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Financial Sector Interconnectedness and Monetary Policy Transmission*

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Abstract

We document that, in the U.S., the share of financial assets that have a direct counterpart in the financial system has increased by between 15.8 and 21.8 percentage points during the period 1952-2011. Using a SVAR and a FAVAR, we find that, during the same period, the impulse responses of several real and financial variables to monetary policy shocks dampened. To relate these two trends, we present a stylized model that illustrates how interbank trading can reduce the sensitivity of lending to the entrepreneur's net worth, thus affecting the transmission mechanism of monetary policy through the credit channel.

JEL classification: E44, E52, G20
Keywords: Financial sector interconnectedness, monetary policy transmission mechanism

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1 Introduction

Two facts constitute the background of this paper. First, the U.S. financial system underwent a radical transformation during the last decades. The complexity and the nature of the process of financial intermediation changed substantially.[1] Figure 1 confirms this well known phenomenon by reporting the evolution of the share of total assets in the U.S. economy held by three major groups of actors: i) the traditional actors (commercial banks, savings institutions and credit unions), ii) the insurance, pension and mutual funds, and iii) the so called *"shadow banking system"* (Government Sponsored Enterprises (GSE), Assets-backed-securities issuers, GSE mortgage pools, finance companies, brokers and dealers).[2] While the share of assets held by the traditional actors declined from about 60% to roughly 30% from 1952 to 2010, the share of assets held by the "new" actors increased from almost zero to more than 40% in 2006.

Second, a well known result in the economic literature is that in more recent samples, the sensitivity of real variables to monetary policy shocks has declined. A common explanation for this empirical finding is an increase in the effectiveness of monetary policy, as for example proposed by Boivin and Giannoni (2006). Another frequently conjectured (but less studied) hypothesis is that structural changes in the financial sector contributed to the changing nature of the monetary policy transmission mechanism.[3] Arguably, at least a part of the difficulty in addressing this hypothesis is the lack of a suitable *measure* of the structural transformation that affected the U.S. financial system.[4]

In this paper, we propose a measure for this structural transformation, and study its implications for monetary policy. The *Measure of Interconnectedness* is a measure of composition of the assets, namely the share of the credit to the financial sector over the total credit market instruments. The U.S. financial sector *Measure of Interconnectedness* increases

[1] See Gorton and Metrik (2012).

[2] See Adrian and Shin (2010), Poznar et al (2012) and references therein for a comprehensive explanation of the concept of Shadow Banking.

[3] A notable exception is Dynan et al (2006), who analyses the impact of monetary policy on real activity before and after relevant regulatory changes.

[4] Contributions in this literature analyze the different responsiveness across different sub-samples of the data.

by between 15.8 and 21.8 percentage points during the period 1952-2011. We suggest that this increase in interconnectedness within the financial sector may have been one of the reasons for the observed lower sensitivity of the real economy to monetary shocks. We interact our measure with both a SVAR and a FAVAR for the U.S. economy, and find that the impulse responses to monetary policy shocks are dampened as the financial system becomes more interconnected. While we do not claim that this is the only possible explanation for the smaller responses of real variables to monetary policy shocks, we argue that interconnectedness might be a contributing factor that has been previously overlooked. Moreover, we present a stylized model that rationalizes our empirical findings by illustrating how interbank trading can reduce the sensitivity of lending to the entrepreneur's net worth, thereby dampening the credit channel transmission of monetary policy.

We proceed in three steps. First, we propose as a measure of the structural transformation of the financial sector, the extent to which it is *interconnected*. The *Measure of Interconnectedness* is the share of the credit market instruments represented by claims whose *direct counterpart* belongs to the financial sector. We compute the measure of interconnectedness for the U.S. financial system for the period 1952-2011, using data from the Flows of Funds. We describe the evolution of the single components of the aggregate measure, and we show the relation between the evolution of our measure and key changes in the U.S. financial regulatory system. Moreover, we discuss the relation between our measure and a measure of liquidity, another factor that has been proposed to affect the monetary policy transmission mechanism.[5]

Second, we propose an empirical analysis of the interaction between our measure of interconnectedness and the response of real activity to monetary policy. We first illustrate through simple autoregressive distributed lag regressions (ADL) that the dynamic correlation between the detrended GDP and the Fed Funds Rate are dampened when our measure of interconnectedness increases. Then, we interact our measure of interconnectedness with a

[5]We also investigate the relation between our measure and the share of finance in U.S. GDP reported by Philippon (2012). While they capture very different concepts, we interestingly find a very high correlation our measure of interconnectedness and the share of finance in non-defence U.S. value added.

structural vector auto-regression (VAR) for the U.S. economy, and produce impulse responses to a monetary policy shock conditional on different levels of interconnectedness. Finally, we propose a Factor-Augmented VAR (FAVAR) model where we produce impulse responses for a large set of real and financial variables. Once again, these impulse responses depend on our measure of interconnectedness. We find that the responses to a monetary policy shock of both real variables, like the GDP, investment and employment and of financial variables, like loans and leases are significantly dampened as the financial sector becomes more interconnected.

Third, in light of our empirical findings, we develop a model in which interbank trading reduces the economy's sensitivity to monetary policy. We focus on the credit transmission channel: lowering the nominal interest rate raises the net worth of borrowers, thereby increasing their "skin in the game" and making them less prone towards taking excessive risk. Banks respond by extending additional credit, which leads to additional investment. Our model's main insight is that this transmission mechanism depends crucially on the presence of a tension between the entrepreneur's preference towards risky projects and the bank's demand for safety (resulting from the need to pay depositors at par). In the presence of an interbank market, banks can pool risk by securitizing their loan portfolios and diversifying their assets; the tension between the borrower's preference towards risky projects and the bank's need to pay depositors at par disappears, and with it the credit channel transmission of monetary policy.

This paper is linked to several strands of the literature. First, it is related to the literature dealing with measurement of financial intermediation and its characteristics. Philippon (2012) provides evidence on the quantitative importance and the cost of financial intermediation in the U.S. in the last 130 years. Greenwood and Scharfstein (2013) analyze the growth of the share of finance on GDP in the U.S. while Philippon and Reshef (2013) analyze the growth of the share of finance for several developed countries. Philippon and Reshef (forthcoming) propose evidence on the evolution of the wages in the financial industry for the period 1909-2006.[6] A somewhat related and fast growing literature deals with the analysis

[6] See also the survey on Financial Intermediation by Gordon and Winton (2003).

of the financial sector using network analysis. This literature, however, is more concerned with the implication of interconnectedness for systemic risk than with the implications for monetary policy.[7]

Second, the paper is related to the literature on the monetary policy transmission mechanism. Boivin and Giannoni (2006) report evidence that the effects of monetary policy shocks on real variables are muted in the post-1980 period, and show how this finding can be explained by an increase in the effectiveness of monetary policy. Boivin et al (2011) report FAVAR evidence as well as evidence from DSGE modeling on the change over time of the monetary transmission mechanism. Confirming the results by Boivin and Giannoni (2006), they also find muted responses of real variables to monetary policy innovations in more recent times, and argue that this is mostly accounted for by changes in policy behavior and the effect of these changes on expectations. Adrian and Shin (2011b) consider more in general the role of financial intermediaries in monetary economics.[8] Closer to our spirit, Dynan et al. (2006) present evidence of the reduced responsiveness of several economic aggregates to shocks, dividing the sample before and after important regulatory changes. We contribute to this literature by exploring how a measure of financial interconnectedness can account for the change over time of the effects on real variables of monetary shocks. Moreover, in our FAVAR exercise, we extend significantly the set of variables analyzed.

Finally, this paper relates to the literature on the specific role played by financial intermediaries in the transmission of monetary policy. Diamond and Rajan (2006) present a model in which the bank's balance sheet conditions affect the transmission mechanism of monetary policy. Evidence of this is provided by Kayshap and Stein (2000). Freixas and Jorge (2008) propose a model of interbank market and analyze the impact of asymmetric information of the transmission mechanism of monetary policy. Bianchi and Bigio (2014) propose a quantitative model to study the transmission of monetary policy through a banking system. None of these papers, however, analyzes the financial sector interconnectedness

[7]See for for instance Acemoglu et al. (2013), Farboodi (2014) and the many references therein.

[8]A recently proposed complementary channel through which changes in the financial conditions can affect the transmission mechanism of monetary policy is the "risk taking channels", proposed by Borio and Zhu (2012). See also Bruno and Shin (2013).

as a factor potentially affecting the monetary policy transmission mechanism.

The paper is organized as follows. In Section 2 we introduce our measure of interconnectedness and document its evolution in the U.S. In Section 3 we present our empirical analysis. In Section 4 we outline our stylized theoretical model. Section 5 concludes with several suggestions for future research.

2 The Measure of Interconnectedness

Our proposed measure of interconnectedness of a financial sector (or a financial institution) is based on the composition of its assets. The *Measure of Interconnectedness* ($INTER$) is conceptually the share of the credit market instruments ($CREDIT$) represented by claims whose *direct counterparts* belong to the financial sector ($CREDIT\_FINANCE$):

$$INTER = \frac{CREDIT\_FINANCE}{CREDIT} \tag{1}$$

The Flow of Funds database provides a quarterly snapshot of the U.S. financial system balance sheet.[9] For our baseline measure, we focus on credit market instruments, which include mortgages, loans, consumer credit, treasuries, municipal bonds, corporate and foreign bonds, open market papers and Agency and GSE-backed securities.

Unfortunately, the level of aggregation of the data in the Flow of Funds prevents us from perfectly measuring the expressionin equation (1). Therefore, we compute two different measures, which we interpret as a lower-bound and an upper-bound for the concept we want to capture.

We label the first as $INTER_1$, and compute it simply as the ratio between total Agency and GSE-backed securities and total credit market instruments. Especially in more recent times, these securities represented an essential element of the growth of the interconnectedness of the financial network, fostered by the process of securitization. Mortgages originated by banks and mortgage brokers were sold to special investment vehicles (SIV). These SIVs

[9] Table L.108 of the Z1 release of March 2012.

were then issuing different "tranches" of securities, which were backed by those mortgages, and characterized by a stratified risk profile. The safest of these emissions (the "Senior Tranches") were often given triple-A ratings, and hence could be bought by some players in the financial system (such as pension funds) which can only invest in safe securities.

The second measure we compute, $INTER_2$, is defined as the share of total credit market instruments consisting of agency and GSE-backed securities, corporate and foreign bonds, and open market papers. Within these last two categories, the Flow of Funds data unfortunately does not distinguish by the sector of the counterpart. By adding their entire value to the numerator of $INTER_2$, we are obviously over-estimating the share of credit market instruments whose counterpart is in the financial sector.[10]

Figure 2 reports the evolution of our measures $INTER_1$ and $INTER_2$ in the period 1952:1-2011:4. Three features stand out. First, both measures are increasing over time. $INTER_1$ increases by 15.8 percentage points while $INTER_2$ increases by 21.8 percentage points. Second, the two measures are highly correlated.[11] The difference between the two seems to be purely a level effect. At a more disaggregated level, this result is driven by the evolution of the shares of corporate and foreign bonds and open market papers, presented in Figure 3.[12] As the Figure clarifies, these two weights had opposite dynamics in the period considered. The share of open market papers share in total market instruments increased until the two thousands and then started declining. The weight of corporate and foreign bonds declined from the fifties to the eighties, and then started rising.

A third notable feature of Figure 2 is the decline in the measures of financial interconnectedness during the housing bubble of 2003-2007. While the reader might be perhaps puzzled at this point, there is a simple explanation for these dynamics. Figure 4 reports

[10]Another important drawback of using Flow of Funds data is that we are not able to say much about non-balance sheet items, such as derivatives. Since derivatives are typically used as a common example of the interconnectedness of the financial sector, we are aware that we are missing an important piece of information, which would make of $INTER_2$ an inaccurate estimate of an upper bound for the concept of financial sector interconnectedness. However, we can confidently say that $INFER_1$ represent a lower-bound estimates of the interconnectedness of the financial sector, and this is the reason why in our empirical section we will use it as our benchmark.

[11]In fact, the correlation between the two is 0.99.

[12]These two asset classes represent the difference between the numerators of $INTER_1$ and $INTER_2$.

the share of mortgages over total credit market instruments. After the big rise in the fifties, sixties and seventies, during the eighties and the nineties, the share of mortgages in total credit declines steadily. Then, we see a huge increase in the mortgage share during the early two-thousands. The securities backed by those mortgages were partly sold outside of the U.S. and bought by foreign investors.[13] So, while U.S. mortgages were growing, the securities backed by those mortgages recorded as assets by U.S. financial institutions, and thus included in the Flow of Funds asset data, were growing *by less*, thus explaining our declining measure of interconnectedness during the U.S. housing bubble.

We also construct alternative measures of interconnectedness which, rather than focusing on the asset side of the balance sheet, focus on the liability side. Consistent with our explanation, we show that the liability-based measure does not decline during the housing bubble. In particular, we compute a measure $INTER_3$ which is the ratio of credit market instruments and repurchasing agreements over total liabilities, and a restricted measure $INTER_4$, which is the ratio of credit market instruments and repurchasing agreements over a smaller set of liabilities.[14] In Figure 5 we report the results obtained for these alternative measures. These measures peak at end of 2008. Unsurprisingly, the two measures are highly correlated, and they both grow a lot during our sample period: $INTER_3$ grows by 20 percentage points and$INTER_4$ grows by 26 percentage points.

Naturally, Figures 2 and 5 point towards an important limitation of our data: we are using a source of information for a single country (Flow of Funds data) to assess a phenomenon of global scope, which is financial interconnectedness. That said, the advantages of our measures are that they are simple, readily available, and potentially extendible to other countries as well as to single financial institutions.[15] We therefore suggest that, despite their limits, our measures can be useful for investigating the interplay between financial sector interconnectedness and the monetary policy transmission mechanism.

[13]Such as European Commercial Banks, Asian Pension Funds etc.

[14]We include in this "adjusted" liabilities series time and savings deposits, the money market mutual funds deposits, the credit market instruments, the repurchasing agreements, the mutual funds shares and the pension funds shares.

[15]Obviously, this would require single institutions' balance sheet data.

Before proceeding in our investigation, we make three remarks regarding: i) the relation between interconnectedness and liquidity, ii) the relation between our measure and financial deregulation, and iii) the relation between our measure and the share of finance in GDP.

Measure of Interconnectedness and Liquidity. Kayshap and Stein (2000) present evidence using micro-level data for U.S. commercial banks on the interplay between the balance sheet liquidity and the effect of monetary policy on lending decisions. While the concept of liquidity is linked to the one of interconnectedness, they are not identical. To make this point, we computed an indicator of liquidity close in spirit to what produced by Kayshap and Stein (2000). We compute LIQ as the share of credit market instruments represented by securities, thus including agency and GSE-backed securities, corporate and foreign bonds, and open market papers, but also treasuries and municipal bonds. Figure 6 plots $INTER_1$ and LIQ on the same graph. The correlation between the two series is pretty low (about 0.27). The liquidity measure first declines from the fifties to the eighties, and then increases. The decline since the 1950s was driven by a decline in treasuries (reported in Figure 7), which represented nearly 40% of credit market instruments in 1952 (and about 10% in 1980).

Measure of Interconnectedness and Financial Deregulation. It is also interesting to note how our measure of interconnectedness shows some relation with key moments in the history of the deregulation of the U.S. financial system, as depicted in Figure 8. The measure has a change in trend in the 1980s, when several deregulation acts were promoted in the U.S.[16]. Moreover, in 1986, the Fed reinterpreted the Glass-Steagall act of 1933, which had separated commercial banks from investment banks. This reinterpretation allowed for a maximum of 5% of commercial bank revenues to come from investment banking activities, thus opening the way for banks to handle mortgage backed securities, commercial papers, municipal bonds (see Sherman, 2009), with clear potential effects on the system overall

[16]For instance, the Depository Institutions Deregulation and Monetary Control Act in 1980, which removed the interest rate ceilings that commercial banks were facing on their offer of deposits, thus allowing them to better compete for customers with money market mutual funds

interconnectedness.[17] Finally, in 1999, The Financial Modernization Act, also known as the Gramm-Leach-Bliley Act, repealed the Glass-Steagall of 1933 and removed the separation between the activities of commercial banking and investment banking, thus spurring a wave of mergers and acquisitions in the U.S. financial sector and leading to a transformation of the business model in several U.S. financial institutions.

Measure of interconnectedness and the share of finance in GDP. It is instructive to investigate the relation between our measures of interconnectedness and the share of finance in GDP, constructed by Philippon (2012). In Figure 9, we plot our measures together with the share of finance in non-defense value added.[18]

While the two series are conceptually different, they are interestingly highly correlated.[19] Our measure of interconnectedness is a way of representing the structural transformation that affected the U.S. financial system in the last 50 years. Philippon (2012) measures the share of finance in U.S. GDP. One could conjecture that the structural transformation of the U.S. financial sector captured by our measure might have contributed to a reallocation of resources towards finance, thus implying a greater share of finance in GDP. However other factors, such as capital-biased technological change or the increasing trend toward financial globalization, might also help explaining Philippon's findings. [20]

Since this paper focuses mainly on the implications for monetary policy of the structural transformation that affected the U.S. financial system, we focus in what follows on our measure of interconnectedness, without taking a strong stance on its contribution to the increase in the share of finance in GDP.

[17]A second reinterpretation would follow in 1996, when the ceiling on the maximum revenues obtainable from investment banking activities was lifted to 25%, though this does not seem to have any significant impact on the trend of our measures.

[18]WhilePhilippon's data are at annual frequency, we interpolated them to transform them into a quarterly series.

[19]The correlation between the two series is 0.98.

[20]Another recent explanation of Philippon's results can be found in Gennaioli, Shleifer and Vishny (2013), who propose a Solow-type growth model augmented with a financial intermediation process featuring a role for trust. In their model, the share of finance over GDP grows over time due to the role of financial intermediation as a tool for wealth management in an environment where the ratio of wealth to GDP grows as the economy approaches its steady state.

3 Interconnectedness and Monetary Policy: Evidence

This section presents some time series evidence to explore how *interconnectedness* affects the responses of economic variables to monetary policy. We take an eclectic approach and present evidence coming from i) autoregressive distributed lag (ADL) regressions, aiming at capturing simple dynamic correlations, ii) a structural VAR (SVAR) approach and iii) a factor-augmented VAR (FAVAR).

ADL Regressions. We first explore the dynamic correlations between our variables of interest by using autoregressive distributed lag (ADL) regressions. We postulate an ADL (p,1) model to study the sensitivity of a macroeconomic aggregate Y_t to monetary policy (FFR). We also add an interaction term between the Fed Funds Rate and our Measure of Interconnectedness ($INTER$):

$$Y_t = \alpha + \rho(L)Y_{t-1} + \beta_1 FFR_{t-1} + \beta_2 INTER_{t-1} + \beta_3(FFR_{t-1} \times INTER_{t-1}) + \varepsilon_t \qquad (2)$$

where $\rho(L)$ is a p-order lag polynomial and ε_t is a white noise process uncorrelated with all regressors. The optimal number of lags p to include is selected through Bayesian information criteria (BIC). Our coefficient of interest is β_3, which we expect to be positive, and hence signal a *dampening* of the negative effect of the increase in the fed fund rate on the outcome variable of interest. We will present the results obtained both using $INTER_1$, thus the measure computed using the asset side of the balance sheet, and using the measure $INTER_3$, which exploit information from the liabilities side of the balance sheet.

In Table 1, we report the results for detrended GDP. In the first three columns, we report the results obtained using the measure $INTER_1$. As the Table shows, the fed funds rate displays a negative and statistically significant coefficient, while the interaction term with our measure of interconnectedness displays a positive and highly statistically significant coefficient.[21] In the second column, we report the results obtained with the measure of liquidity.

[21]Note that we are reporting p-values in parentheses.

Also in this case, the interaction term with the federal fund rate is positive and (weakly) statistically significant. However, when we insert both variables (interconnectedness and liquidity) in column three, only the interaction term with our measure of interconnectedness maintains its statistical significance. Columns four and five present similar results obtained with the measure $INTER_3$.

Table 2 reports similar results obtained from using the annualized rate of GDP growth as our dependent variable, and Table 3 reports the results obtained using annualized growth of loans and leases as the dependent variable. We use this financial outcome variable because the model presented in Section 4 is based on a credit channel for monetary policy. Table 3 broadly confirms the result of a dampening effect of our measure of interconnectedness on the negative effect of an increase of the federal fund rate on the growth of loans and leases, albeit with a somewhat weaker statistical significance than the one found for detrended GDP and GDP growth.

The results presented in Tables 1-3 are purely dynamic correlations. In order to move forward in our understanding of the interplay between financial sector interconnectedness and monetary policy transmission, it is necessary to move beyond simple correlation and analyze the impact of identified monetary shocks.

SVAR. In order to explore the responses of the real variables to a monetary policy shock, and how these change with financial sector interconnectedness, we adapt the approach of Boivin and Giannoni (2006) by including our measure of interconnectedness $INTER$ as an exogenous variable.[22] While our measure might be an endogenous variable, the result obtained in Figure 2 indicates that the movements in the interconnectedness are more long-run smooth movements, and thus we believe it can be considered as exogenous when using business cycle frequency data. In addition, the interconnectedness is included with one lag. The model can be written as follows:

[22] All the results displayed make use of $INTER_1$. The results obtained using $INTER_2$ are broadly similar, and included in an online appendix.

$$Y_t = \Phi(L)Y_{t-1} + \beta INTER_{t-1}Y_{t-1} + e_t \tag{3}$$

where Y_t is a $K \times 1$ vector of endogenous variables, $\Phi(L)$ is a matrix polynomial of order p and $INTER_{t-1}$ is exogenous. The reduced form errors, e_t, are assumed to be linear combinations of structural shocks, ε_t:

$$e_t = H\varepsilon_t$$

with $E(\varepsilon_t\varepsilon_t') = \Sigma$, a diagonal matrix[23].

It is easy to see that the impulse responses to any shock in ε_t will depend on $INTER_{t-1}$. For simplicity, we assume $p = 2$. Developing $\Phi(L)$, we get:

$$\begin{aligned} Y_t &= \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \beta INTER_{t-1}Y_{t-1} + e_t \\ &= (\Phi_1 + \beta INTER_{t-1})\, Y_{t-1} + \Phi_2 Y_{t-2} + e_t \\ &= \Phi_{1,t-1}Y_{t-1} + \Phi_2 Y_{t-2} + e_t, \end{aligned}$$

where $\Phi_{1,t-1} = (\Phi_1 + \beta INTER_{t-1})$. Hence, the impulse response functions (IRFs) are obtained for any level of $INTER_{t-1}$ by inverting the previous expression:

$$Y_t = \left[\mathbf{I} - \Phi_{1,t-1}L - \Phi_2 L^2\right]^{-1} H\varepsilon_t. \tag{4}$$

In practice, the coefficient matrices $\Phi(L)$ and β are estimated by OLS regression on (3), and H is deduced by imposing enough identification restrictions. The IRFs are then easily computed using (4). The confidence bands can be constructed using a parametric bootstrap.[24] Following Boivin and Giannoni (2006), Y_t contains the deviation of the natural logarithm of quarterly real GDP (GDPQ) from a linear deterministic trend, the annualized

[23] We thus implicitly assume here a time-invariant distribution of the shocks.

[24] We use the following procedure:

1. Shuffle the time dimension of OLS residuals $\hat{e}_t$ and get bootstrap innovations e_t^*

rate of change in the quarterly GDP deflator (GDPD), the natural logarithm of the quarterly average of the monthly spot market commodity price index (PSCCOM) and the quarterly average of the Federal Funds Rate (FFR). The exogenous variable $INTER_{t-1}$ contains our aggregate Measure of Interconnectedness. We present here the results obtained using $INTER_1$.[25] The data ranges from 1959Q1 to 2009Q1. Four lags are included in the VAR. The identification of structural shocks is achieved by the following recursive ordering: [PSCCOM, GDPQ, GDPD, FFR]. Hence, the unexpected monetary policy shock is ordered last in ε_t. The rotation matrix H is obtained using Choleski decomposition of the covariance matrix of $\hat{e}_t$. The 90% confidence intervals are computed using 1000 bootstrap replications.

In Figure (10), we compare the impulse responses of elements in Y_t to an adverse monetary policy shock when the Measure of Interconnectedness is low and high, respectively $INTER_1 = 0.028$ and $INTER_1 = 0.11$. These are the average values of our interconnectedness measure $INTER_1$ for the periods 1959Q1-1983Q4 and 1984Q1-2009Q1. As we can see from the Figure, at the level of interconnectedness of 0.028 the adverse monetary shock generates a decrease in output, which exhibits a hump-shaped response. The price level decreases too, but only after a few quarters (the well known price puzzle phenomenon). When we consider a higher level of interconnectedness of 0.11, instead, we see that the response of the GDP to the same monetary policy shock is now much lower.[26] Also the responses of the quarterly GDP deflator and the spot market commodity price index are muted at the higher level of interconnection. Interestingly, there is no evidence of price puzzle in that case.

In order to assess whether the difference in the impulse response we obtained under different levels of interconnectedness is statistically significant, we plot the difference in Figure (11), and we include confidence intervals at 90% significance level. As the figure

2. Using $[Y_1, \ldots, Y_p]$ as initial values and $INTER_{t-1}$, get the bootstrap endogenous variables from

$$Y_t^* = \hat{\Phi}(L)Y_{t-1}^* + \hat{\beta} INTER_{t-1} Y_{t-1}^* + e_t^*.$$

3. Impose the identification restrictions to get H and calculate impulse responses.

[25] The results obtained using the other measures, are broadly in line with what we present in the paper. We omitted them due to space constraints, and they are available upon request.

[26] In an unreported result, we show that this response is in fact not statistically different from zero.

shows, the impulse responses of GDP and GDP deflator are statistically different under the two scenarios, while the impulse responses of the commodity price index and the federal funds rate are not statistically significantly different.

The results reported in Figure (11) are robust to the inclusion of a time trend in the model, as well as to a different specification of the lag structure.[27]. However, the results are not statistically different from those that one would obtain by simply interacting a time trend in place of our measure of interconnectedness, and then considering the impulse responses for the pre-1984 versus post-1984 period. This is not terribly surprising, given the presence of a time trend (albeit a non-linear one) in our measure. In the next subsection we shows how this is not the case when moving to the FAVAR analysis. However, this finding also implies the need to be cautios in interpreting our results in a causal sense. Our results, in fact, simply point to the existence of a correlation between the level of interconnectedness of a financial system and the response of economic variables to a monetary policy shock. In the next Section we propose a model that can rationalize this intriguing result.

FAVAR. We also conduct a more refined exercise, inspired by the model from Bernanke et al. (2005). In contrast to standard structural VAR models, factor models have a number of advantages: i) they allow for the consideration of large amounts of information potentially observed by agents, and thus minimize the risk of omitted variable bias; ii) they are not sensitive to the choice of a specific data series, which may be arbitrary; iii) they are less likely to be subject to non-fundamentalness issues raised by Forni et al. (2009)[28]; and iv) they allow us to compute the response of a larger set of variables of interest to identified shocks.

As in the case of SVAR, we introduce our measure of interconnectedness through interaction terms, in order to obtain impulse response functions that are conditional on a certain level of interconnectedness. Formally, we consider the following static factor model with

[27] We omitted the results here, they are available upon request.

[28] If the shocks in the VAR model are fundamental, then the dynamic effects implied by the moving average representation can have a meaningful interpretation, i.e. the structural shocks can be recovered from current and past values of observable series. Forni et al. (2009) argue that while non-fundamentalness is generic of small scale models, it is highly unlikely to arise in large dimensional dynamic factor models.

latent and observed factors:

$$
\begin{aligned}
X_t &= \Lambda^F F_t + \Lambda^R R_t + u_t & (5) \\
\begin{bmatrix} F_t \\ R_t \end{bmatrix} &= \Phi(L) \begin{bmatrix} F_{t-1} \\ R_{t-1} \end{bmatrix} + \beta INTER_{t-1} \begin{bmatrix} F_{t-1} \\ R_{t-1} \end{bmatrix} + e_t & (6)
\end{aligned}
$$

where F_t is vector of K latent factors and R_t is the observed factor. In our case, R_t is the the Federal Funds Rate, since the objective here is to identify the monetary policy shock. X_t contains N macroeconomic and financial indicators organized into a block of 'slow-moving' variables that are largely predetermined to monetary policy, and another consisting of 'fast moving' variables that are sensitive to the Fed's rule. The idiosyncratic errors are assumed such that (5) is an approximate factor model (see Bai and Ng (2006) for details).

In our application, X_t contains $N = 108$ quarterly time series from Ng and Stevanovic (2012), that run from 1959Q1 to 2009Q1. Data include both macroeconomic variables such as GDP, employment, investment, hours worked, inflation rate as well as financial variables such as credit spreads, loans, etc. This represents an important contribution of our paper, which extends significantly the set of variables analyzed relative to previous studies.[29] The data have been transformed to induce stationarity and are standardized prior to estimation. The IC_{p2} information criterion from Bai and Ng (2002) and Onatski (2010) suggests $K = 3$ latent factors. The lag order of $\Phi(L)$ is set to 4. The estimation and identification of structural shocks consist of several steps. First, following Bernanke, Boivin and Eliasz (2005), we impose R_t as an observed factor when estimating F_t. Second, using $\hat{F}_t$, we estimate (6) as in the case of the SVAR model. Since $\hat{F}_t$ can be correlated with R_t, we identify the monetary policy by ordering R_t last. Finally, we invert (6) to obtain factors' impulse responses, and multiply them by factor loadings to get the IRFs of all the elements in X_t. While all the impulse responses are available upon request, we present here only a subset of them.

As before, we compare the impulse responses to an adverse monetary policy shock when the interconnectedness is low and high, respectively $INTER_1 = 0.028$ and $INTER_1 =$

[29]The complete description of the data and their transformation is presented in the appendix.

0.11.[30] In Figure (12) we report the responses of several variables of interest to an identified monetary policy shock. The responses of real variables (such as GDP, consumption, investment, employment) to a monetary innovation are generally muted at higher level of interconnectedness. Moreover, several financial variables display a similar pattern. Of particular interest for the story we will develop in the next Section, is to notice how the response of credit-related variables are dampened as the interconnectedness within the financial sector increases. This is true both for quantities (bank credit, loans and leases, and real estate loans) and, to a lesser extent, for prices (in particular the BBA spread). These responses are consistent with the mechanism that we will propose in the next Section, based on the sensitivity of lenders to the financial soundness of the borrowers.

In order to test whether these differences are statistically significant, we compute the difference between the impulse responses and we compute via bootstrap a 90% confidence internal. In Figure (13) we report the results. The impulse responses of most variables analyzed are indeed statistically different, at least in the first few quarters.

Finally, we repeat the exercise but including a simple time trend instead of our measure of interconnectedness. Figure (14) reports the results we obtained for the same varibles as before, just dividing the sample into pre-1984 and post-1984. As the Figure shows, we still find a certain attenuation in the responses of several variables to a monetary policy innovation, but the attenuation displayed is significantly lower than the one obtained using our measure of interconnectedness. In fact, by computing via bootstrap a 90% confidence interval, which we show in Figure (15), we can see how for most of the variables, the two impulse responses are not statistically different (with the exception of some real variables, like GDP, investment and employment, where the difference if significant for the first few quarters). It is interesting to notice how the responses of the financial variables such as credit, loans ad lease and the real estate loans are not statistically different under the two time period considered.

We conclude that the inclusion of our measure of interconnectedness into a SVAR or a

[30]Also for the case of the FAVAR, we repeated our procedure using all the measures proposed in Section 2, and we obtained very similar results.

FAVAR for the U.S. economy generates statistically different responses to monetary policy innovations. Moreover, while in the case of the SVAR these results are not substantially different from those that one would obtain by interacting the system with a time trend, including the measure of interconnectedness in the FAVAR generates results which are different from those obtained simply including a time trend.

4 Interconnectedness and Monetary Policy: Theory

We present a stylized model that captures a possible relationship between the interconnectedness of the financial sector and the sensitivity of real activity to monetary policy. Of course, there are many possible mechanisms through which financial interconnectedness may alter monetary policy transmission. We focus on the credit channel transmission of monetary policy, and show how a financial sector more interconnected implies a lower sensitivity of lending to monetary policy shocks.[31]

There are two periods indexed $t = 0, 1$, and a unit measure of islands. Each island has a unit measure of savers, a unit measure of banks, and a unit measure of borrowers. Each saver is endowed with 1 unit of the final good at $t = 0$. Savers value consumption only at $t = 1$, so they deposit their savings at a bank. Banks cannot write contingent contracts with depositors: rather, they must offer some certain return of $1 + r_d$. Banks are competitive: savers deposit their endowment in the bank that promises the highest return. In equilibrium, all banks post the same deposit rate r_d, and we can therefore assume that each bank receives 1 unit of deposits.

Banks have access only to depositors and borrowers from their own island. In addition, banks can store deposits at a rate of return of 1; this store of value will be referred to as "money" (m). The interest rate that the borrower (entrepreneur) faces is denoted by r.

The entrepreneur can choose to invest in a risky project or in a safe project. The gross return on the safe project is 1. The gross return on the risky project is $R > 2$ with probability

[31] See Ciccarelli et. al (2015) for a recent empirical exploration of the importance of the credit channel for the transmission of monetary policy.

0.5, and 0 otherwise (in other words, the mean of the risky project is higher than the mean of the safe project). The entrepreneur is risk neutral. Importantly, the success of the risky project is perfectly correlated across entrepreneurs within an island, and independent across islands. This reflects some local risk associated with investment, which washes out in the aggregate.

If the entrepreneur cannot repay his debt, his wealth $A \geq 0$ is taken away from him. We assume that A is an indivisible asset, that is valuable to the entrepreneur but has no resale value; in other words, taking away A is a threat to the entrepreneur, but does not yield any benefits to the lending bank. In addition, A cannot be sold in order to repay the debt. This assumption is useful as it simplifies the analysis, and can be thought of as an extreme form of the more standard assumption that the liquidation value is lower than the continuation value.[32] The expected return to investing $I_r > 0$ units in the risky project is then:

$$0.5(R - (1 + r))I_r - 0.5A \tag{7}$$

We assume the following parametric restriction:

$$0.5(R - A) > 1 \tag{8}$$

This assumption guarantees that, if $r = 0$, there are strictly positive returns for the entrepreneur from choosing $I_r = 1$.[33] The entrepreneur faces a menu of interest rates $r(I)$, that depend on the size of his loan. The entrepreneur allocates I_s units of investment to the safe project, and I_r units of investment towards the risky project. The entrepreneur maximizes:

$$\max_{I_s, I_r, I} (0.5(R - (1 + r))I_r - 0.5A\chi\{I_r > 0\} + I_s(-r) \tag{9}$$

[32] However, making this more standard assumption would not affect the main qualitative results of our model, at the cost of complicating the analysis.

[33] For this to be true, it would be sufficient, from (7), the weaker condition $R - A \geq 1$. The reason why we make a stronger parametric restriction is going to be clearer later.

s.t.:

$$I_s + I_r = I \tag{10}$$

$$r = r(I) \tag{11}$$

where $\chi\{I_r > 0\}$ is an indicator function that takes the value 1 if $I_r > 0$ and 0 otherwise. [34] The bank maximizes expected profits at $t = 1$, subject to the constraint that it must have enough profits to repay depositors. It allocates its unit of deposits between loans (I) and money (m). Importantly, the bank can only choose the size of loans I; it cannot choose I_s and I_r directly. It solves:

$$\max_{I,m} E_s((1 + r(I, s))I) + m - 1 - r_d \tag{12}$$

s.t.

$$I + m = 1 \tag{13}$$

$$(1 + r(I, s))I + m \geq 1 + r_d \tag{14}$$

where $r(I, s)$ is the state dependent return to loans, given a loan size of I. In other words, if the entrepreneur is unable to repay the loan, $r(I, s) = -1$; otherwise $r(I, s) = r(I)$.

Benchmark: no interbank markets. In the absence of an interbank market, an equilibrium is defined as a set $(I, I_s, I_r, m, r(I), r_d)$, such that (a) no bank can make strictly positive profits from deviating from r_d and $r(I)$, (b) I and m solve the bank's optimization problem given r_d and $r(I)$, and (c) I, I_s and I_r solve the entrepreneur's maximization problem given $r(I)$.

To solve for the equilibrium, note that, as banks must repay depositors, they cannot take on the risk of failed projects. The bank therefore chooses the size of the loan so that the entrepreneur does not choose to invest in the risky project.[35] In this case, $r_d = 0$ as a rate

[34]Notice that if the entrepreneur chooses the safe project, whose return is 1, the profits for him are equal to $1 - 1 - r$.

[35]It is assumed that the bank can observe the entrepreneur's credit with other banks, and takes the market interest rate schedule $r(I)$ as given.

of return of 1 is the maximum that any bank can guarantee. When $R > 1 + r$, it is easy to see that this can be achieved only when $A > 0$ and:

$$0.5(R - (1 + r(I)))I_r - 0.5A \leq 0 \Rightarrow I_r \leq \frac{A}{R - (1 + r(I))} \tag{15}$$

It follows that $r(I) = 0$ for $I \leq \frac{A}{R-1}$ and $r(I) = \infty$ otherwise. In other words, the bank rations credit to induce entrepreneurs to select the safe project.[36]

In this environment, the quantity of lending is sensitive to A. In equilibrium, the entrepreneur chooses $I = I_s = \frac{A}{R-1}$. Note that given the parametric restriction we made, this is an interior solution, with $I_s < 1$. Hence, changes in his net worth (A) translate into changes in the quantity of of investment:

$$\frac{\partial I}{\partial A} = \frac{1}{R - 1} \tag{16}$$

For simplicity, we assume in the background an interaction between monetary policy and A. We would agree that there are indeed other transmission channels for monetary policy, but we choose to focus on this one just to illustrate a potential channel of how interconnectedness can dampen transmission. A represents the entrepreneur's equity in an indivisible investment good (such as a house or a factory), which is partially financed by nominal debt contracts. An increase in the nominal interest rate raises the value of these debt contracts and effectively reduces the entrepreneur's equity and the size of the loan offered to him by the bank. The fact that investment depends in A corresponds, in this environment, to the transmission of monetary policy. In other words, equation (16) is equivalent to a situation where the real activity (I) is sensitive to monetary policy, in the absence of an interbank market.

Interbank trading. Consider an alternative environment in which banks can pool risk across islands. A bank issuing a loan can then sell its returns and purchase other bank's returns. Let I^{sec} denote the securitized loans sold by the bank, and let I^d denote the bank's

[36]In this simplified setting, there is also a less interesting equilibrium with no lending ($I = 0$ and $m = 1$). We concentrate our attention to the equilibrium with lending. While additional assumptions, at the cost of complicating the analysis, could rule out the no lending equilibrium, this would not add much to the qualitative insights on which we want to focus here.

demand for securitized loans. p is the price of securitized loans (in terms of $t = 1$ goods). The bank's problem is modified to:

$$\max_{I,m,I^{sec},I^d} E_s((1+r(I,s))(I - I^{sec})) + m + pI^{sec} - pI^d + \int_0^1 (1+r(s))I^d ds - 1 - r_d \quad (17)$$

s.t.

$$I + m = 1 \quad (18)$$

and, for every state s:

$$(1+r(I,s))(I - I^{sec}) + m + pI^{sec} - pI^d + \int_0^1 (1+r(s))I^d ds \geq 1 + r_d \quad (19)$$

Where $r(s)$ is now defined as the equilibrium return on securitized loans in state s. The definition of equilibrium is now modified to include I^{sec} and I^d that must be optimal for the bank given p. The market clearing condition for p is $I^{sec} = I^d$ (otherwise, p implies either excess supply or excess demand of securities).

We conjecture an equilibrium in which banks sell their entire loan portfolio ($I^{sec} = I$) at the price p, and buy a diversified portfolio of loans ($I^d = I$). Entrepreneurs implement the risky project, and the interest rate is such that entrepreneurs make no profits from investing $I_r = 1$:

$$0.5(R - (1+r)) = 0.5A \Rightarrow 1 + r = R - A \quad (20)$$

The interest schedule $r(I)$ is given by $r(I) = R - A - 1$ for $I \leq 1$ and $r(I) = \infty$ otherwise. The price p is the expected return to securities, $p = 0.5(1+r) = 0.5(R - A)$. Since $I = I_r$, $m = 0$, and $I^{sec} = I^d$, the bank's (deterministic) profits are given by the expected value of securitized loans minus the gross return on deposits:

$$0.5(1+r) - 1 - r_d = 0.5(R - A) - 1 - r_d \quad (21)$$

The deposit rate r_d is then determined by the zero profit condition, that sets $r_d = 0.5(R - A) - 1$, which is positive given our parametric restriction.

Note that this is an equilibrium, as banks competing for deposits would like to offer the highest possible deposit rate; any deviation from this strategy would result either in losses (for a higher deposit rate) or in no deposits (for a lower deposit rate). Furthermore, it is easy to see that given $r(I)$ and p, neither banks nor entrepreneurs can make strictly positive profits from deviating from the proposed equilibrium strategies.[37] In this environment, banks have no incentive to ration credit in order to induce entrepreneurs to stay away from the risky project; thus, in this equilibrium, $I = 1$ and the entire deposits are invested in the risky project. This corner solution implies that banks' lending decisions are insensitive to small changes in the borrower's net worth:

$$I = 1 \Rightarrow \frac{\partial I}{\partial A} = 0 \tag{22}$$

In other words, equation (22) is equivalent to a situation where interbank trading makes banks insensitive to the net worth of their borrowers, and, in this environment, insensitive to monetary policy.[38]

Measure of interconnectedness and sensitivity to monetary policy. In this context, the measure of interconnectedness presented in Section 2 can be thought of as a function of the measure of islands that are parts of the interbank market. Assume that a measure $\lambda \leq 1$ of islands are able to share risk, while a measure $1 - \lambda$ of islands do not participate in interbank markets. Note that the λ banks that participate in interbank markets have the

[37]To see this, note that the entrepreneur's profits are 0. If the entrepreneur invests $I_r < 1$, his expected profits are negative because:

$$0.5(R - (1 + r))I_r - 0.5A = 0.5(R - (R - A))I_r - 0.5A = 0.5A(I_r - 1) \geq 0 \Leftrightarrow I_r \geq 1$$

Furthermore, since $r(I) = \infty$ for $I > 1$, the entrepreneur cannot make strictly positive profits from choosing $I > 1$. Obviously, since the return to the safe project is 1 there are no profits to be made from choosing $I_s > 0$. To see that the bank cannot increase its by deviating from the schedule $r(I)$, note that if a bank offers $r(I) < R - A - 1$ for $I \leq 1$ it will be unable to sell its securities at the price p, as the expected return is lower than p. The bank will then be unable to diversify and will not be able to repay depositors in all states. If a bank offers $r(I) > R - A - 1$ for $I \leq 1$ it will be unable to lend as entrepreneurs will prefer to borrow from another bank. The bank obviously cannot lend more than $I = 1$ so it cannot increase its profits by changing $r(I) = \infty$ for $I > 1$.

[38]See Hobjin and Ravenna (2010) for a more quantitative model of bank securitization and monetary policy transmission.

following balance sheet. On the asset side, banks hold securities from other banks amounting to the value of deposits. On their liability side, they have deposits. Thus, all of their assets and none of their liabilities have counterparts that are in the financial system. The banks measure of interconnectedness is therefore 1, and the aggregate measure of interconnectedness is therefore λ. Moreover, the aggregate sensitivity to changes in A (and hence to monetary policy) is:

$$\frac{\partial I}{\partial A} = (1-\lambda)\frac{1}{R-1} + \lambda \cdot 0 \tag{23}$$

Quite clearly, we see from equation (23) that the sensitivity of real activity to monetary policy is decreasing in the interconnectedness of the financial sector (proxied by λ), consistent with our empirical results presented in Section 3.

5 Conclusions

This paper documents a rising trend in the share of financial claims whose direct counterpart is in the financial sector. The financial sector's increased ability to buffer idiosyncratic liquidity shocks may have contributed to a decrease in the sensitivity of investment to fundamentals such as the borrower's net worth. In this paper, we illustrate how this may have contributed to the dampening of the responsiveness to monetary policy. Of course, the implications of this structural change in the financial system may go far beyond the transmission of monetary policy shocks. We outline here several potential avenues for future research that make use of the measure of interconnectedness.

First, it would be interesting to develop a quantitative macroeconomic model embedding the concept of interconnectedness explored in this paper. This could also be used to evaluate the relative importance of the policy behavior and the interconnectedness in explaining the muted responses of monetary policy innovations on economic variables found using more recent samples.

Second, it may be insightful to analyze the dynamics of the interconnection of the financial sector for additional countries, and study how connection was related to performance during the Great Recession.

Finally, and especially for policy purposes, it would be important to go beyond the aggregate perspective we take in this paper and use balance sheet data on single financial institutions to analyze the impact of their interconnection with other financial firms on a range of performance measures. This could also help improve the regulation and monitoring of financial institutions. We plan to pursue these avenues in our future research.

A Appendix: Data Used in the FAVAR

The transformation codes are: 1 no transformation; 2 first difference; 4 logarithm; 5 first difference of logarithm; 0 variable not used in the estimation (only used for transforming other variables). A * indicates a series that is deflated with the GDP deflator (series #89).

No.	Series Code	T-Code	Series Description
1	DRIINTL:GDPRC@US.Q	5	NIA REAL GROSS DOMESTIC PRODUCT (CHAINED-2000), SA - U.S.
2	USCEN:GDPGDR.Q	5	REAL GDP-GDS,BILLIONS OF CH (2000) $,SAAR-US
3	USCEN:GDPSVR.Q	5	REAL GDP-SVC,BILLIONS OF CH (2000) $,SAAR-US
4	USCEN:GDPSR.Q	5	REAL GDP-STRUC,BILLIONS OF CH (2000) $,SAAR-US
5	BASIC:IPN11.M	5	INDUSTRIAL PRODUCTION INDEX - PRODUCTS, TOTAL
6	BASIC:IPN300.M	5	INDUSTRIAL PRODUCTION INDEX - FINAL PRODUCTS
7	BASIC:IPN12.M	5	INDUSTRIAL PRODUCTION INDEX - CONSUMER GOODS
8	BASIC:IPN13.M	5	INDUSTRIAL PRODUCTION INDEX - DURABLE CONSUMER GOODS
9	BASIC:IPN18.M	5	INDUSTRIAL PRODUCTION INDEX - NONDURABLE CONSUMER GOODS
10	BASIC:IPN25.M	5	INDUSTRIAL PRODUCTION INDEX - BUSINESS EQUIPMENT
11	BASIC:IPN32.M	5	INDUSTRIAL PRODUCTION INDEX - MATERIALS
12	BASIC:IPN34.M	5	INDUSTRIAL PRODUCTION INDEX - DURABLE GOODS MATERIALS
13	BASIC:IPN38.M	5	INDUSTRIAL PRODUCTION INDEX - NONDURABLE GOODS MATERIALS
14	BASIC:IPN10.M	5	INDUSTRIAL PRODUCTION INDEX - TOTAL INDEX
15	USCEN:UTLB00004.M	1	CAPACITY UTILIZ-MFG,SA-US
16	BASIC:PMI.M	1	PURCHASING MANAGERS' INDEX (SA)
17	BASIC:PMP.M	1	NAPM PRODUCTION INDEX (PERCENT)
18	DRIINTL:WS@US.Q	5*	NIA NOMINAL TOTAL COMPENSATION OF EMPLOYEES, SA - U.S.
19	USCEN:YPR.M	5	PERS INCOME CH 2000 $,SA-US
20	USCEN:YP@V00C.M	5	PERS INCOME LESS TRSF PMT CH 2000 $,SA-US
21	USCEN:AHPMF.M	5*	AHE,PROD WORKERS: MFG,SA-US
22	USCEN:AHPCON.M	5*	AHE,PROD WORKERS: CONSTR,SA-US
23	USCEN:HPMF.M	5	AWH,PROD WORKERS: MFG,SA-US
24	USCEN:HOPMD.M	5	AVG WEEKLY OT,PROD WORKERS: DUR,SA-US
25	BASIC:LHEL.M	5	INDEX OF HELP-WANTED ADVERTISING IN NEWSPAPERS (1967=100;SA)
26	BASIC:LHELX.M	1	EMPLOYMENT: RATIO; HELP-WANTED ADS:NO. UNEMPLOYED CLF
27	BASIC:LHEM.M	5	CIVILIAN LABOR FORCE: EMPLOYED, TOTAL (THOUS.,SA)
28	BASIC:LHNAG.M	5	CIVILIAN LABOR FORCE: EMPLOYED, NONAGRIC.INDUSTRIES (THOUS.,SA)
29	BASIC:LHUR.M	1	UNEMPLOYMENT RATE: ALL WORKERS, 16 YEARS & OVER (%,SA)
30	BASIC:LHU680.M	1	UNEMPLOY.BY DURATION: AVERAGE(MEAN)DURATION IN WEEKS (SA)
31	BASIC:LHU5.M	5	UNEMPLOY.BY DURATION: PERSONS UNEMPL.LESS THAN 5 WKS (THOUS.,SA)
32	BASIC:LHU14.M	5	UNEMPLOY.BY DURATION: PERSONS UNEMPL.5 TO 14 WKS (THOUS.,SA)
33	BASIC:LHU15.M	5	UNEMPLOY.BY DURATION: PERSONS UNEMPL.15 WKS + (THOUS.,SA)
34	BASIC:LHU26.M	5	UNEMPLOY.BY DURATION: PERSONS UNEMPL.15 TO 26 WKS (THOUS.,SA)
35	BASIC:CES001.M	5	EMPLOYEES, NONFARM - TOTAL NONFARM
36	BASIC:CES002.M	5	EMPLOYEES, NONFARM - TOTAL PRIVATE
37	BASIC:CES003.M	5	EMPLOYEES, NONFARM - GOODS-PRODUCING
38	USCEN:CR.Q	5	REAL PCE,BILLIONS OF CH (2000) $,SAAR-US
39	USCEN:JQCDR.Q	5	REAL PCE-DUR,QTY INDEX (2000=100),SA,SA-US
40	USCEN:JQCNR.Q	5	REAL PCE-NDUR,QTY INDEX (2000=100),SA,SA-US
41	USCEN:JQCSVR.Q	5	REAL PCE-SVC,QTY INDEX (2000=100),SA,SA-US
42	USCEN:JQCXFAER.Q	5	REAL PCE EX FOOD&ENERGY,QTY INDEX (2000=100),SAAR-US
43	DRIINTL:CGRCUS.Q	5	REAL GOVERNMENT CONS. EXPEND.& GROSS INVESTMENT (CHAINED-2000), SA - U.S.
44	USCEN:I.Q	5*	GROSS PRIV DOM INVEST,BILLIONS OF $,SAAR-US
45	USCEN:IF.Q	5*	GROSS PRIV DOM INVEST-FIXED,BILLIONS OF $,SAAR-US
46	USCEN:IFNRE.Q	5*	GROSS PRIV DOM INVEST-FIXED NONRES,BILLIONS OF $,SAAR-US
47	USCEN:IFRES.Q	5*	PRIV FIXED INVEST-RES-STRUC,BILLIONS OF $,SAAR-US
48	USCEN:IFRE.Q	5*	GROSS PRIV DOM INVEST-FIXED RES,BILLIONS OF $,SAAR-US

49	USCEN:II.Q	1	GROSS PRIV DOM INVEST-CH IN PRIV INVENT,BILLIONS OF $,SAAR-US
50	USCEN:IIF.Q	1	GROSS PRIV DOM INVEST-CH IN PRIV INVENT-FARM,BILLIONS OF $,SAAR-US
51	BASIC:HSFR.M	4	HOUSING STARTS:NONFARM(1947-58);TOTAL FARM&NONFARM(1959-)(THOUS.,SA
52	BASIC:HMOB.M	4	MOBILE HOMES: MANUFACTURERS' SHIPMENTS (THOUS.OF UNITS,SAAR)
53	BASIC:PMNV.M	1	NAPM INVENTORIES INDEX (PERCENT)
54	BASIC:PMNO.M	1	NAPM NEW ORDERS INDEX (PERCENT)
55	BASIC:PMDEL.M	1	NAPM VENDOR DELIVERIES INDEX (PERCENT)
56	BASIC:MOCMQ.M	5	NEW ORDERS (NET) - CONSUMER GOODS & MATERIALS, 1996 DOLLARS (BCI)
57	BASIC:MSONDQ.M	5	NEW ORDERS, NONDEFENSE CAPITAL GOODS, IN 1996 DOLLARS (BCI)
58	USCEN:M.Q	5	IMPORTS OF GDS&SVC,BILLIONS OF $,SAAR-US
59	USCEN:X.Q	5	EXPORTS OF GDS&SVC,BILLIONS OF $,SAAR-US
60	BASIC:FSPCOM.M	5	S&P'S COMMON STOCK PRICE INDEX: COMPOSITE (1941-43=10)
61	BASIC:FSPIN.M	5	S&P'S COMMON STOCK PRICE INDEX: INDUSTRIALS (1941-43=10)
62	BASIC:FSDXP.M	1	S&P'S COMPOSITE COMMON STOCK: DIVIDEND YIELD (% PER ANNUM)
63	BASIC:FSPXE.M	1	S&P'S COMPOSITE COMMON STOCK: PRICE-EARNINGS RATIO (%,NSA)
64	BASIC:EXRUK.M	5	FOREIGN EXCHANGE RATE: UNITED KINGDOM (CENTS PER POUND)
65	BASIC:EXRCAN.M	5	FOREIGN EXCHANGE RATE: CANADA (CANADIAN $ PER U.S.$)
66	BASIC:FYGM3.M	1	INTEREST RATE: U.S.TREASURY BILLS,SEC MKT,3-MO.(% PER ANN,NSA)
67	BASIC:FYGM6.M	1	INTEREST RATE: U.S.TREASURY BILLS,SEC MKT,6-MO.(% PER ANN,NSA)
68	BASIC:FYGT1.M	1	INTEREST RATE: U.S.TREASURY CONST MATURITIES,1-YR.(% PER ANN,NSA)
69	BASIC:FYGT5.M	1	INTEREST RATE: U.S.TREASURY CONST MATURITIES,5-YR.(% PER ANN,NSA)
70	BASIC:FYGT10.M	1	INTEREST RATE: U.S.TREASURY CONST MATURITIES,10-YR.(% PER ANN,NSA)
71	BASIC:FYAAAC.M	1	BOND YIELD: MOODY'S AAA CORPORATE (% PER ANNUM)
72	BASIC:FYBAAC.M	1	BOND YIELD: MOODY'S BAA CORPORATE (% PER ANNUM)
73	FYGM6-FYFF	1	
74	FYGM3-FYFF	1	
75	FYGT1-FYFF	1	
76	FYGT5-FYFF	1	
77	FYGT10-FYFF	1	
78	FYAAAC-FYFF	1	
79	FYBAAC-FYFF	1	
80	BASIC:FM1.M	5	MONEY STOCK: M1(CURR,TRAV.CKS,DEM DEP,OTHER CK'ABLE DEP)(BIL$,SA)
81	BASIC:FM2.M	5	MONEY STOCK:M2(M1+O'NITE RPS,EURO$,G/P&B/D MMMFS&SAV&SM TIME DEP(BIL$)
82	USCEN:MNY2@00.M	5	MONEY SUPPL-M2 IN 2000 $,SA-US
83	BASIC:FMFBA.M	5	MONETARY BASE, ADJ FOR RESERVE REQUIREMENT CHANGES(MIL$,SA)
84	BASIC:FMRRA.M	5	DEPOSITORY INST RESERVES:TOTAL,ADJ FOR RESERVE REQ CHGS(MIL$,SA)
85	BASIC:FMRNBA.M	2	DEPOSITORY INST RESERVES:NONBORROWED,ADJ RES REQ CHGS(MIL$,SA)
86	USCEN:ALCIBL00Z.M	5	COML&IND LOANS OUTST,SA-US
87	BASIC:FCLBMC.M	1	WKLY RP LG COM'L BANKS:NET CHANGE COM'L & INDUS LOANS(BIL$,SAAR)
88	BASIC:CCINRV.M	5	CONSUMER CREDIT OUTSTANDING - NONREVOLVING(G19)
89	DRIINTL:PGDP@US.Q	5	NIA PRICE DEFLATOR - GROSS DOMESTIC PRODUCT, SA - U.S.
90	DRIINTL:PCP@US.Q	5	NIA PRICE DEFLATOR - PRIVATE CONSUMPTION EXPENDITURE, SA - U.S.
91	USCEN:PDII.Q	5	GROSS PRIV DOM INVEST,PRICE DEFLATORS (2000=100),SA,SA-US
92	USCEN:JPCD.Q	5	PCE-DUR,PRICE INDEX (2000=100),SA,SA-US
93	USCEN:JPCN.Q	5	PCE-NDUR,PRICE INDEX (2000=100),SA,SA-US
94	USCEN:JPCSV.Q	5	PCE-SVC,PRICE INDEX (2000=100),SA,SA-US
95	BASIC:PUXM.M	5	CPI-U: ALL ITEMS LESS MEDICAL CARE (82-84=100,SA)
96	BASIC:PUXHS.M	5	CPI-U: ALL ITEMS LESS SHELTER (82-84=100,SA)
97	BASIC:PUXF.M	5	CPI-U: ALL ITEMS LESS FOOD (82-84=100,SA)
98	BASIC:PUS.M	5	CPI-U: SERVICES (82-84=100,SA)
99	BASIC:PUCD.M	5	CPI-U: DURABLES (82-84=100,SA)
100	BASIC:PUC.M	5	CPI-U: COMMODITIES (82-84=100,SA)
101	BASIC:PUNEW.M	5	CPI-U: ALL ITEMS (82-84=100,SA)
102	BASIC:PWFSA.M	5	PRODUCER PRICE INDEX: FINISHED GOODS (82=100,SA)
103	BASIC:PMCP.M	1	NAPM COMMODITY PRICES INDEX (PERCENT)
104	UOMO83	1	COMPONENT INDEX OF CONSUMER EXPECTATIONS, NSA, CONFBOARD AND U.MICH.
105	DRIINTL:JLEAD@US.Q	5	COMPOSITE CYCLICAL INDICATOR (1996) - LEADING, SA - U.S.
106	DRIINTL:JLAG@US.Q	5	COMPOSITE CYCLICAL INDICATOR (1996) - LAGGING, SA - U.S.

107	DRIINTL:JCOIN@US.Q	5	COMPOSITE CYCLICAL INDICATOR (1996) - COINCIDENT, SA - U.S.
108	FYBAAC-FYGT10.M	1	BAA SPREAD
109	USCEN:NC16&Z.M	0	CIVILIAN NONINSTITUTIONAL POP: 16 YEARS&OVER,SA-US
110	BASIC:FYFF.M	1	INTEREST RATE: FEDERAL FUNDS (EFFECTIVE) (% PER ANNUM,NSA)

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Table 1: **ADL(p,1) Regressions. Dependent Variable: Detrended GDP.**

	(1)	(2)	(3)	(4)	(5)
Measure:	$INTER_1$	$INTER_1$	$INTER_1$	$INTER_3$	$INTER_3$
const	0.0068	0.0251	0.0247	0.0093	0.0329
p-value	(0.0075)	(0.0673)	(0.0603)	(0.0028)	(0.0104)
GDP(t-1)	1.2836	1.3152	1.2811	1.2780	1.2714
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
GDP(t-2)	-0.2782	-0.3363	-0.2884	-0.2679	-0.2756
	(0.0005)	(0.0000)	(0.0002)	(0.0009)	(0.0005)
FFR(t-1)	-0.0013	-0.0034	-0.0008	-0.0018	-0.0037
	(0.0075)	(0.0768)	(0.7274)	(0.0068)	(0.0443)
INTER(t-1)	-0.0583		-0.0771	-0.0401	-0.0464
	(0.0025)		(0.0024)	(0.0023)	(0.0019)
LIQ(t-1)		-0.0529	-0.0334		-0.0488
		(0.0783)	(0.2636)		(0.0849)
FFR x INTER(t-1)	0.0110		0.0214	0.0076	0.0109
	(0.0078)		(0.0256)	(0.0116)	(0.0259
FFR x LIQ(t-1)		0.0071	-0.0037		0.0027
		(0.1062)	(0.6194)		(0.6156)
R2-adj	0.9567	0.9561	0.9571	0.9569	0.9573

P-values in Parenthesis.

Table 2: **ADL(p,1) Regressions. Dependent Variable: Annualized GDP Growth Rate.**

	(1)	(2)	(3)	(4)	(5)
Measure:	$INTER_1$	$INTER_1$	$INTER_1$	$INTER_3$	$INTER_3$
const	5.0623	8.4281	10.4834	5.9482	14.3398
p-value	(0.0000)	(0.1139)	(0.0342)	(0.0000)	(0.0045)
GDP(t-1)	0.2785	0.3116	0.2738	0.2751	0.2645
	(0.0002)	(0.0001)	(0.0003)	(0.0003)	(0.0005)
FFR(t-1)	-0.5048	-0.9329	-0.0209	-0.6845	-1.2907
	(0.0014)	(0.2143)	(0.9813)	(0.0012)	(0.0675)
INTER(t-1)	-24.0286		-34.8738	-15.9583	-20.5178
	(0.0010)		(0.0001)	(0.0010)	(0.0001)
LIQ(t-1)		-11.7908	-8.2100		-15.7445
		(0.3037)	(0.4266)		(0.1294)
FFR x INTER(t-1)	4.4971		9.6093	2.9664	4.8379
	(0.0038)		(0.0080)	(0.0058)	(0.0052)
FFR x LIQ(t-1)		1.7425	-2.4787		0.3992
		(0.3142)	(0.3612)		(0.8380)
R2-adj	0.1652	0.1391	0.1712	0.1685	0.1749

P-values in Parenthesis.

Table 3: **ADL(p,1) Regressions. Dependent Variable: Loans and Leases, Annualized Growth Rate.**

	(1)	(2)	(3)	(4)	(5)
Measure:	$INTER_1$	$INTER_1$	$INTER_1$	$INTER_3$	$INTER_3$
const	4.7720	6.2982	7.6454	5.8508	12.4540
p-value	(0.0000)	(0.1279)	(0.0440)	(0.0000)	(0.0059)
LOANS(t-1)	0.6956	0.7411	0.6925	0.6920	0.6885
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
FFR(t-1)	-0.3418	-0.4957	0.0328	-0.5426	-0.8671
	(0.0414)	(0.4771)	(0.9696)	(0.0475)	(0.2081)
INTER(t-1)	-26.5937		-33.6583	-15.5162	-22.6179
	(0.0242)		(0.0169)	(0.0125)	(0.0053)
LIQ(t-1)		-8.4138	-3.8981		-11.8910
		(0.3682)	(0.6144)		(0.1565)
FFR x INTER(t-1)	3.9713		7.2169	2.4553	4.8123
	(0.1087)		(0.0885)	(0.0787)	(0.0286)
FFR x LIQ(t-1)		0.9500	-1.7244		-0.2739
		(0.5896)	(0.5322)		(0.8874)
R2-adj	0.5210	0.5019	0.5188	0.5236	0.5238

P-values in Parenthesis.

Figure 1: **Asset Shares of Different Actors (source: FED Flow of Funds)**

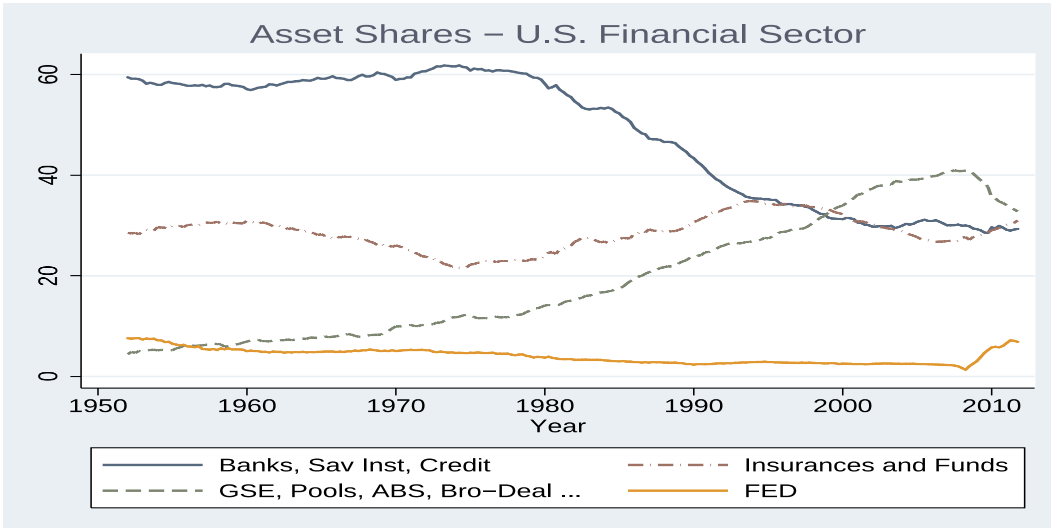

Figure 2: **The *Measure of Interconnectedness*: U.S. 1952-2009, Aggregate**

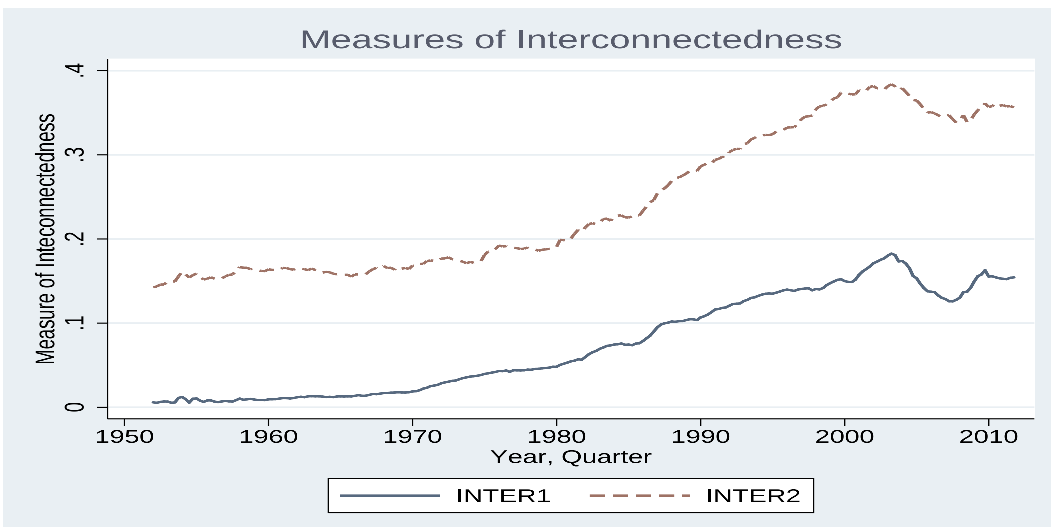

Figure 3: **Corporate Bonds and Commercial Papers over Total Credit**

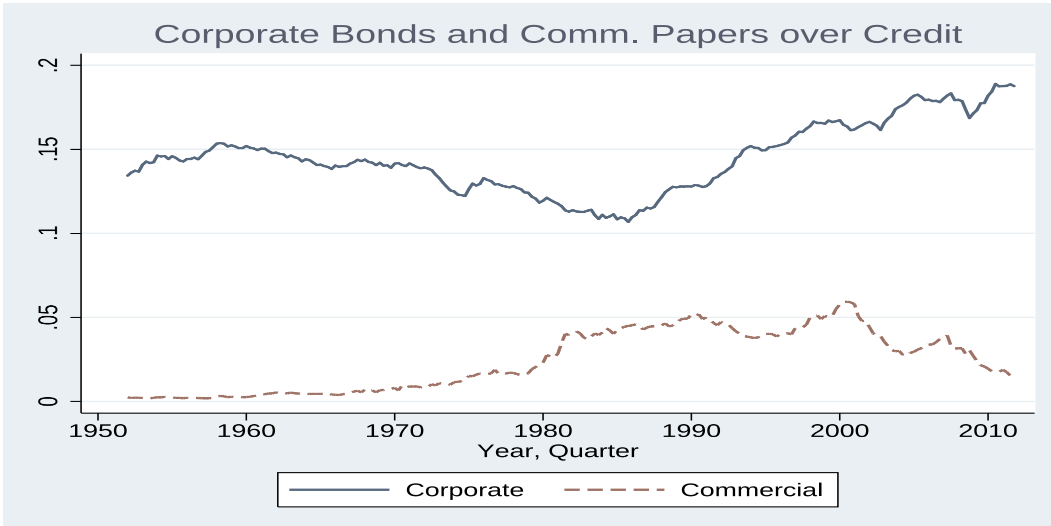

Figure 4: **Mortgages over Total Credit**

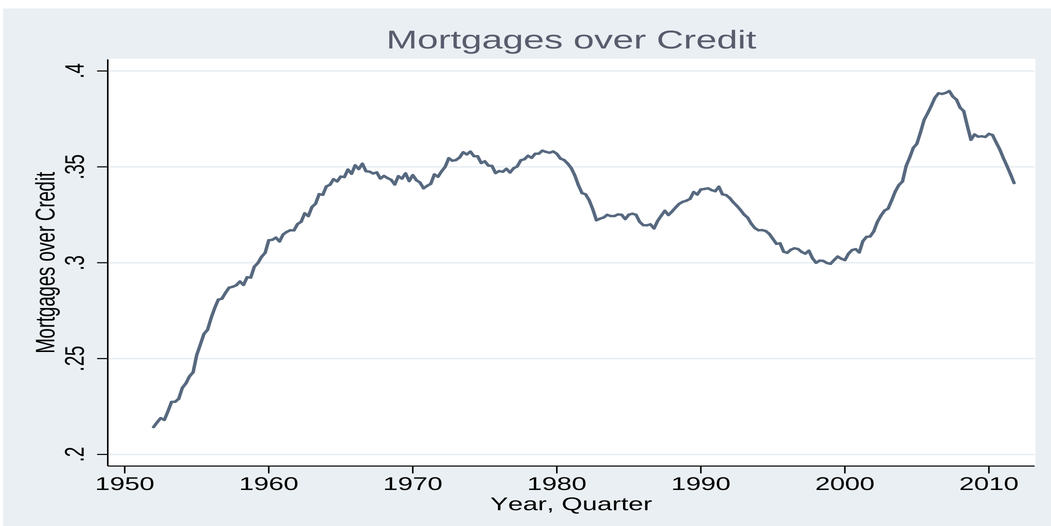

Figure 5: **Measure of Interconnectedness: Liabilities**

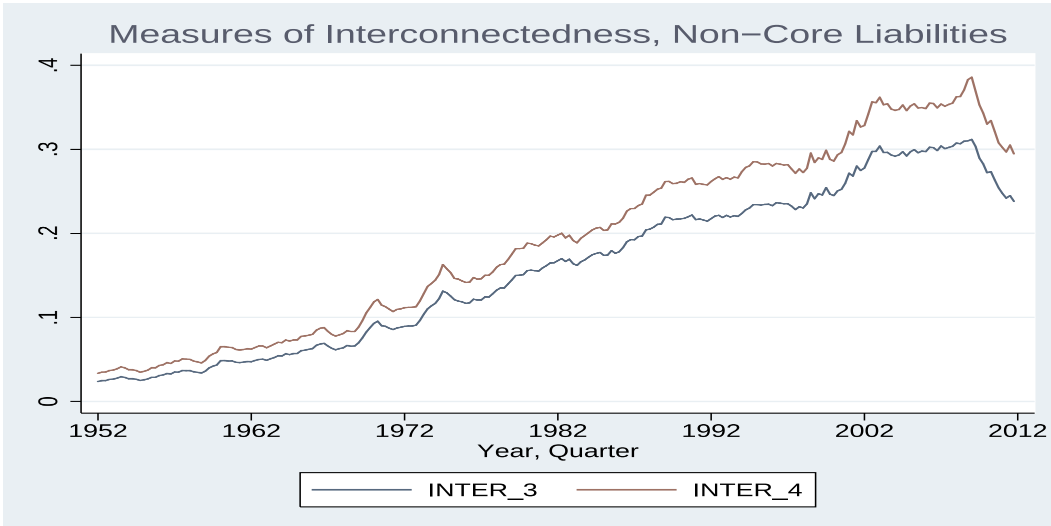

Figure 6: **Interconnectedness and Liquidity**

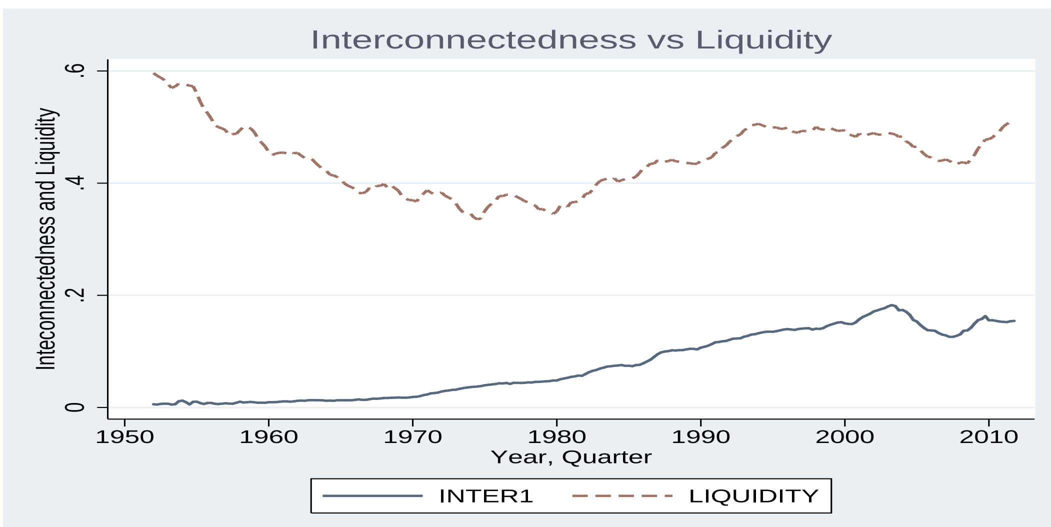

Figure 7: **Treasuries over Total Credit**

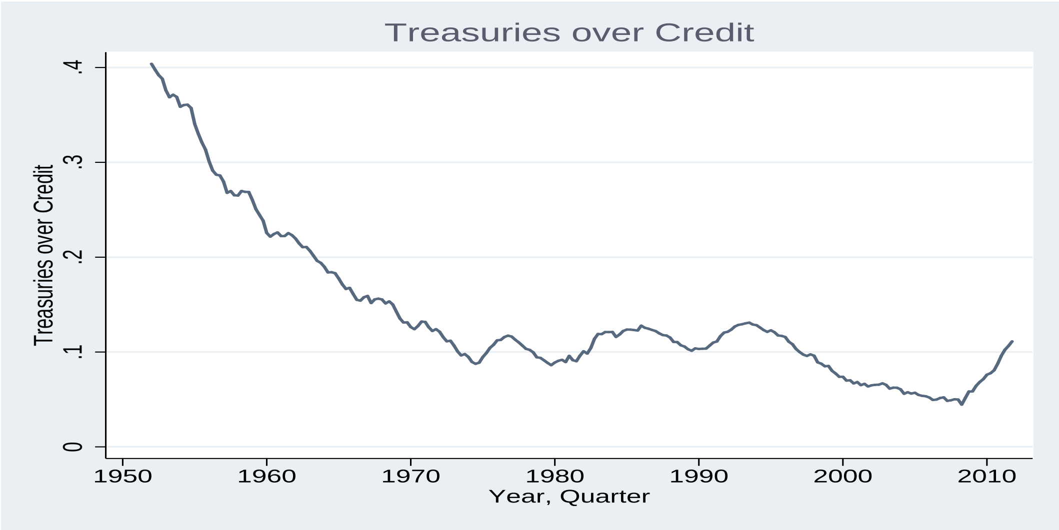

Figure 8: **Interconnectedness and Financial (De)Regulation Periods**

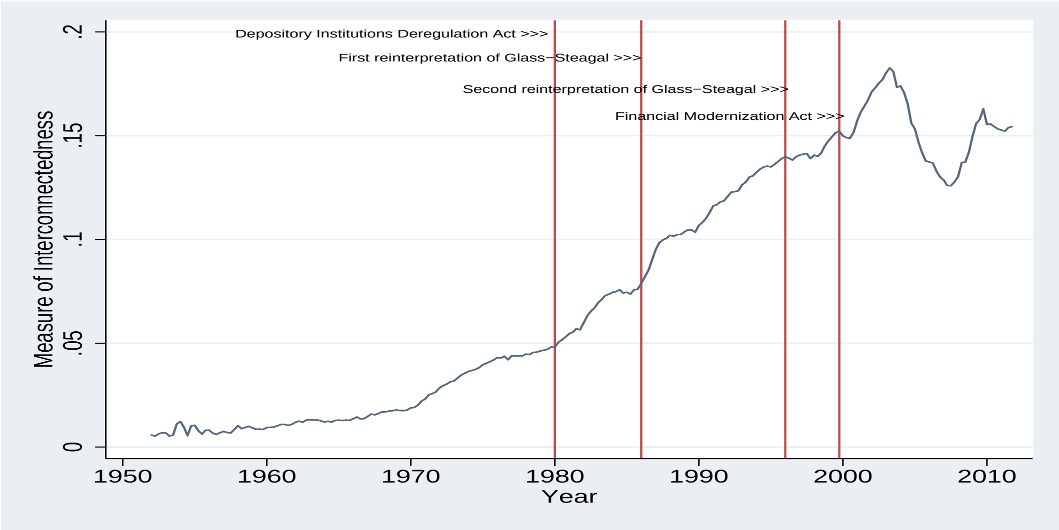

Figure 9: **Interconnectedness and Share of Finance in GDP (Philippon, 2012)**

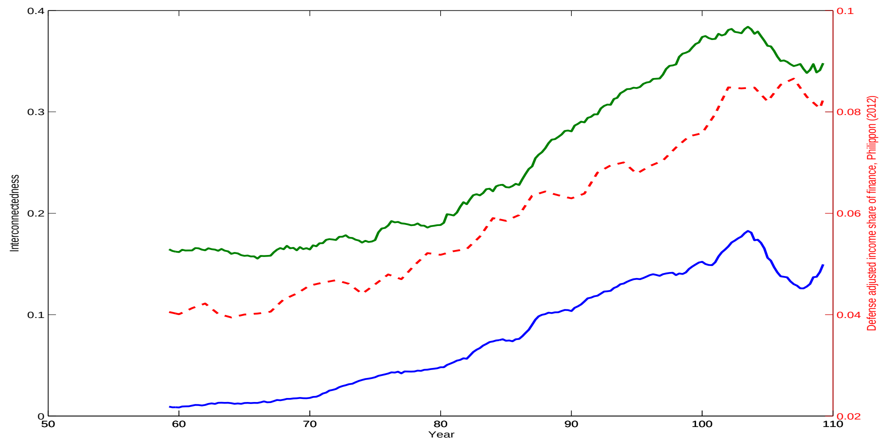

Figure 10: **Comparison of IRFs to a monetary policy shock conditional on different degrees of Interconnectedness in SVAR**

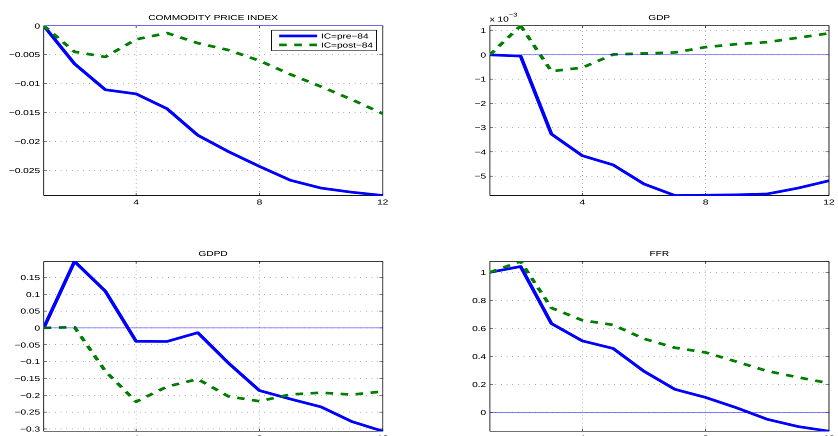

Figure 11: **Difference between IRFs to a monetary policy shock with different levels of Connectedness**

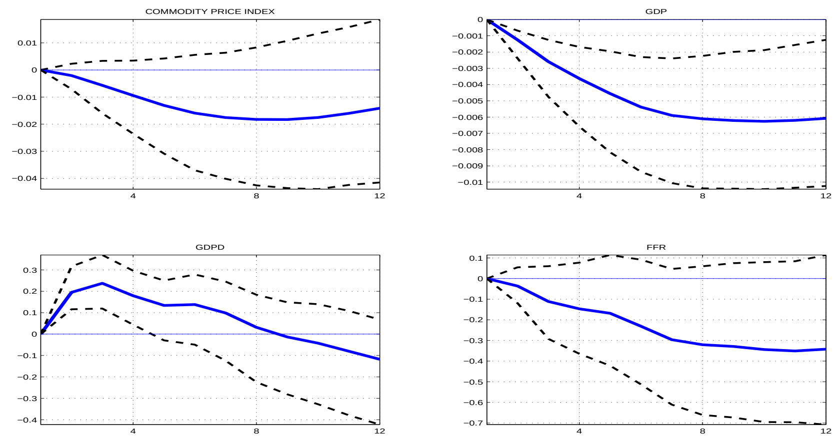

Figure 12: **Comparison of IRFs to a monetary policy shock with different levels of Interconnectedness, FAVAR Selected Variables**

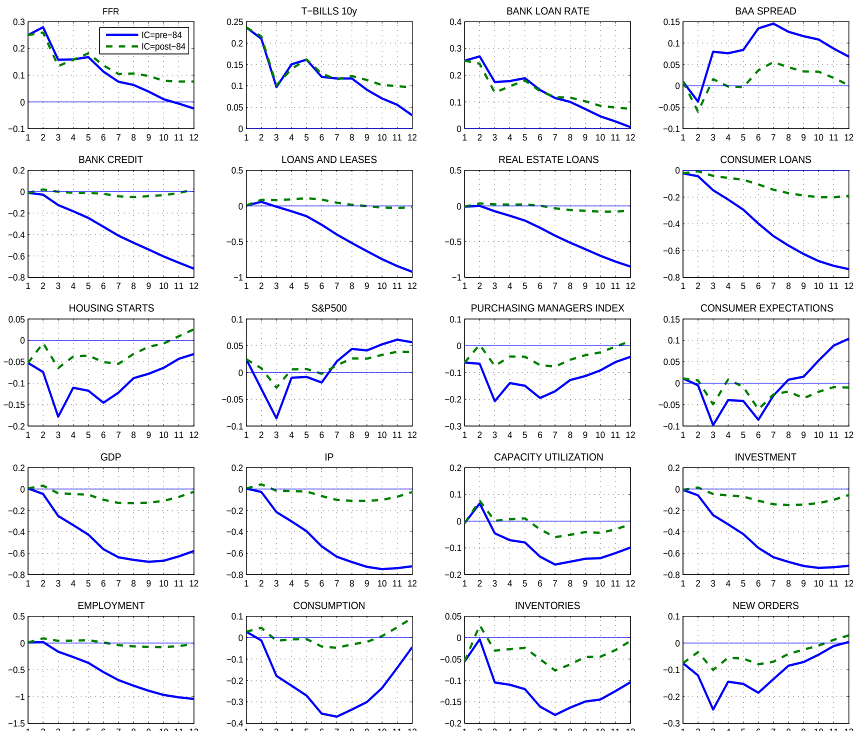

Figure 13: **Difference between IRFs to a monetary policy shock with different levels of Interconnectedness, FAVAR Selected Variables**

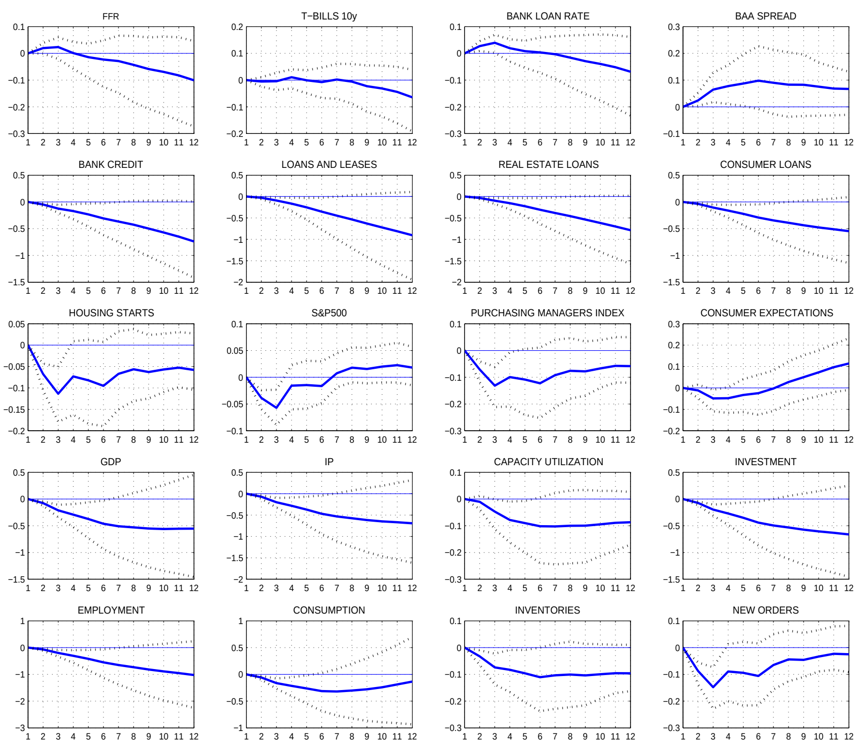

Figure 14: **Comparison of IRFs to a monetary policy shock in different time periods (pre and post 1984), FAVAR Selected Variables**

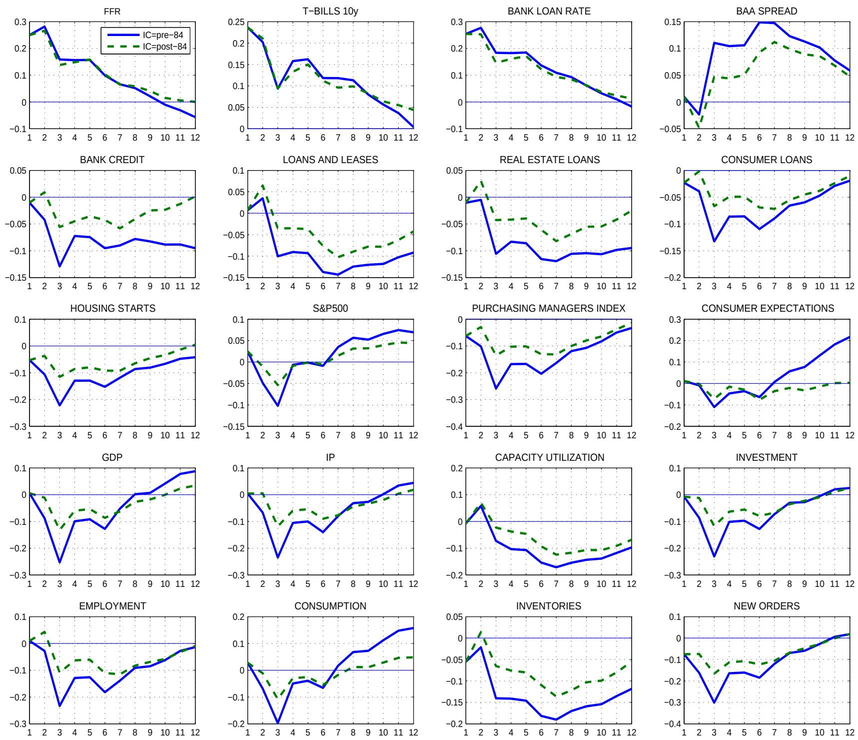

Figure 15: **Difference between IRFs to a monetary policy shock in different time periods (pre and post 1984), FAVAR Selected Variables**