kW) 1861-1913	Power-line tower metal consump. (thou. t.) 1861-1913
1861	.000	.022	.829	135.800	.000	2.06	.0	.00
1862	.000	.022	.886	154.025	.000	2.34	.0	.00
1863	.000	.024	.953	161.525	.000	2.45	.0	.00
1864	.000	.028	1.040	151.675	.000	2.30	.0	.00
1865	.000	.027	1.124	152.600	.000	2.31	.0	.00
1866	.000	.023	1.183	124.850	.000	1.89	.0	.00
1867	.000	.022	1.232	97.875	.000	1.48	.0	.00
1868	.000	.022	1.279	98.525	.000	1.49	.0	.00
1869	.000	.023	1.331	89.425	.000	1.36	.0	.00
1870	.000	.023	1.385	99.475	.000	1.51	.0	.00
1871	.000	.022	1.431	102.625	.000	3.32	.0	.00
1872	.000	.023	1.481	113.400	.000	5.49	.0	.00
1873	.000	.021	1.520	133.975	.000	8.66	.0	.00
1874	.000	.021	1.556	140.300	.000	9.06	.0	.00
1875	.000	.023	1.601	122.500	.000	7.91	.0	.00
1876	.000	.023	1.649	119.825	.000	7.74	.0	.00
1877	.000	.025	1.703	116.100	.000	7.50	.0	.00
1878	.000	.025	1.757	117.925	.000	7.62	.0	.00
1879	.000	.025	1.813	126.675	.000	8.18	.0	.00
1880	.000	.026	1.870	146.150	.000	9.44	.0	.00
1881	.000	.027	1.937	173.925	.000	11.24	.0	.00
1882	.000	.029	2.016	216.325	.000	13.98	.0	.00
1883	.000	.031	2.108	242.000	.000	15.63	.0	.00
1884	.000	.035	2.225	232.175	.000	15.00	.0	.03
1885	.000	.038	2.368	226.675	.000	14.64	.1	.03
1886	.000	.041	2.535	222.825	.000	14.40	.0	.06
1887	.000	.043	2.726	223.225	.000	14.42	.2	.09
1888	.000	.042	2.903	242.725	.000	15.68	.1	.15
1889	.000	.038	3.034	223.675	.000	14.45	.4	.15
1890	.000	.036	3.144	203.275	.000	13.13	.1	.06
1891	.000	.037	3.259	174.900	.090	11.41	.1	.39
1892	.000	.037	3.377	156.675	.698	10.96	1.2	.66
1893	.000	.039	3.506	136.550	.261	9.14	1.0	.54
1894	.000	.037	3.622	146.025	.906	10.52	.8	.60
1895	.000	.036	3.720	90.875	2.239	8.56	1.2	.93
1896	.000	.035	3.812	77.125	1.843	7.19	1.9	2.13
1897	.003	.035	3.900	80.175	4.026	10.01	5.2	5.73
1898	.007	.036	4.001	79.500	2.540	8.18	13.9	5.82
1899	.012	.038	4.120	84.475	3.558	9.73	5.5	3.63
1900	.016	.041	4.265	97.475	.181	6.51	6.6	6.00
1901	.018	.040	4.402	104.975	.110	6.91	13.4	7.29
1902	.022	.040	4.545	121.425	.040	7.89	10.9	10.98
1903	.025	.044	4.724	118.675	.102	7.79	25.7	16.26
1904	.034	.046	4.924	129.125	.066	8.42	28.5	11.07
1905	.039	.045	5.123	143.900	.050	9.36	8.4	11.01
1906	.050	.045	5.321	178.475	.098	11.65	28.3	20.31
1907	.056	.046	5.538	203.650	.000	13.16	39.4	23.07
1908	.060	.048	5.772	229.175	.000	14.81	37.5	22.11
1909	.075	.046	5.999	267.550	.257	17.59	36.2	22.38
1910	.090	.047	6.238	302.150	.068	19.60	38.4	29.49
1911	.105	.049	6.510	314.275	.000	20.30	59.9	29.82
1912	.117	.050	6.800	328.175	.000	21.20	39.5	29.58
1913	.129	.049	7.093	323.100	.177	21.09	59.1	29.58

Sources: see text.

Table F.51
Machinery Maintenance Index, 1861-1913 (1911 = 1.000)

	(1)	(2)	(3)	(4)	(5)	(6)
	Coal or coal-equivalent (thousand tons)					
	Net imports of coal 1861-1913	Petroleum, nat. gas consumed 1861-1913	Consumed by the railways 1861-1913	Consumed by gas works 1861-1913	Consumed by non-met. mineral product kilns Prel. est. 1861-1913	Final est. 1861-1913
1861	477	0	85	80	202	19
1862	477	0	104	85	244	23
1863	422	0	124	89	246	23
1864	584	2	144	95	255	24
1865	488	12	165	100	271	25
1866	557	17	196	106	215	21
1867	524	25	199	113	213	22
1868	587	48	212	120	210	23
1869	657	40	236	127	218	25
1870	940	52	259	135	227	27
1871	779	58	284	144	249	32
1872	1,034	56	316	153	271	36
1873	955	47	349	163	321	45
1874	1,027	59	372	174	348	52
1875	1,052	61	385	185	297	47
1876	1,449	60	411	197	286	48
1877	1,326	68	395	210	302	53
1878	1,321	56	382	223	305	56
1879	1,515	80	397	238	313	61
1880	1,729	78	429	253	341	70
1881	2,064	81	454	270	366	84
1882	2,168	83	476	287	425	108
1883	2,343	92	523	307	454	128
1884	2,599	100	564	327	478	150
1885	2,949	126	572	347	507	177
1886	2,920	97	618	369	530	205
1887	3,575	102	666	392	512	220
1888	3,867	95	742	414	514	246
1889	3,990	97	790	438	517	275
1890	4,348	97	828	464	542	320
1891	3,903	100	820	483	556	364
1892	3,865	104	809	502	540	393
1893	3,712	105	823	550	553	447
1894	4,683	104	837	522	565	508
1895	4,288	98	854	540	524	523
1896	4,062	99	887	587	525	525
1897	4,236	96	919	593	539	539
1898	4,414	99	978	648	553	553
1899	4,839	100	1,034	674	578	578
1900	4,923	103	1,088	658	609	609
1901	4,813	98	1,163	686	664	664
1902	5,373	99	1,216	685	747	747
1903	5,518	98	1,264	733	823	823
1904	5,870	101	1,358	793	889	889
1905	6,435	102	1,433	813	976	976
1906	7,642	104	1,543	872	1,042	1,042
1907	8,260	122	1,735	940	1,119	1,119
1908	8,406	139	1,882	974	1,214	1,214
1909	9,252	151	2,008	1,029	1,428	1,428
1910	9,291	150	2,070	1,050	1,648	1,648
1911	9,555	211	2,120	1,089	1,776	1,776
1912	10,031	202	2,147	1,080	1,864	1,864
1913	10,642	213	2,178	1,151	1,887	1,887

Table F.51 (continued)

	(7)	(8)	(9)	(10)	(11)	(12)
	Coal or coal-equivalent (thousand tons)					
	Consumed, not for steam, by					
	Chemical works		Metalmaking works		Engineering works	Sugar refineries
	Prel. est. 1861-1913	Final est. 1861-1913	Prel. est. 1861-1913	Final est. 1861-1913	1861-1913	1861-1913
1861	8	3	35	4	42	4
1862	8	3	29	3	41	4
1863	9	3	24	2	40	4
1864	11	4	26	3	39	3
1865	10	4	22	2	38	3
1866	10	4	25	3	36	4
1867	10	4	25	3	38	3
1868	11	4	24	3	41	4
1869	12	5	25	3	44	5
1870	13	5	28	4	47	5
1871	13	5	25	3	45	5
1872	15	6	32	5	47	5
1873	15	6	27	4	47	10
1874	17	7	34	5	50	11
1875	16	7	33	6	55	12
1876	18	8	31	5	54	12
1877	21	10	31	6	55	16
1878	24	11	29	6	52	16
1879	25	12	45	9	56	21
1880	26	13	48	10	66	12
1881	31	16	56	13	79	19
1882	33	18	59	16	90	20
1883	37	21	71	21	99	26
1884	42	25	78	25	109	29
1885	46	29	83	30	115	30
1886	52	34	98	39	132	30
1887	52	36	129	57	160	30
1888	54	39	162	79	166	30
1889	55	42	169	92	156	30
1890	58	46	139	83	141	30
1891	62	51	120	80	116	28
1892	70	61	110	81	99	28
1893	75	68	121	98	95	27
1894	87	83	121	109	100	26
1895	108	107	129	129	105	29
1896	107	107	133	133	108	27
1897	120	120	140	140	112	28
1898	131	131	158	158	122	28
1899	153	153	174	174	142	38
1900	224	224	194	194	156	63
1901	241	241	176	176	148	69
1902	296	296	172	172	144	78
1903	355	355	190	190	149	102
1904	409	409	211	211	162	60
1905	501	501	243	243	190	72
1906	544	544	414	414	240	83
1907	559	559	474	474	283	105
1908	588	588	503	503	312	145
1909	806	806	397	397	337	106
1910	1,040	1,040	416	416	358	147
1911	973	973	418	418	372	139
1912	1,096	1,096	473	473	392	164
1913	1,177	1,177	454	454	386	256

Table F.51 (continued)

	(13) Net imports of raw sugar (thou. t.) 1861-1913	(14) Coal or eq.(thou. t.) Consumed for elec. lighting 1861-1913	(15) Coal or eq.(thou. t.) Net for steam (eff. units) 1861-1913	(16) Net hydro-electric power (Mill. kWh) 1861-1913	(17) Eq. dir. water power (Mill. kWh) 1861-1913	(18) Power-driven mach. maint. index (1911 = 1) 1861-1913
1861	12	0	101	0	93	.052
1862	12	0	89	0	102	.053
1863	28	0	94	0	112	.058
1864	36	0	92	0	122	.061
1865	10	0	88	0	131	.064
1866	12	0	98	0	141	.070
1867	9	0	97	0	151	.073
1868	13	0	132	0	162	.083
1869	14	0	145	0	172	.089
1870	15	0	182	0	182	.099
1871	14	0	199	0	192	.106
1872	16	0	218	0	203	.113
1873	30	0	211	0	213	.116
1874	34	0	260	0	224	.128
1875	38	0	277	0	235	.135
1876	37	0	307	0	246	.144
1877	47	0	352	0	257	.156
1878	48	0	415	0	274	.173
1879	65	0	468	0	292	.189
1880	36	0	538	0	308	.206
1881	59	0	621	0	320	.225
1882	62	0	705	0	333	.244
1883	78	0	808	0	351	.268
1884	88	0	862	0	374	.286
1885	138	0	976	0	392	.312
1886	56	1	1,099	0	406	.337
1887	137	1	1,208	1	417	.360
1888	41	2	1,314	2	430	.383
1889	78	2	1,388	2	448	.403
1890	89	3	1,388	3	474	.413
1891	83	4	1,336	4	499	.414
1892	83	5	1,400	6	513	.431
1893	79	6	1,365	10	522	.430
1894	75	6	1,351	13	526	.430
1895	82	6	1,356	16	530	.433
1896	76	6	1,403	20	536	.445
1897	76	7	1,361	32	536	.442
1898	72	9	1,373	59	522	.449
1899	61	11	1,390	89	500	.455
1900	51	12	1,448	113	479	.466
1901	37	13	1,485	156	451	.478
1902	16	15	1,499	204	438	.493
1903	4	15	1,563	251	442	.523
1904	0	17	1,780	309	446	.583
1905	1	19	1,970	351	450	.632
1906	3	22	2,147	401	454	.683
1907	13	25	2,375	504	458	.761
1908	1	27	2,477	625	462	.825
1909	1	29	2,492	738	466	.872
1910	1	31	2,504	858	470	.920
1911	2	33	2,617	1,015	474	1.000
1912	1	35	2,686	1,177	478	1.074
1913	1	37	2,821	1,342	482	1.160

Table F.51 (continued)

	(19) Sewing machines (thousand tons) Net imports 1861-1913	(20) Sewing machines (thousand tons) Mid-year stock 1861-1913	(21) Bicycles Taxed, fiscal year[a] (thousand) 1861-1913	(22) Bicycles Mean stock (thou. t.) 1861-1913	(23) User-driven mach. maint. index (1911 = 1) 1861-1913	(24) Machinery maintenance index (1911 = 1) 1861-1913
1861	.000	0	0	0	.000	.047
1862	.000	0	0	0	.000	.048
1863	.000	0	0	0	.000	.052
1864	.000	0	0	0	.000	.055
1865	.000	0	0	0	.000	.058
1866	.000	0	0	0	.000	.063
1867	.000	0	0	0	.000	.066
1868	.000	0	0	0	.000	.075
1869	.000	0	0	0	.000	.080
1870	.000	0	0	0	.000	.089
1871	.000	0	0	0	.000	.095
1872	.000	0	0	0	.000	.102
1873	.000	0	0	0	.000	.104
1874	.000	0	0	0	.000	.115
1875	.000	0	0	0	.000	.122
1876	.000	0	0	0	.000	.130
1877	.000	0	0	0	.000	.140
1878	.000	0	0	0	.000	.156
1879	.000	0	0	0	.000	.170
1880	.000	0	0	0	.000	.185
1881	.000	0	0	0	.000	.203
1882	.000	0	0	0	.000	.220
1883	.000	0	0	0	.000	.241
1884	.000	0	0	0	.000	.257
1885	.000	0	0	0	.000	.281
1886	.000	0	0	0	.000	.303
1887	.246	0	0	0	.000	.324
1888	.646	1	0	0	.004	.345
1889	1.045	1	0	0	.004	.363
1890	1.416	3	0	0	.013	.373
1891	1.946	4	0	0	.017	.374
1892	1.725	6	13	0	.025	.390
1893	1.006	7	26	0	.034	.390
1894	1.188	8	39	1	.082	.395
1895	1.220	9	51	1	.086	.398
1896	1.878	10	64	1	.091	.410
1897	2.323	12	77	1	.099	.408
1898	1.717	14	109	2	.152	.419
1899	2.159	16	128	2	.160	.426
1900	2.416	17	142	3	.217	.441
1901	2.821	20	173	3	.226	.453
1902	2.967	22	199	3	.238	.468
1903	2.815	24	240	4	.295	.500
1904	3.470	27	272	5	.352	.560
1905	2.920	29	296	5	.365	.605
1906	3.486	32	368	6	.426	.657
1907	4.792	35	406	7	.487	.734
1908	5.246	39	467	8	.548	.797
1909	4.962	43	605	10	.657	.851
1910	5.700	48	931	13	.807	.909
1911	6.066	52	996	17	1.000	1.000
1912	6.285	57	1,109	20	1.149	1.082
1913	3.984	61	1,225	22	1.254	1.169

[a]from July 1 of the indicated year.

Sources: see text.

Table F.52
Estimated New Production of General-engineering Products, 1861-1913

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	New production (thousand tons)						
	Fabri-cated metal 1861-1913	Machines merely assembled 1861-1913	Truss-structure components 1861-1913	Other general equipment 1861-1913	Precision instru-ments 1861-1913	Clocks and watches merely assembled 1861-1913	Clocks and watches from metal 1861-1913
1861	67.07	.40	1.72	3.86	.036	.004	.022
1862	65.46	.40	1.95	3.76	.036	.004	.022
1863	63.56	.32	2.04	3.27	.036	.006	.024
1864	61.85	.27	1.92	2.78	.043	.011	.028
1865	58.66	.62	1.93	2.99	.042	.006	.027
1866	55.24	.39	1.58	3.02	.032	.006	.023
1867	59.75	.57	1.23	3.23	.030	.011	.022
1868	63.80	.54	1.24	3.61	.030	.010	.022
1869	68.02	1.12	1.13	3.91	.031	.015	.023
1870	73.60	.80	1.26	4.11	.030	.016	.023
1871	69.64	.84	2.77	3.70	.028	.016	.022
1872	70.03	1.64	4.58	3.89	.033	.020	.023
1873	66.17	2.23	7.22	3.90	.037	.018	.021
1874	71.45	2.17	7.55	4.22	.037	.017	.021
1875	80.90	1.53	6.59	4.49	.037	.021	.023
1876	78.97	1.63	6.45	4.24	.038	.030	.023
1877	79.85	1.69	6.25	4.22	.038	.031	.025
1878	74.63	1.50	6.35	4.09	.041	.030	.025
1879	79.59	1.30	6.82	4.61	.044	.046	.025
1880	93.04	2.54	7.87	5.78	.049	.037	.026
1881	108.74	3.90	9.37	7.29	.054	.062	.027
1882	123.98	5.68	11.65	8.57	.058	.062	.029
1883	139.71	6.31	13.03	10.15	.061	.083	.031
1884	156.14	7.86	12.53	11.99	.066	.081	.035
1885	165.16	9.12	12.23	13.61	.072	.092	.038
1886	189.45	8.02	12.05	16.22	.080	.113	.041
1887	223.16	9.71	12.09	19.62	.112	.124	.043
1888	234.44	8.90	13.19	24.66	.129	.098	.042
1889	220.70	7.23	12.17	30.83	.110	.072	.038
1890	185.45	5.34	10.99	35.62	.095	.087	.036
1891	146.44	3.64	9.83	34.84	.082	.091	.037
1892	119.98	2.84	9.68	31.52	.073	.092	.037
1893	112.69	2.58	8.07	33.70	.073	.110	.039
1894	113.50	2.95	9.27	38.86	.068	.082	.037
1895	113.74	2.87	7.91	47.86	.065	.088	.036
1896	109.59	2.46	7.77	55.59	.074	.077	.035
1897	102.79	2.19	13.12	56.94	.088	.086	.038
1898	108.31	1.75	11.67	62.66	.108	.084	.043
1899	121.76	2.96	11.13	74.95	.122	.106	.050
1900	132.87	5.41	10.43	85.95	.128	.120	.057
1901	126.94	4.17	11.83	80.50	.134	.085	.058
1902	122.20	4.24	15.73	71.40	.137	.131	.062
1903	127.99	4.05	20.04	72.85	.143	.122	.069
1904	144.25	5.81	16.24	88.27	.152	.143	.080
1905	167.38	5.84	16.98	110.39	.167	.143	.084
1906	208.76	8.59	26.63	134.53	.205	.128	.095
1907	252.49	11.27	30.19	152.33	.239	.139	.102
1908	290.53	16.67	30.77	170.42	.255	.146	.108
1909	328.48	11.06	33.31	189.18	.255	.131	.121
1910	355.74	12.33	40.91	194.58	.259	.160	.137
1911	367.76	14.18	41.77	194.78	.277	.160	.154
1912	385.07	11.65	42.32	196.02	.290	.175	.167
1913	385.93	11.07	42.23	186.83	.299	.160	.178

Table F.52 (continued)

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Metal consumption (thousand tons)						
	Fabri-cated metal 1861-1913	Machines merely assembled 1861-1913	Truss-structure components 1861-1913	Other general equipment 1861-1913	Precision instru-ments 1861-1913	Clocks and watches merely assembled 1861-1913	Clocks and watches from metal 1861-1913
1861	90.55	.00	2.06	4.82	.09	.00	.06
1862	88.37	.00	2.34	4.70	.09	.00	.06
1863	85.80	.00	2.45	4.09	.09	.00	.06
1864	83.50	.00	2.30	3.48	.11	.00	.07
1865	79.19	.00	2.31	3.74	.11	.00	.07
1866	74.57	.00	1.89	3.77	.08	.00	.06
1867	80.66	.00	1.48	4.04	.08	.00	.06
1868	86.13	.00	1.49	4.51	.08	.00	.06
1869	91.83	.00	1.36	4.89	.08	.00	.06
1870	99.36	.00	1.51	5.14	.08	.00	.06
1871	94.01	.00	3.32	4.63	.07	.00	.06
1872	94.54	.00	5.49	4.86	.08	.00	.06
1873	89.33	.00	8.66	4.88	.09	.00	.05
1874	96.46	.00	9.06	5.27	.09	.00	.05
1875	109.21	.00	7.91	5.61	.09	.00	.06
1876	106.61	.00	7.74	5.30	.10	.00	.06
1877	107.80	.00	7.50	5.27	.10	.00	.06
1878	100.75	.00	7.62	5.11	.10	.00	.06
1879	107.45	.00	8.18	5.76	.11	.00	.06
1880	125.61	.00	9.44	7.22	.12	.00	.07
1881	146.80	.00	11.24	9.11	.14	.00	.07
1882	167.37	.00	13.98	10.71	.15	.00	.07
1883	188.61	.00	15.63	12.69	.15	.00	.08
1884	210.79	.00	15.03	14.99	.17	.00	.09
1885	222.97	.00	14.67	17.01	.18	.00	.10
1886	255.76	.00	14.46	20.28	.20	.00	.10
1887	301.27	.00	14.51	24.52	.28	.00	.11
1888	316.49	.00	15.83	30.83	.32	.00	.11
1889	297.95	.00	14.60	38.54	.28	.00	.10
1890	250.36	.00	13.19	44.53	.24	.00	.09
1891	197.70	.00	11.80	43.55	.21	.00	.09
1892	161.97	.00	11.62	39.40	.18	.00	.09
1893	152.13	.00	9.68	42.13	.18	.00	.10
1894	153.22	.00	11.12	48.57	.17	.00	.09
1895	153.55	.00	9.49	59.83	.16	.00	.09
1896	147.95	.00	9.32	69.49	.19	.00	.09
1897	138.77	.00	15.74	71.18	.22	.00	.10
1898	146.22	.00	14.00	78.33	.27	.00	.11
1899	164.38	.00	13.36	93.69	.31	.00	.13
1900	179.37	.00	12.51	107.44	.32	.00	.14
1901	171.37	.00	14.20	100.62	.34	.00	.15
1902	164.97	.00	18.87	89.25	.34	.00	.16
1903	172.79	.00	24.05	91.06	.36	.00	.17
1904	194.74	.00	19.49	110.34	.38	.00	.20
1905	225.96	.00	20.37	137.99	.42	.00	.21
1906	281.82	.00	31.96	168.16	.51	.00	.24
1907	340.86	.00	36.23	190.41	.60	.00	.26
1908	392.22	.00	36.92	213.02	.64	.00	.27
1909	443.45	.00	39.97	236.47	.64	.00	.30
1910	480.25	.00	49.09	243.22	.65	.00	.34
1911	496.48	.00	50.12	243.48	.69	.00	.39
1912	519.84	.00	50.78	245.03	.73	.00	.42
1913	521.00	.00	50.67	233.54	.75	.00	.45

Sources: see text.

Table F.53
Estimated Value Added and Metal Consumption in the Maintenance of Fabricated Metal and Machinery, 1861-1913

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Value added in maintenance (million lire at 1911 prices)						
	of fabricated metal			of	of preci-	of	
	by black-smiths 1861-1913	by other smiths 1861-1913	other 1861-1913	general equipment 1861-1913	sion in-struments 1861-1913	clocks, watches 1861-1913	total 1861-1913
1861	96.44	29.83	4.80	1.54	.23	3.53	136
1862	97.06	30.05	4.84	1.58	.23	3.77	138
1863	97.68	30.27	4.87	1.71	.23	4.05	139
1864	98.31	30.50	4.91	1.81	.23	4.42	140
1865	98.94	30.72	4.95	1.91	.24	4.78	142
1866	99.57	31.10	5.01	2.07	.24	5.03	143
1867	100.21	31.48	5.07	2.17	.24	5.24	144
1868	100.85	31.85	5.13	2.46	.24	5.44	146
1869	101.49	32.16	5.18	2.63	.24	5.66	147
1870	102.14	32.39	5.22	2.92	.24	5.89	149
1871	102.80	32.62	5.25	3.12	.24	6.09	150
1872	103.45	32.86	5.29	3.35	.25	6.30	152
1873	104.12	33.09	5.33	3.42	.25	6.47	153
1874	104.78	33.25	5.35	3.78	.26	6.62	154
1875	105.45	33.64	5.42	4.01	.26	6.81	156
1876	106.13	33.95	5.47	4.27	.27	7.01	157
1877	106.81	34.42	5.54	4.60	.27	7.24	159
1878	107.49	34.96	5.63	5.13	.27	7.47	161
1879	108.18	35.28	5.68	5.59	.28	7.71	163
1880	108.87	35.68	5.75	6.08	.28	7.95	165
1881	109.57	36.00	5.80	6.67	.28	8.24	167
1882	110.27	36.32	5.85	7.23	.28	8.51	168
1883	110.98	36.57	5.89	7.92	.29	8.81	170
1884	111.69	36.97	5.95	8.45	.29	9.20	173
1885	112.40	37.38	6.02	9.23	.30	9.66	175
1886	113.12	37.86	6.10	9.96	.32	10.18	178
1887	113.84	38.27	6.16	10.65	.35	10.77	180
1888	114.57	38.76	6.24	11.34	.38	11.26	183
1889	115.31	39.33	6.33	11.93	.41	11.53	185
1890	116.04	39.91	6.43	12.26	.43	11.68	187
1891	116.79	40.32	6.49	12.29	.44	11.82	188
1892	117.53	40.58	6.53	12.82	.44	11.94	190
1893	118.29	40.84	6.58	12.82	.44	12.07	191
1894	119.04	41.35	6.66	12.98	.45	12.12	193
1895	119.81	41.85	6.74	13.08	.45	12.08	194
1896	120.57	42.30	6.81	13.47	.45	11.99	196
1897	121.34	43.00	6.92	13.41	.46	11.86	197
1898	122.12	43.62	7.02	13.77	.48	11.77	199
1899	122.90	44.16	7.11	14.00	.51	11.73	200
1900	123.69	44.71	7.20	14.49	.54	11.77	202
1901	124.48	45.34	7.30	14.89	.58	11.55	204
1902	125.28	45.90	7.39	15.38	.61	11.34	206
1903	126.08	46.55	7.50	16.43	.65	11.23	208
1904	126.89	47.20	7.60	18.40	.69	11.18	212
1905	127.70	47.85	7.71	19.88	.74	11.09	215
1906	128.51	48.68	7.84	21.59	.81	10.97	218
1907	129.34	49.61	7.99	24.12	.91	10.89	223
1908	130.16	50.71	8.16	26.19	1.03	10.84	227
1909	131.00	51.30	8.26	27.96	1.13	10.74	230
1910	131.84	52.33	8.43	29.87	1.24	10.64	234
1911	132.68	53.72	8.65	32.86	1.36	10.63	240
1912	133.53	55.03	8.86	35.55	1.49	10.63	245
1913	134.38	56.53	9.10	38.41	1.62	10.60	251

Table F.53 (continued)

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Metal consumption in maintenance (thousand tons)						
	of fabricated metal			of	of preci-	of	
	by black-smiths 1861-1913	by other smiths 1861-1913	other 1861-1913	general equipment 1861-1913	sion in-struments 1861-1913	clocks, watches 1861-1913	total 1861-1913
1861	3.81	.23	.19	.18	.00	.01	4.42
1862	3.83	.23	.19	.18	.00	.01	4.44
1863	3.86	.24	.19	.20	.00	.02	4.51
1864	3.88	.24	.19	.21	.00	.02	4.54
1865	3.91	.24	.19	.22	.00	.02	4.58
1866	3.93	.24	.20	.24	.00	.02	4.63
1867	3.96	.25	.20	.25	.00	.02	4.68
1868	3.98	.25	.20	.28	.00	.02	4.73
1869	4.01	.25	.20	.30	.00	.02	4.78
1870	4.03	.25	.21	.34	.00	.02	4.85
1871	4.06	.26	.21	.36	.00	.02	4.91
1872	4.09	.26	.21	.39	.00	.02	4.97
1873	4.11	.26	.21	.39	.00	.02	4.99
1874	4.14	.26	.21	.44	.00	.02	5.07
1875	4.16	.26	.21	.46	.00	.03	5.12
1876	4.19	.27	.21	.49	.00	.03	5.19
1877	4.22	.27	.22	.53	.00	.03	5.27
1878	4.25	.27	.22	.59	.00	.03	5.36
1879	4.27	.28	.22	.64	.00	.03	5.44
1880	4.30	.28	.23	.70	.00	.03	5.54
1881	4.33	.28	.23	.77	.00	.03	5.64
1882	4.35	.28	.23	.83	.00	.03	5.72
1883	4.38	.29	.23	.91	.00	.03	5.84
1884	4.41	.29	.23	.97	.00	.03	5.93
1885	4.44	.29	.24	1.06	.00	.04	6.07
1886	4.47	.30	.24	1.15	.00	.04	6.20
1887	4.50	.30	.24	1.23	.00	.04	6.31
1888	4.52	.30	.25	1.31	.00	.04	6.42
1889	4.55	.31	.25	1.38	.00	.04	6.53
1890	4.58	.31	.25	1.41	.00	.04	6.59
1891	4.61	.32	.26	1.42	.00	.04	6.65
1892	4.64	.32	.26	1.48	.00	.04	6.74
1893	4.67	.32	.26	1.48	.00	.05	6.78
1894	4.70	.32	.26	1.50	.00	.05	6.83
1895	4.73	.33	.26	1.51	.00	.05	6.88
1896	4.76	.33	.27	1.55	.00	.05	6.96
1897	4.79	.34	.27	1.55	.00	.04	6.99
1898	4.82	.34	.28	1.59	.00	.04	7.07
1899	4.85	.35	.28	1.61	.00	.04	7.13
1900	4.88	.35	.28	1.67	.00	.04	7.22
1901	4.92	.35	.29	1.72	.00	.04	7.32
1902	4.95	.36	.29	1.77	.00	.04	7.41
1903	4.98	.36	.29	1.90	.00	.04	7.57
1904	5.01	.37	.30	2.12	.01	.04	7.85
1905	5.04	.37	.30	2.29	.01	.04	8.05
1906	5.08	.38	.31	2.49	.01	.04	8.31
1907	5.11	.39	.31	2.78	.01	.04	8.64
1908	5.14	.40	.32	3.02	.01	.04	8.93
1909	5.17	.40	.32	3.23	.01	.04	9.17
1910	5.21	.41	.33	3.45	.01	.04	9.45
1911	5.24	.42	.34	3.79	.01	.04	9.84
1912	5.27	.43	.35	4.10	.01	.04	10.20
1913	5.31	.44	.36	4.43	.01	.04	10.59

Sources: see text.

Table F.54
Estimated Output of Precious Metal Products, 1861-1913 (tons)

	(1)	(2)	(3)	(4)	(5)
	Estimated net imports			Silverware equivalent	
	gold products 1861-1913	silver products 1861-1913	weighted total 1861-1913	Estimated consumption 1861-1913	Estimated output 1861-1913
1861	1.918	1.587	14.280	110.197	101.526
1862	1.918	1.587	14.280	111.832	103.925
1863	2.032	1.778	15.187	116.267	106.087
1864	1.732	1.528	13.054	115.100	108.156
1865	.961	1.731	8.418	111.832	104.250
1866	1.006	1.310	8.280	98.290	97.635
1867	1.064	1.355	8.689	91.987	91.959
1868	.915	1.763	8.161	95.489	98.301
1869	.604	1.734	6.181	114.166	103.393
1870	.122	1.941	3.363	101.092	110.224
1871	.770	2.223	7.711	114.400	109.884
1872	1.073	2.324	9.714	116.734	112.084
1873	1.168	.346	8.332	112.298	109.888
1874	.936	2.268	8.798	109.263	109.640
1875	1.215	3.070	11.351	117.668	110.330
1876	.577	1.635	5.912	111.832	111.698
1877	.867	3.259	9.356	113.699	109.430
1878	.705	3.360	8.440	108.330	105.561
1879	1.533	4.266	14.543	109.497	104.855
1880	1.531	3.196	13.460	115.801	111.587
1881	1.009	4.084	11.072	130.042	117.121
1882	1.455	6.348	16.135	126.774	122.275
1883	2.233	6.595	21.265	138.214	119.322
1884	2.962	8.600	27.845	138.447	123.245
1885	3.770	9.419	33.735	155.490	124.928
1886	4.085	13.081	39.374	161.093	133.299
1887	3.947	16.278	41.705	176.035	133.173
1888	3.249	11.179	32.225	153.622	129.799
1889	2.439	12.895	28.858	141.015	121.211
1890	2.725	12.334	30.092	140.081	118.787
1891	3.000	11.441	30.925	145.451	119.570
1892	3.126	14.536	34.810	149.187	124.177
1893	2.305	13.353	28.475	151.521	126.319
1894	2.637	13.018	30.223	150.821	127.099
1895	3.531	14.921	37.737	154.323	127.524
1896	2.761	15.357	33.341	157.591	130.842
1897	2.234	12.911	27.587	157.591	134.533
1898	3.257	15.052	36.148	163.195	139.337
1899	2.553	11.920	28.598	166.463	140.787
1900	2.430	14.574	30.480	164.595	146.202
1901	2.249	13.037	27.807	170.199	145.182
1902	2.020	12.786	26.119	161.093	147.719
1903	2.215	24.374	38.931	180.238	146.418
1904	2.663	21.597	38.966	177.670	151.225
1905	2.675	26.569	44.013	192.612	154.318
1906	4.548	32.483	61.682	211.756	165.865
1907	4.563	33.680	62.973	234.403	178.595
1908	4.218	29.601	56.729	241.407	201.299
1909	3.731	35.832	59.903	274.326	204.480
1910	6.446	44.363	85.473	265.921	216.797
1911	6.221	39.556	79.254	298.840	219.586
1912	7.942	39.321	89.820	312.148	226.646
1913	9.340	43.077	102.350	302.809	212.182

Sources: see text.

Summary Table F.1
The engineering industries: physical output and maintenance, 1861-1913

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		New production					
	Fabri-cated metal	Seagoing vessels					
		Naval vessels (displacement tons)					
	(thousand tons)	Armored frigates	Frigates, corvettes	Battle-ships	Armored cruisers	Protected cruisers	Torpedo cruisers
code:	faa01	fba01	fba02	fba03	fba04	fba05	fba06
source:	f52c01	f16c01	f16c02	f16c03	f16c04	f16c05	f16c06
note:	(a)	(b)	(b)	(b)	(b)	(b,c)	(b,d)
1861	67.07	2,136	2,887	0	0	0	0
1862	65.46	2,679	2,472	0	0	0	61
1863	63.56	4,292	2,066	0	0	0	122
1864	61.85	3,555	1,197	0	0	0	122
1865	58.66	3,657	851	0	0	0	122
1866	55.24	3,999	458	0	0	0	122
1867	59.75	3,659	645	0	0	0	122
1868	63.80	2,825	833	0	0	0	122
1869	68.02	2,243	833	0	0	0	35
1870	73.60	2,243	681	0	0	0	0
1871	69.64	2,224	146	0	0	0	0
1872	70.03	1,796	0	0	0	0	0
1873	66.17	1,367	0	1,844	0	507	204
1874	71.45	1,197	0	2,926	0	579	823
1875	80.90	276	0	2,926	0	579	908
1876	78.97	0	0	3,878	0	508	1,027
1877	79.85	0	0	5,712	0	0	1,100
1878	74.63	0	0	5,712	0	0	598
1879	79.59	0	0	5,712	0	410	480
1880	93.04	0	0	4,041	0	1,644	130
1881	108.74	0	0	4,804	0	1,940	0
1882	123.98	0	0	7,332	0	1,940	0
1883	139.71	0	0	7,018	0	2,266	0
1884	156.14	0	0	8,694	0	2,759	209
1885	165.16	0	0	9,629	0	2,606	1,029
1886	189.45	0	0	9,685	0	3,360	2,263
1887	223.16	0	0	9,204	0	3,300	1,817
1888	234.44	0	0	8,274	0	1,525	1,464
1889	220.70	0	0	5,799	0	2,320	1,890
1890	185.45	0	0	5,355	1,008	2,468	1,653
1891	146.44	0	0	4,761	1,008	2,909	1,235
1892	119.98	0	0	4,170	1,113	3,312	1,348
1893	112.69	0	0	3,801	3,505	3,191	830
1894	113.50	0	0	4,617	4,937	2,910	378
1895	113.74	0	0	3,320	8,893	1,728	356
1896	109.59	0	0	2,736	11,597	1,284	171
1897	102.79	0	0	2,736	11,690	827	775
1898	108.31	0	0	3,045	9,167	333	933
1899	121.76	0	0	7,083	8,250	333	849
1900	132.87	0	0	7,255	7,804	333	572
1901	126.94	0	0	10,490	3,241	138	0
1902	122.20	0	0	11,294	7,147	0	0
1903	127.99	0	0	10,060	9,636	0	0
1904	144.25	0	0	11,629	1,568	0	0
1905	167.38	0	0	10,225	4,813	0	0
1906	208.76	0	0	8,866	6,582	0	0
1907	252.49	0	0	8,293	10,431	330	0
1908	290.53	0	0	5,168	11,660	661	0
1909	328.48	0	0	3,138	10,143	826	0
1910	355.74	0	0	12,991	6,096	1,973	0
1911	367.76	0	0	22,352	1,449	2,320	0
1912	385.07	0	0	32,592	0	3,927	0
1913	385.93	0	0	30,065	0	3,486	839

Summary Table F.1 (continued)

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	New production (continued)						
	Seagoing vessels (continued)						
	Naval vessels (continued) (displacement tons)						
	Destroyers	Submarines	Torpedo boats	Gunboats	Tugs	Bulk transports	Other auxiliaries
code:	fba07	fba08	fba09	fba10	fba11	fba12	fba13
source:	f16c07	f16c08	f16c09	f16c10	f16c11	f16c12	f16c13
note:	(b)	(b)	(b)	(b)	(b)	(b)	(b)
1861	0	0	0	0	0	0	0
1862	0	0	0	0	0	0	0
1863	0	0	0	0	0	0	582
1864	0	0	0	333	71	0	2,816
1865	0	0	0	666	132	0	3,010
1866	0	0	0	666	74	0	1,630
1867	0	0	0	752	58	0	253
1868	0	0	0	909	58	0	141
1869	0	0	0	833	54	0	21
1870	0	0	0	600	37	0	0
1871	0	0	0	257	169	0	0
1872	0	0	0	92	380	0	0
1873	0	0	0	149	697	0	0
1874	0	0	0	149	657	0	0
1875	0	0	0	107	547	0	0
1876	0	0	0	33	273	212	118
1877	0	0	0	0	0	346	439
1878	0	0	0	0	0	195	252
1879	0	0	0	0	0	27	0
1880	0	0	0	0	0	0	0
1881	0	0	5	0	0	0	0
1882	0	0	29	216	0	0	23
1883	40	0	83	432	0	0	30
1884	146	0	200	432	44	525	24
1885	212	0	288	348	96	1,060	218
1886	212	0	710	434	106	548	327
1887	118	0	1,226	610	150	189	319
1888	12	0	826	610	158	562	492
1889	0	6	608	434	380	813	530
1890	0	38	944	130	620	421	177
1891	0	38	917	204	694	179	88
1892	0	13	618	407	362	691	0
1893	0	0	363	407	150	1,077	0
1894	0	0	236	204	30	698	0
1895	0	0	26	0	0	135	0
1896	0	0	23	20	0	443	0
1897	41	0	63	40	0	501	0
1898	91	0	86	153	0	80	0
1899	224	0	122	265	31	65	0
1900	460	0	131	152	267	85	0
1901	433	0	36	40	361	43	0
1902	481	0	82	40	403	0	0
1903	312	28	166	640	207	949	0
1904	188	153	548	1,620	40	6,277	0
1905	491	223	1,900	1,400	40	8,267	0
1906	1,340	188	2,320	390	106	3,839	0
1907	959	268	875	0	186	0	0
1908	545	293	261	132	139	32	0
1909	545	120	159	98	141	64	0
1910	545	379	462	0	274	674	0
1911	1,225	1,080	1,738	429	747	643	0
1912	2,790	1,305	1,531	448	1,019	0	0
1913	3,306	1,191	763	0	1,032	1,776	1,544

Summary Table F.1 (continued)

	(15)	(16)	(17)	(18)	(19)
	New production (continued)				
	Seagoing v. (continued) Merchant vessels (thou. gross reg. tons)		Rail-guided vehicles (thousand tons)		
	Sail-powered	Engine-powered	Loco-motives	Passenger cars	Freight cars
code:	fba14	fba15	fca01	fca02	fca03
source:	f21c04	f21c08	f38c01	f38c02	f38c03
note:	(e)	(e)	(f,g)	(f)	(f,h)
1861	25.0	.0	.12	.74	1.44
1862	32.4	.0	.25	1.92	3.54
1863	38.4	.2	.24	1.56	4.03
1864	48.5	.2	.05	.57	2.94
1865	58.2	.4	.04	.82	5.58
1866	63.9	.7	.17	.88	4.86
1867	77.5	.4	.38	.65	1.50
1868	88.8	.7	.50	.63	3.05
1869	89.9	2.0	.40	.68	2.93
1870	77.3	1.4	.32	.30	2.87
1871	64.8	.2	.37	.11	2.95
1872	63.0	.2	.41	.08	3.93
1873	71.6	2.6	.42	.28	4.11
1874	84.3	3.5	.52	1.09	1.86
1875	80.7	1.2	.32	1.20	2.13
1876	56.6	.2	.31	.62	2.98
1877	35.5	.2	.54	.39	3.33
1878	25.6	.7	.50	.64	2.19
1879	18.0	.7	.44	1.35	2.21
1880	13.2	.5	.59	1.62	9.82
1881	13.9	1.7	.88	2.13	15.72
1882	16.0	1.6	.95	3.95	13.66
1883	15.1	1.6	1.06	3.69	11.00
1884	12.3	1.8	1.34	2.77	7.63
1885	10.9	.5	2.04	3.02	8.31
1886	8.5	.3	1.12	3.06	16.21
1887	5.2	1.2	1.27	4.74	24.48
1888	8.2	1.6	3.22	6.84	25.05
1889	19.3	.9	3.13	5.65	19.04
1890	25.9	4.5	2.09	3.10	9.43
1891	20.0	6.0	1.42	2.04	3.61
1892	15.4	2.4	1.22	1.65	3.60
1893	10.9	1.9	.88	1.27	4.16
1894	5.7	3.2	1.47	1.02	5.69
1895	4.4	5.2	1.68	1.96	5.56
1896	3.5	9.4	1.95	2.45	5.37
1897	4.3	17.2	4.09	1.99	8.50
1898	6.5	31.7	6.02	2.12	14.45
1899	8.8	52.5	7.07	3.60	18.33
1900	8.8	60.5	8.20	5.21	18.47
1901	15.4	40.5	6.74	4.15	23.17
1902	26.4	24.5	5.15	2.24	27.54
1903	19.1	22.8	7.06	4.08	23.10
1904	8.2	32.6	7.33	9.15	13.15
1905	7.8	36.9	10.36	8.71	15.84
1906	8.9	41.1	14.12	4.32	44.56
1907	9.1	40.2	14.58	4.77	73.41
1908	7.8	27.7	13.57	10.50	72.93
1909	6.7	25.5	12.01	10.67	56.60
1910	6.0	20.2	13.23	8.35	49.72
1911	5.2	21.4	15.24	10.34	62.77
1912	6.9	38.3	16.21	10.32	71.69
1913	9.1	43.9	16.19	11.49	58.11

Summary Table F.1 (continued)

	(20)	(21)	(22)	(23)	(24)	(25)	(26)
	New production (continued)						
	General equipment (thousand tons)			Precision equipment (thousand tons)			
	Machines merely assembled	Truss-structure components	Other general equipment	Precision instruments	Clocks and watches merely assembled	Clocks and watches from metal	Precious-metal products (tons)
code:	fda01	fda02	fda03	fea01	fea02	fea03	ffa01
source:	f52c02	f52c03	f52c04	f52c05	f52c06	f52c07	f54c05
note:	(i)	(j)	(a)	(k)	(i)	(k)	(l)
1861	.40	1.72	3.86	.036	.004	.022	101.526
1862	.40	1.95	3.76	.036	.004	.022	103.925
1863	.32	2.04	3.27	.036	.006	.024	106.087
1864	.27	1.92	2.78	.043	.011	.028	108.156
1865	.62	1.93	2.99	.042	.006	.027	104.250
1866	.39	1.58	3.02	.032	.006	.023	97.635
1867	.57	1.23	3.23	.030	.011	.022	91.959
1868	.54	1.24	3.61	.030	.010	.022	98.301
1869	1.12	1.13	3.91	.031	.015	.023	103.393
1870	.80	1.26	4.11	.030	.016	.023	110.224
1871	.84	2.77	3.70	.028	.016	.022	109.884
1872	1.64	4.58	3.89	.033	.020	.023	112.084
1873	2.23	7.22	3.90	.037	.018	.021	109.888
1874	2.17	7.55	4.22	.037	.017	.021	109.640
1875	1.53	6.59	4.49	.037	.021	.023	110.330
1876	1.63	6.45	4.24	.038	.030	.023	111.698
1877	1.69	6.25	4.22	.038	.031	.025	109.430
1878	1.50	6.35	4.09	.041	.030	.025	105.561
1879	1.30	6.82	4.61	.044	.046	.025	104.855
1880	2.54	7.87	5.78	.049	.037	.026	111.587
1881	3.90	9.37	7.29	.054	.062	.027	117.121
1882	5.68	11.65	8.57	.058	.062	.029	122.275
1883	6.31	13.03	10.15	.061	.083	.031	119.322
1884	7.86	12.53	11.99	.066	.081	.035	123.245
1885	9.12	12.23	13.61	.072	.092	.038	124.928
1886	8.02	12.05	16.22	.080	.113	.041	133.299
1887	9.71	12.09	19.62	.112	.124	.043	133.173
1888	8.90	13.19	24.66	.129	.098	.042	129.799
1889	7.23	12.17	30.83	.110	.072	.038	121.211
1890	5.34	10.99	35.62	.095	.087	.036	118.787
1891	3.64	9.83	34.84	.082	.091	.037	119.570
1892	2.84	9.68	31.52	.073	.092	.037	124.177
1893	2.58	8.07	33.70	.073	.110	.039	126.319
1894	2.95	9.27	38.86	.068	.082	.037	127.099
1895	2.87	7.91	47.86	.065	.088	.036	127.524
1896	2.46	7.77	55.59	.074	.077	.035	130.842
1897	2.19	13.12	56.94	.088	.086	.038	134.533
1898	1.75	11.67	62.66	.108	.084	.043	139.337
1899	2.96	11.13	74.95	.122	.106	.050	140.787
1900	5.41	10.43	85.95	.128	.120	.057	146.202
1901	4.17	11.83	80.50	.134	.085	.058	145.182
1902	4.24	15.73	71.40	.137	.131	.062	147.719
1903	4.05	20.04	72.85	.143	.122	.069	146.418
1904	5.81	16.24	88.27	.152	.143	.080	151.225
1905	5.84	16.98	110.39	.167	.143	.084	154.318
1906	8.59	26.63	134.53	.205	.128	.095	165.865
1907	11.27	30.19	152.33	.239	.139	.102	178.595
1908	16.67	30.77	170.42	.255	.146	.108	201.299
1909	11.06	33.31	189.18	.255	.131	.121	204.480
1910	12.33	40.91	194.58	.259	.160	.137	216.797
1911	14.18	41.77	194.78	.277	.160	.154	219.586
1912	11.65	42.32	196.02	.290	.175	.167	226.646
1913	11.07	42.23	186.83	.299	.160	.178	212.182

Summary Table F.1 (continued)

	(27)	(28)	(29)	(30)	(31)	(32)	(33)
	(value added: Maintenance million lire at 1911 prices)						
	Fabricated metal			Seagoing vessels			
					Merchant vessels		
	by blacksmiths	by other smiths	other	Naval vessels	Sail-powered	Engine-powered dry-dock	Engine-powered other
code:	fab01v	fab02v	fab03v	fbb01v	fbb02v	fbb03v	fbb04v
source:	f53c01	f53c02	f53c03	f22c11	f27c10	f27c03	f27c02
note:	(m)	(n)	(n)	(o)	(p)	(q)	(r)
1861	96.44	29.83	4.80	1.93	3.61	.17	.04
1862	97.06	30.05	4.84	1.91	3.68	.23	.11
1863	97.68	30.27	4.87	1.89	3.88	.26	.19
1864	98.31	30.50	4.91	1.84	3.92	.28	.26
1865	98.94	30.72	4.95	1.79	4.19	.27	.29
1866	99.57	31.10	5.01	1.80	4.57	.30	.30
1867	100.21	31.48	5.07	1.92	4.86	.29	.31
1868	100.85	31.85	5.13	2.16	5.26	.30	.31
1869	101.49	32.16	5.18	2.51	5.65	.35	.33
1870	102.14	32.39	5.22	2.68	6.01	.37	.40
1871	102.80	32.62	5.25	2.58	6.24	.42	.48
1872	103.45	32.86	5.29	2.35	6.27	.48	.52
1873	104.12	33.09	5.33	2.23	6.27	.54	.60
1874	104.78	33.25	5.35	2.30	6.30	.63	.70
1875	105.45	33.64	5.42	2.32	6.47	.68	.75
1876	106.13	33.95	5.47	2.32	6.69	.70	.79
1877	106.81	34.42	5.54	2.31	6.74	.73	.79
1878	107.49	34.96	5.63	2.34	6.72	.72	.80
1879	108.18	35.28	5.68	2.43	6.57	.81	.86
1880	108.87	35.68	5.75	2.53	6.39	.91	.93
1881	109.57	36.00	5.80	2.62	6.27	1.00	1.06
1882	110.27	36.32	5.85	2.68	6.16	1.16	1.24
1883	110.98	36.57	5.89	2.76	6.05	1.33	1.39
1884	111.69	36.97	5.95	2.87	5.94	1.32	1.57
1885	112.40	37.38	6.02	3.01	5.81	1.45	1.68
1886	113.12	37.86	6.10	3.15	5.63	1.27	1.81
1887	113.84	38.27	6.16	3.32	5.28	1.30	2.07
1888	114.57	38.76	6.24	3.66	4.94	1.56	2.27
1889	115.31	39.33	6.33	4.06	4.64	1.74	2.40
1890	116.04	39.91	6.43	4.35	4.38	1.69	2.47
1891	116.79	40.32	6.49	4.57	4.34	2.86	2.59
1892	117.53	40.58	6.53	4.90	4.22	2.66	2.68
1893	118.29	40.84	6.58	5.37	4.10	3.25	2.73
1894	119.04	41.35	6.66	5.78	3.94	3.56	2.76
1895	119.81	41.85	6.74	5.97	3.84	3.93	2.85
1896	120.57	42.30	6.81	6.06	3.69	4.20	3.06
1897	121.34	43.00	6.92	6.23	3.58	4.62	3.33
1898	122.12	43.62	7.02	6.55	3.62	4.58	3.60
1899	122.90	44.16	7.11	6.88	3.73	4.69	3.99
1900	123.69	44.71	7.20	7.04	3.84	5.23	4.62
1901	124.48	45.34	7.30	7.09	3.89	6.04	5.31
1902	125.28	45.90	7.39	7.04	3.90	6.24	5.78
1903	126.08	46.55	7.50	6.92	3.92	6.00	6.00
1904	126.89	47.20	7.60	6.75	3.92	6.05	6.09
1905	127.70	47.85	7.71	6.62	3.78	5.53	6.22
1906	128.51	48.68	7.84	6.49	3.61	6.39	6.72
1907	129.34	49.61	7.99	6.35	3.46	6.96	7.30
1908	130.16	50.71	8.16	6.33	3.34	7.46	7.83
1909	131.00	51.30	8.26	6.44	3.27	8.18	8.59
1910	131.84	52.33	8.43	6.64	3.21	7.81	9.33
1911	132.68	53.72	8.65	7.05	3.11	7.73	9.75
1912	133.53	55.03	8.86	7.75	2.89	8.70	10.35
1913	134.38	56.53	9.10	8.71	2.70	10.11	11.58

Summary Table F.1 (continued)

	(34)	(35)	(36)	(37)	(38)	(39)
	Maintenance (continued) (value added: million lire at 1911 prices)					
	Rail-guided vehicles					
	Railway vehicles			Steam-tramway vehicles		
	Loco-motives	Passenger cars	Freight cars	Loco-motives	Passenger cars	Freight cars
code:	fcb01v	fcb02v	fcb03v	fcb04v	fcb05v	fcb06v
source:	f41c01	f41c02	f41c03	f42c01	f42c02	f42c03
note:	(g,s)	(s)	(h,s)	(g,t)	(t)	(t)
1861	.97	.43	.60	.00	.00	.00
1862	1.19	.49	.69	.00	.00	.00
1863	1.41	.60	.84	.00	.00	.00
1864	1.65	.68	.96	.00	.00	.00
1865	1.88	.75	1.06	.00	.00	.00
1866	2.24	.87	1.24	.00	.00	.00
1867	2.28	.90	1.28	.00	.00	.00
1868	2.43	1.03	1.46	.00	.00	.00
1869	2.69	1.13	1.67	.00	.00	.00
1870	2.97	1.25	1.96	.00	.00	.00
1871	3.25	1.37	2.25	.00	.00	.00
1872	3.62	1.54	2.64	.00	.00	.00
1873	3.99	1.66	3.09	.00	.00	.00
1874	4.25	1.71	3.11	.00	.00	.00
1875	4.40	1.84	3.23	.00	.00	.00
1876	4.67	1.91	3.65	.00	.00	.00
1877	4.94	1.97	3.73	.00	.00	.00
1878	4.97	2.06	3.68	.01	.00	.00
1879	5.24	2.18	3.92	.03	.02	.01
1880	5.89	2.26	4.47	.08	.06	.02
1881	6.42	2.38	4.62	.15	.11	.03
1882	6.87	2.47	4.98	.23	.17	.05
1883	7.33	2.67	5.57	.29	.21	.07
1884	8.06	2.94	5.98	.33	.24	.08
1885	8.28	3.14	6.07	.36	.26	.09
1886	9.03	3.40	6.28	.39	.28	.10
1887	9.80	3.67	6.64	.41	.30	.10
1888	11.11	4.03	7.38	.42	.31	.10
1889	11.64	4.27	7.70	.44	.33	.11
1890	11.77	4.39	7.83	.48	.35	.12
1891	11.76	4.49	7.67	.50	.37	.13
1892	11.82	4.60	7.82	.51	.38	.13
1893	12.17	4.79	8.28	.54	.40	.14
1894	12.23	4.91	8.60	.56	.42	.14
1895	12.44	5.09	8.61	.57	.43	.15
1896	12.79	5.30	9.09	.57	.43	.15
1897	13.43	5.48	9.79	.57	.43	.15
1898	13.93	5.64	10.16	.58	.44	.15
1899	14.72	5.85	10.87	.59	.45	.16
1900	15.38	6.25	11.12	.60	.46	.16
1901	15.89	6.51	11.45	.62	.47	.17
1902	16.84	6.92	12.38	.62	.49	.18
1903	17.65	7.25	13.14	.61	.49	.19
1904	18.93	7.80	14.09	.61	.48	.19
1905	19.93	8.32	14.10	.62	.49	.20
1906	21.41	9.76	15.20	.64	.50	.21
1907	22.30	9.83	15.40	.64	.51	.24
1908	24.63	11.07	16.40	.65	.51	.25
1909	25.89	11.68	17.66	.66	.62	.27
1910	27.00	13.54	18.32	.67	.75	.29
1911	27.80	14.41	19.45	.68	.77	.31
1912	28.79	15.17	20.64	.68	.78	.33
1913	29.78	16.47	21.82	.68	.79	.35

Summary Table F.1 (continued)

	(40)	(41)	(42)	(43)	(44)	(45)
	Maintenance (continued) (value added: million lire at 1911 prices)					
	Rail-guided vehicles (continued)				Precision equipment	
	Electric-tramway vehicles					
	Loco-motives	Passenger cars	Freight cars	General equipment	Precision instruments	Clocks and watches
code:	fcb07v	fcb08v	fcb09v	fdb01v	feb01v	feb02v
source:	f42c04	f42c05	f42c06	f53c04	f53c05	f53c06
note:	(g,t)	(t)	(t)	(u)	(v)	(v)
1861	.00	.00	.00	1.54	.23	3.53
1862	.00	.00	.00	1.58	.23	3.77
1863	.00	.00	.00	1.71	.23	4.05
1864	.00	.00	.00	1.81	.23	4.42
1865	.00	.00	.00	1.91	.24	4.78
1866	.00	.00	.00	2.07	.24	5.03
1867	.00	.00	.00	2.17	.24	5.24
1868	.00	.00	.00	2.46	.24	5.44
1869	.00	.00	.00	2.63	.24	5.66
1870	.00	.00	.00	2.92	.24	5.89
1871	.00	.00	.00	3.12	.24	6.09
1872	.00	.00	.00	3.35	.25	6.30
1873	.00	.00	.00	3.42	.25	6.47
1874	.00	.00	.00	3.78	.26	6.62
1875	.00	.00	.00	4.01	.26	6.81
1876	.00	.00	.00	4.27	.27	7.01
1877	.00	.00	.00	4.60	.27	7.24
1878	.00	.00	.00	5.13	.27	7.47
1879	.00	.00	.00	5.59	.28	7.71
1880	.00	.00	.00	6.08	.28	7.95
1881	.00	.00	.00	6.67	.28	8.24
1882	.00	.00	.00	7.23	.28	8.51
1883	.00	.00	.00	7.92	.29	8.81
1884	.00	.00	.00	8.45	.29	9.20
1885	.00	.00	.00	9.23	.30	9.66
1886	.00	.00	.00	9.96	.32	10.18
1887	.00	.00	.00	10.65	.35	10.77
1888	.00	.00	.00	11.34	.38	11.26
1889	.00	.00	.00	11.93	.41	11.53
1890	.01	.00	.00	12.26	.43	11.68
1891	.02	.00	.00	12.29	.44	11.82
1892	.02	.00	.00	12.82	.44	11.94
1893	.03	.00	.00	12.82	.44	12.07
1894	.04	.00	.00	12.98	.45	12.12
1895	.07	.01	.00	13.08	.45	12.08
1896	.11	.01	.00	13.47	.45	11.99
1897	.19	.02	.00	13.41	.46	11.86
1898	.44	.04	.00	13.77	.48	11.77
1899	.75	.07	.01	14.00	.51	11.73
1900	1.02	.09	.01	14.49	.54	11.77
1901	1.33	.12	.01	14.89	.58	11.55
1902	1.52	.14	.01	15.38	.61	11.34
1903	1.58	.17	.02	16.43	.65	11.23
1904	1.66	.20	.02	18.40	.69	11.18
1905	1.76	.23	.02	19.88	.74	11.09
1906	1.95	.28	.03	21.59	.81	10.97
1907	2.23	.33	.03	24.12	.91	10.89
1908	2.50	.38	.04	26.19	1.03	10.84
1909	2.67	.41	.04	27.96	1.13	10.74
1910	2.75	.42	.04	29.87	1.24	10.64
1911	3.06	.48	.05	32.86	1.36	10.63
1912	3.61	.58	.06	35.55	1.49	10.63
1913	4.14	.69	.07	38.41	1.62	10.60

Summary Table F.1 (continued)

NOTES

(a) Production is directly estimated in the census years, and interpolated allowing for the likely split between domestic production and imports, subject to a shared metal-consumption constraint.

(b) The series is derived from ship-specific data.

(c) Includes colonial and scout cruisers.

(d) Includes despatch boats and scouts.

(e) Production is directly estimated from abundant official data.

(f) Production is estimated as reported numbers acquired, multiplied by unit weight, minus net imports.

(g) Includes rail-cars.

(h) Includes baggage cars, service cars, and tenders.

(i) Domestic assembly of imported parts, estimated from the data on international trade.

(j) Production is estimated on the basis of a single data point for bridges and canopies, extrapolated on the basis of construction movements, and another for power-line towers, extrapolated on the basis of the growth of hydroelectric capacity.

(k) Production is directly estimated in the census years, and interpolated allowing for the likely split between domestic production and imports.

(l) Production is measured in silverware equivalent. It is directly estimated in 1911, and extrapolated with a luxury-good consumption index.Summary Table F.1 (continued)

(m) Maintenance is directly estimated in 1911, and extrapolated at the long-run growth rate of the agricultural population.

(n) Maintenance is directly estimated in 1911, and extrapolated in proportion to the estimated maintenance of private structures, allowing for the progressive diffusion of metal.

(o) Maintenance is estimated in 1911 from budget data, and extrapolated in proportion to the aggregate (weighted) displacement of the vessels maintained; the indicated source is that displacement series.

(p) Maintenance is estimated from the net tonnage of the sailing fleet, adjusted for trade in maintenance services.

(q) Dry-dock maintenance is estimated from the dry-docks’ throughput, documented from 1885, and extrapolated allowing for the size of the fleet and international port movements.

(r) Other maintenance is estimated from the total required by the domestic fleet, excluding the dry-dock component.

(s) Maintenance is estimated in 1911 from budget data, and extrapolated in proportion to aggregate vehicle-ton-mileage; the indicated source is that mileage series.

(t) Maintenance per ton of vehicle is estimated in 1911 from railway data, and extrapolated in proportion to the aggregate weight of the stock maintained; the indicated source is that weight series.

(u) Maintenance is directly estimated in 1911, and extrapolated in proportion to the apparent consumption if energy absorbed by industrial and agricultural machinery, allowing for user-powered sewing machines and bicycles.

(v) Maintenance is directly estimated in 1911, and extrapolated in proportion to the stock estimated as a permanent inventory.

Summary Table F.2
The engineering industries: value added in 1911

1. By product or activity

(1) Physical series code	(2) product	(3) Value added per unit	(4) Total value added million lire	(5) series code
NEW PRODUCTION				
FABRICATED METAL				
faa01	fabricated metal	415.000 lire/ton	152.620	faa01v
SEAGOING VESSELS				
Naval vessels				
fba01	armored frigates	1,000.000 lire/disp. ton	.000	fba01v
fba02	frigates, corvettes	1,350.000 lire/disp. ton	.000	fba02v
fba03	battleships	1,000.000 lire/disp. ton	22.352	fba03v
fba04	armored cruisers	1,000.000 lire/disp. ton	1.449	fba04v
fba05	protected cruisers	1,350.000 lire/disp. ton	3.132	fba05v
fba06	torpedo cruisers	1,550.000 lire/disp. ton	.000	fba06v
fba07	destroyers	2,000.000 lire/disp. ton	2.450	fba07v
fba08	submarines	3,800.000 lire/disp. ton	4.104	fba08v
fba09	torpedo boats	2,800.000 lire/disp. ton	4.866	fba09v
fba10	gunboats	700.000 lire/disp. ton	.300	fba10v
fba11	tugs	700.000 lire/disp. ton	.523	fba11v
fba12	bulk carriers	200.000 lire/disp. ton	.129	fba12v
fba13	other auxiliaries	450.000 lire/disp. ton	.000	fba13v
Merchant vessels				
fba14	sail-powered	235.000 lire/g. r. ton	1.222	fba14v
fba14	engine-powered	325.000 lire/g. r. ton	6.955	fba15v
RAIL-GUIDED VEHICLES				
fca01	locomotives	1,250.000 lire/ton	19.050	fca01v
fca02	passenger cars	1,050.000 lire/ton	10.857	fca02v
fca03	freight cars	450.000 lire/ton	28.247	fca03v
GENERAL EQUIPMENT				
fda01	machines merely assembled	300.000 lire/ton	4.254	fda01v
fda02	truss-structure components	350.000 lire/ton	14.620	fda02v
fda03	other general equipment	900.000 lire/ton	175.302	fda03v
PRECISION EQUIPMENT				
fea01	precision instruments clocks and watches	16,500.000 lire/ton	4.571	fea01v
fea02	merely assembled	8,000.000 lire/ton	1.280	fea02v
fea03	from metal	15,000.000 lire/ton	2.310	fea03v
PRECIOUS-METAL PRODUCTS				
ffa01	precious-metal products	145,000.000 lire/ton	31.840	ffa01v

Summary Table F.2 (continued)

(1) Value added series code	(2) product	(3) Total value added million lire	(4) series code
MAINTENANCE			
FABRICATED METAL			
fab01v	by blacksmiths	132.680	fab01v
fab02v	by other smiths	53.720	fab02v
fab03v	other	8.650	fab03v
SEAGOING VESSELS			
Naval vessels			
fbb01v	naval vessels	7.050	fbb01v
Merchant vessels			
fbb02v	sail-powered	3.110	fbb02v
	engine-powered		
fbb03v	dry-dock	7.730	fbb03v
fbb04v	other	9.750	fbb04v
RAIL-GUIDED VEHICLES			
Railway vehicles			
fcb01v	locomotives	27.800	fcb01v
fcb02v	passenger cars	14.410	fcb02v
fcb03v	freight cars	19.450	fcb03v
Steam-tramway vehicles			
fcb04v	locomotives	.680	fcb04v
fcb05v	passenger cars	.770	fcb05v
fcb06v	freight cars	.310	fcb06v
Elctric-tramway vehicles			
fcb07v	locomotives	3.060	fcb07v
fcb08v	passenger cars	.480	fcb08v
fcb09v	freight cars	.050	fcb09v
GENERAL EQUIPMENT			
fdb01v	general equipment	32.860	fdb01v
PRECISION EQUIPMENT			
feb01v	precision instruments	1.360	feb01v
feb02v	clocka and watches	10.630	feb02v

Summary Table F.2 (continued)

2. By industry

(1) Code	(2) Industry	(3) Value added (million lire)	(4) Component series
Fabricated metal			
faav	new production	152.620	faa01v
fabv	maintenance	195.050	fab01v-fab03v
Seagoing vessels			
fbav	new construction, total	47.482	fba01v--fba15v
	naval	39.305	fba01v--fba13v
	merchant	8.177	fba14v--fba15v
fbbv	maintenance, total	27.639	fbb01v--fbb04v
	naval	7.049	fbb01v
	merchant	20.590	fbb02v--fbb04v
Rail-guided vehicles			
fcav	new production	58.154	fca01v--fca03v
fcbv	maintenance	67.007	fcb01v--fcb09v
General equipment			
fdav	new production	194.176	fda01v--fda03v
fdbv	maintenance	32.860	fdb01v
Precision equipment			
feav	new production	8.161	fea01v--fea03v
febv	maintenance	11.990	feb01v--feb02v
Precious-metal products			
ffav	new production	31.840	fca01v--fca03v

3. By industry group

(1) Code	(2) Industry group	(3) Value added (million lire)	(4) Component series
fav	fabricated metal	347.670	faav--fabv
fbv	seagoing vessels	75.121	fbav--fbbv
fcv	rail-guided vehicles	125.161	fcav--fcbv
fdv	general equipment	227.036	fdav--fdbv
fev	precision equipment	20.151	feav--febv
ffv	precious-metal products	31.840	ffav
fv	engineering	826.979	fav--ffv

Note to Panel 1: the disaggregated new-production value added series identified in col. 5 are the physical series identified in col. 1, weighted by the unit value added estimates in col. 3. The latter are variously obtained from evidence on output prices and per-unit raw material costs, or on (total or per-unit) labor and capital costs.

Note to Panels 2 and 3: the aggregate value added series identified in col. 1 are simple sums of the component series identified in col. 4.

Summary Table F.3
The engineering industries: value added at 1911 prices, 1861-1913
(million lire)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				New production			
	Fabri-cated metal	Sea-going vessels	Rail-guided vehicles	General equipment	Precision equipment	Precious-metal products	Total
code:	faav	fbav	fcav	fdav	feev	ffav	
1861	27.834	11.908	1.575	4.196	.956	14.721	61.190
1862	27.166	13.725	3.922	4.187	.956	15.069	65.025
1863	26.377	16.621	3.752	3.753	1.002	15.383	66.888
1864	25.668	18.373	1.984	3.255	1.218	15.683	66.181
1865	24.344	20.715	3.422	3.553	1.146	15.116	68.296
1866	22.925	21.302	3.324	3.388	.921	14.157	66.017
1867	24.796	23.742	1.833	3.509	.913	13.334	68.127
1868	26.477	25.975	2.659	3.845	.905	14.254	74.115
1869	28.228	25.829	2.533	4.251	.977	14.992	76.810
1870	30.544	22.229	2.007	4.380	.968	15.982	76.110
1871	28.901	18.012	1.906	4.552	.920	15.933	70.224
1872	29.062	16.996	2.365	5.596	1.050	16.252	71.321
1873	27.461	22.475	2.669	6.706	1.070	15.934	76.315
1874	29.652	27.693	2.632	7.092	1.062	15.898	84.029
1875	33.574	25.203	2.619	6.807	1.124	15.998	85.325
1876	32.773	19.831	2.380	6.563	1.212	16.196	78.955
1877	33.138	16.091	2.583	6.493	1.250	15.867	75.422
1878	30.971	13.035	2.283	6.354	1.292	15.306	69.241
1879	33.030	11.472	2.962	6.926	1.469	15.204	71.063
1880	38.612	9.726	6.858	8.719	1.495	16.180	81.590
1881	45.127	11.256	10.411	11.011	1.792	16.983	96.580
1882	51.452	14.474	11.482	13.495	1.888	17.730	110.521
1883	57.980	14.774	10.150	15.589	2.136	17.302	117.931
1884	64.798	17.519	8.017	17.535	2.262	17.871	128.002
1885	68.541	19.317	9.461	19.266	2.494	18.115	137.194
1886	78.622	22.870	11.908	21.222	2.839	19.328	156.789
1887	92.611	22.470	17.581	24.803	3.485	19.310	180.260
1888	97.293	18.257	22.480	29.481	3.543	18.821	189.875
1889	91.591	19.385	18.413	34.176	2.961	17.576	184.102
1890	76.962	23.282	10.111	37.507	2.804	17.224	167.890
1891	60.773	21.676	5.542	35.889	2.636	17.338	143.854
1892	49.792	18.699	4.878	32.608	2.496	18.006	126.479
1893	46.766	17.701	4.306	33.929	2.670	18.316	123.688
1894	47.103	17.413	5.469	39.104	2.333	18.429	129.851
1895	47.202	17.921	6.660	46.704	2.317	18.491	139.295
1896	45.480	20.376	7.427	53.489	2.362	18.972	148.106
1897	42.658	23.731	11.027	56.495	2.710	19.507	156.128
1898	44.949	26.484	16.254	61.004	3.099	20.204	171.994
1899	50.530	37.239	20.866	72.239	3.611	20.414	204.899
1900	55.141	39.723	24.032	82.629	3.927	21.199	226.651
1901	52.680	31.955	23.209	77.842	3.761	21.051	210.498
1902	50.713	34.110	21.183	71.038	4.239	21.419	202.702
1903	53.116	33.573	23.504	73.794	4.371	21.231	209.589
1904	59.864	30.628	24.688	86.870	4.852	21.928	228.830
1905	69.463	38.675	29.224	107.046	5.160	22.376	271.944
1906	86.635	41.902	42.238	132.975	5.832	24.050	333.632
1907	104.783	39.890	56.268	151.045	6.586	25.896	384.468
1908	120.570	31.687	60.806	169.149	6.996	29.188	418.396
1909	136.319	26.429	51.686	185.239	7.071	29.650	436.394
1910	147.632	33.876	47.679	193.140	7.609	31.436	461.372
1911	152.620	47.482	58.154	194.176	8.161	31.840	492.433
1912	159.804	67.815	63.359	194.725	8.690	32.864	527.257
1913	160.161	67.524	58.452	186.249	8.884	30.766	512.036

Summary Table F.3 (continued)

	(8)	(9)	(10)	(11) Maintenance	(12)	(13)
	Fabri-cated metal	Sea-going vessels	Rail-guided vehicles	General equipment	Precision equipment	Total
code:	fabv	fbbv	fcbv	fdbv	febv	
1861	131.070	5.751	2.000	1.540	3.760	144.121
1862	131.950	5.932	2.371	1.580	4.000	145.833
1863	132.820	6.216	2.856	1.710	4.280	147.882
1864	133.720	6.298	3.280	1.810	4.650	149.758
1865	134.610	6.540	3.691	1.910	5.020	151.771
1866	135.680	6.969	4.353	2.070	5.270	154.342
1867	136.760	7.381	4.452	2.170	5.480	156.243
1868	137.830	8.032	4.916	2.460	5.680	158.918
1869	138.830	8.843	5.494	2.630	5.900	161.697
1870	139.750	9.460	6.182	2.920	6.130	164.442
1871	140.670	9.717	6.861	3.120	6.330	166.698
1872	141.600	9.619	7.791	3.350	6.550	168.910
1873	142.540	9.637	8.741	3.420	6.720	171.058
1874	143.380	9.931	9.071	3.780	6.880	173.042
1875	144.510	10.223	9.480	4.010	7.070	175.293
1876	145.550	10.497	10.230	4.270	7.280	177.827
1877	146.770	10.567	10.646	4.600	7.510	180.093
1878	148.080	10.579	10.719	5.130	7.740	182.248
1879	149.140	10.666	11.399	5.590	7.990	184.785
1880	150.300	10.755	12.762	6.080	8.230	188.127
1881	151.370	10.949	13.706	6.670	8.520	191.215
1882	152.440	11.240	14.762	7.230	8.790	194.462
1883	153.440	11.533	16.136	7.920	9.100	198.129
1884	154.610	11.702	17.638	8.450	9.490	201.890
1885	155.800	11.954	18.186	9.230	9.960	205.130
1886	157.080	11.859	19.477	9.960	10.500	208.876
1887	158.270	11.972	20.932	10.650	11.120	212.944
1888	159.570	12.433	23.362	11.340	11.640	218.345
1889	160.970	12.838	24.495	11.930	11.940	222.173
1890	162.380	12.890	24.956	12.260	12.110	224.596
1891	163.600	14.356	24.944	12.290	12.260	227.450
1892	164.640	14.460	25.292	12.820	12.380	229.592
1893	165.710	15.452	26.340	12.820	12.510	232.832
1894	167.050	16.037	26.901	12.980	12.570	235.538
1895	168.400	16.587	27.342	13.080	12.530	237.939
1896	169.680	17.010	28.436	13.470	12.440	241.036
1897	171.260	17.760	30.060	13.410	12.320	244.810
1898	172.760	18.348	31.392	13.770	12.250	248.520
1899	174.170	19.289	33.454	14.000	12.240	253.153
1900	175.600	20.730	35.102	14.049	12.310	258.232
1901	177.120	22.331	36.585	14.890	12.130	263.056
1902	178.570	22.960	39.111	15.380	11.950	267.971
1903	180.130	22.844	41.109	16.430	11.880	272.393
1904	181.690	22.814	43.977	18.400	11.870	278.751
1905	183.260	22.149	45.667	19.880	11.830	282.786
1906	185.030	23.213	49.982	21.590	11.780	291.595
1907	186.940	24.066	51.504	24.120	11.800	298.430
1908	189.030	24.963	56.424	26.190	11.870	308.477
1909	190.560	26.482	59.892	27.960	11.870	316.764
1910	192.600	26.991	63.774	29.870	11.880	325.115
1911	195.050	27.639	67.007	32.860	11.990	334.546
1912	197.420	29.687	70.639	35.550	12.120	345.416
1913	200.010	33.104	74.784	38.410	12.220	358.528

Summary Table F.3 (continued)

	(14)	(15)	(16)	(17)	(18)	(19)	(20)
				All production			
	Fabri-cated metal	Sea-going vessels	Rail-guided vehicles	General equipment	Precision equipment	Precious-metal products	Total
code:	fav	fbv	fcv	fdv	fev	ffv	fv
1861	158.904	17.659	3.575	5.736	4.716	14.721	205.311
1862	159.116	19.657	6.293	5.767	4.956	15.069	210.858
1863	159.197	22.837	6.608	5.463	5.282	15.383	214.770
1864	159.388	24.671	5.264	5.065	5.868	15.683	215.939
1865	158.954	27.255	7.113	5.463	6.166	15.116	220.067
1866	158.605	28.271	7.677	5.458	6.191	14.157	220.359
1867	161.556	31.123	6.285	5.679	6.393	13.334	224.370
1868	164.307	34.007	7.575	6.305	6.585	14.254	233.033
1869	167.058	34.672	8.027	6.881	6.877	14.992	238.507
1870	170.294	31.689	8.189	7.300	7.098	15.982	240.552
1871	169.571	27.729	8.767	7.672	7.250	15.933	236.922
1872	170.662	26.615	10.156	8.946	7.600	16.252	240.231
1873	170.001	32.112	11.410	10.126	7.790	15.934	247.373
1874	173.032	37.624	11.703	10.872	7.942	15.898	257.071
1875	178.084	35.426	12.099	10.817	8.194	15.998	260.618
1876	178.323	30.328	12.610	10.833	8.492	16.196	256.782
1877	179.908	26.658	13.229	11.093	8.760	15.867	255.515
1878	179.051	23.614	13.002	11.484	9.032	15.306	251.489
1879	182.170	22.138	14.361	12.516	9.459	15.204	255.848
1880	188.912	20.481	19.620	14.799	9.725	16.180	269.717
1881	196.497	22.205	24.117	17.681	10.312	16.983	287.795
1882	203.892	25.714	26.244	20.725	10.678	17.730	304.983
1883	211.420	26.307	26.286	23.509	11.236	17.302	316.060
1884	219.408	29.221	25.655	25.985	11.752	17.871	329.892
1885	224.341	31.271	27.647	28.496	12.454	18.115	342.324
1886	235.702	34.729	31.385	31.182	13.339	19.328	365.665
1887	250.881	34.442	38.513	35.453	14.605	19.310	393.204
1888	256.863	30.690	45.842	40.821	15.183	18.821	408.220
1889	252.561	32.223	42.908	46.106	14.901	17.576	406.275
1890	239.342	36.172	35.067	49.767	14.914	17.224	392.486
1891	224.373	36.032	30.486	48.179	14.896	17.338	371.304
1892	214.432	33.159	30.170	45.428	14.876	18.006	356.071
1893	212.476	33.153	30.646	46.749	15.180	18.316	356.520
1894	214.153	33.450	32.370	52.084	14.903	18.429	365.389
1895	215.602	34.508	34.002	59.784	14.847	18.491	377.234
1896	215.160	37.386	35.863	66.959	14.802	18.972	389.142
1897	213.918	41.491	41.087	69.905	15.030	19.507	400.938
1898	217.709	44.832	47.646	74.774	15.349	20.204	420.514
1899	224.700	56.528	54.320	86.239	15.851	20.414	458.052
1900	230.741	60.453	59.134	97.119	16.237	21.199	484.883
1901	229.800	54.286	59.794	92.732	15.891	21.051	473.554
1902	229.283	57.070	60.294	86.418	16.189	21.419	470.673
1903	233.246	56.417	64.613	90.224	16.251	21.231	481.982
1904	241.554	53.442	68.665	105.270	16.722	21.928	507.581
1905	252.723	60.824	74.891	126.926	16.990	22.376	554.730
1906	271.665	65.115	92.220	154.565	17.612	24.050	625.227
1907	291.723	63.956	107.772	175.165	18.386	25.896	682.898
1908	309.600	56.650	117.230	195.339	18.866	29.188	726.873
1909	326.879	52.911	111.578	213.199	18.941	29.650	753.158
1910	340.232	60.867	111.453	223.010	19.489	31.436	786.487
1911	347.670	75.121	125.161	227.036	20.151	31.840	826.979
1912	357.224	97.502	133.998	230.275	20.810	32.864	872.673
1913	360.171	100.628	133.236	224.659	21.104	30.766	870.564