



Universität St.Gallen



Insurability of Pandemic Risks

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*“From insight
to impact”* 

Research questions

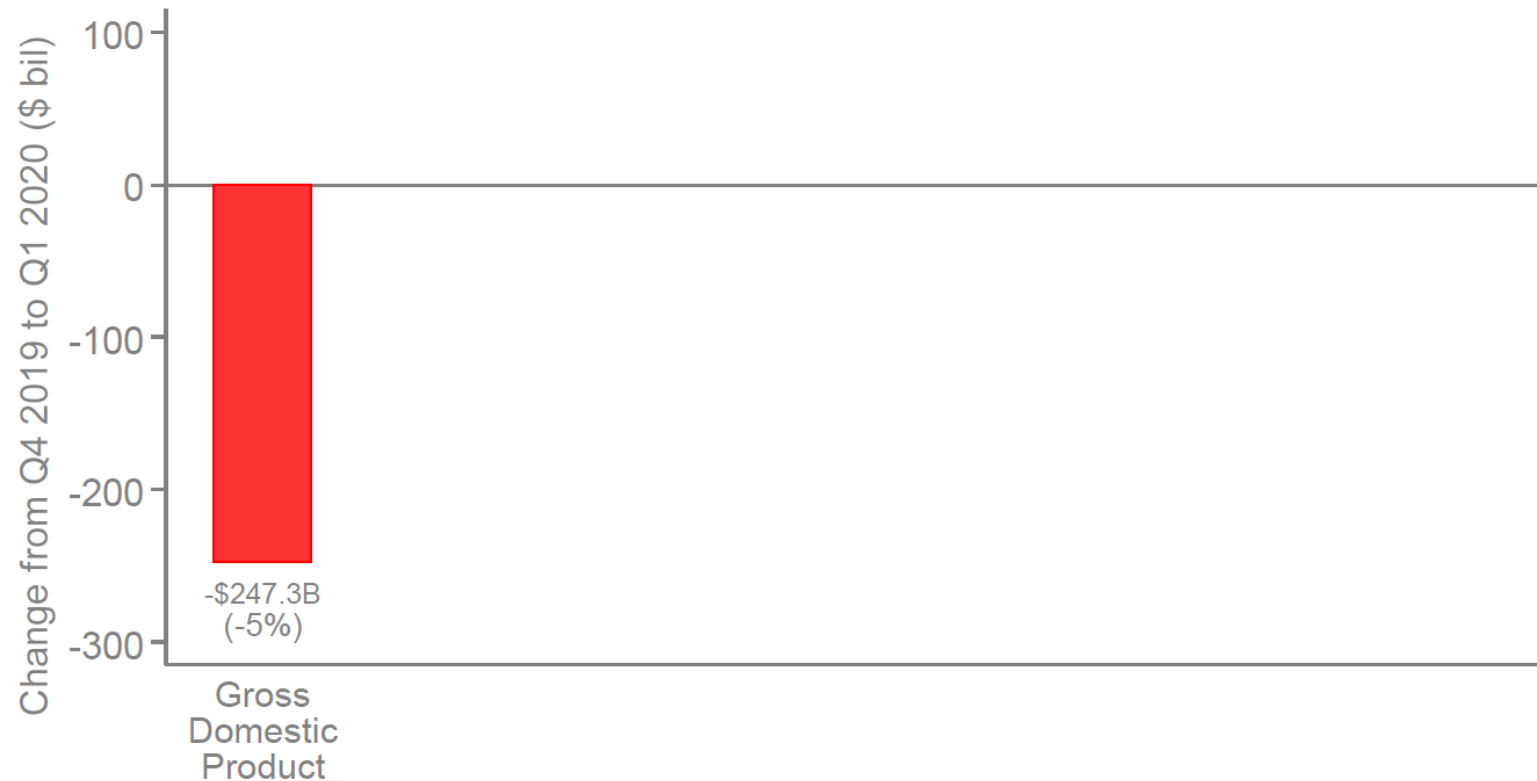
- Is pandemic risk insurable? Is there scope for private insurance market?
- How the price of pandemic risk insurance compares to prices of other catastrophe risks, i.e. hurricanes, earthquakes, tornados, etc.?
- How can the functions be distributed between the insurance industry, the government and the financial market in order to enable pandemic risk transfer?

Outline

1. Analyze a hypothetical insurance contract that provides income in the event of business closures due to a pandemic
 - Use a novel dataset developed by Chetty et al and Opportunities Insights Team
 - The data uses private sector data on consumer spending, small business revenues, employment, job postings, and education
2. Compare the pricing of a hypothetical insurance contract to insurance pricing of natural catastrophe risks
 - Model insurance supply of catastrophe risks
 - Estimate the model using the actual prices of catastrophe risk insurance in the US
 - Compare the price markups of the existing NatCat insurance and of the pandemic insurance contract
3. Evaluate the factors driving pandemic insurance prices and possible public policy and financial market solutions

Economic impact of COVID-19 on US GDP

National Accounts Data: Changes in GDP and its Components

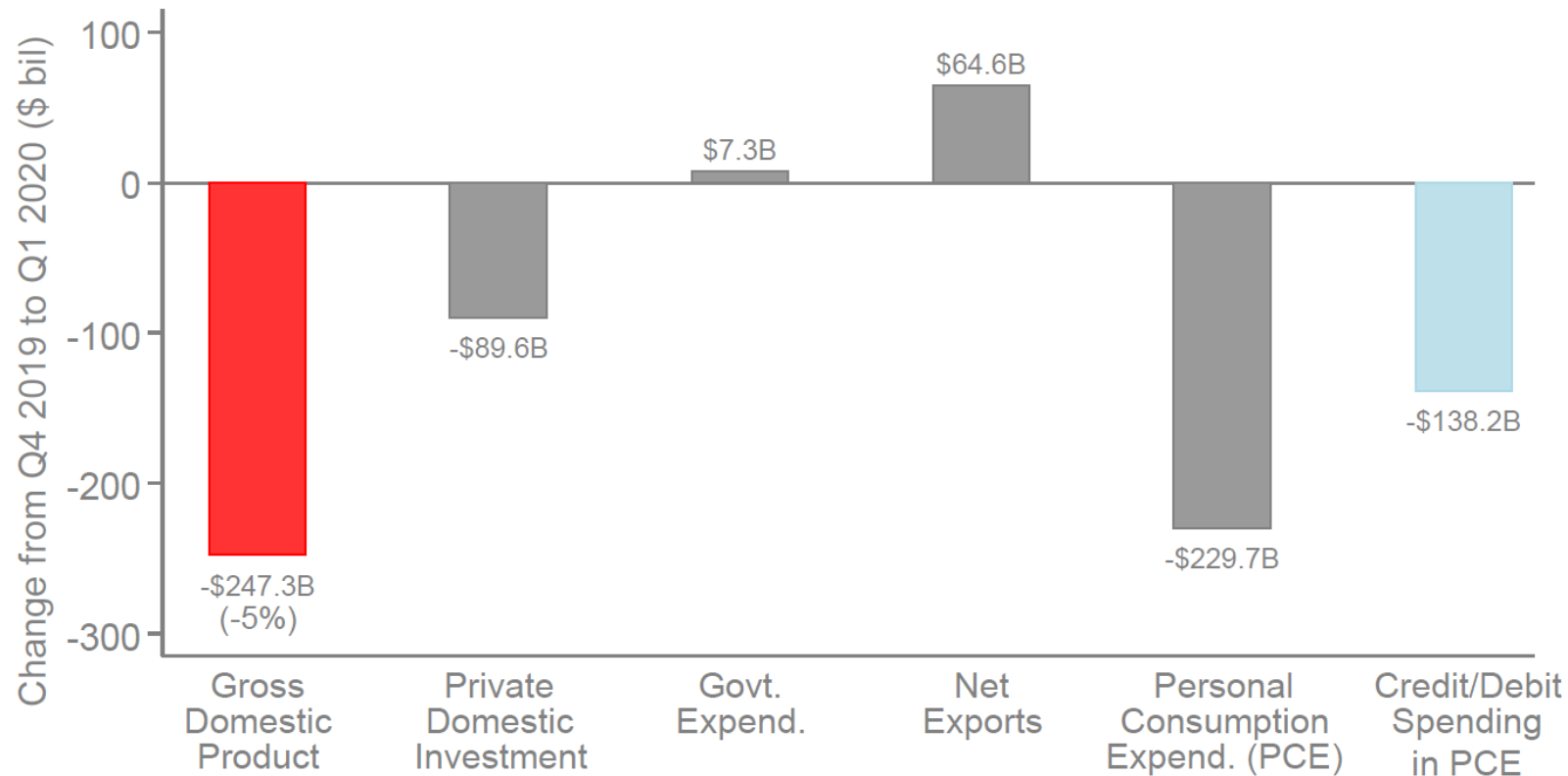


Source: Chetty et al, How did COVID-19 and stabilization policies affect spending and employment? A new real-time economic tracker based on private sector data, June 2020 @MarcusAcademy

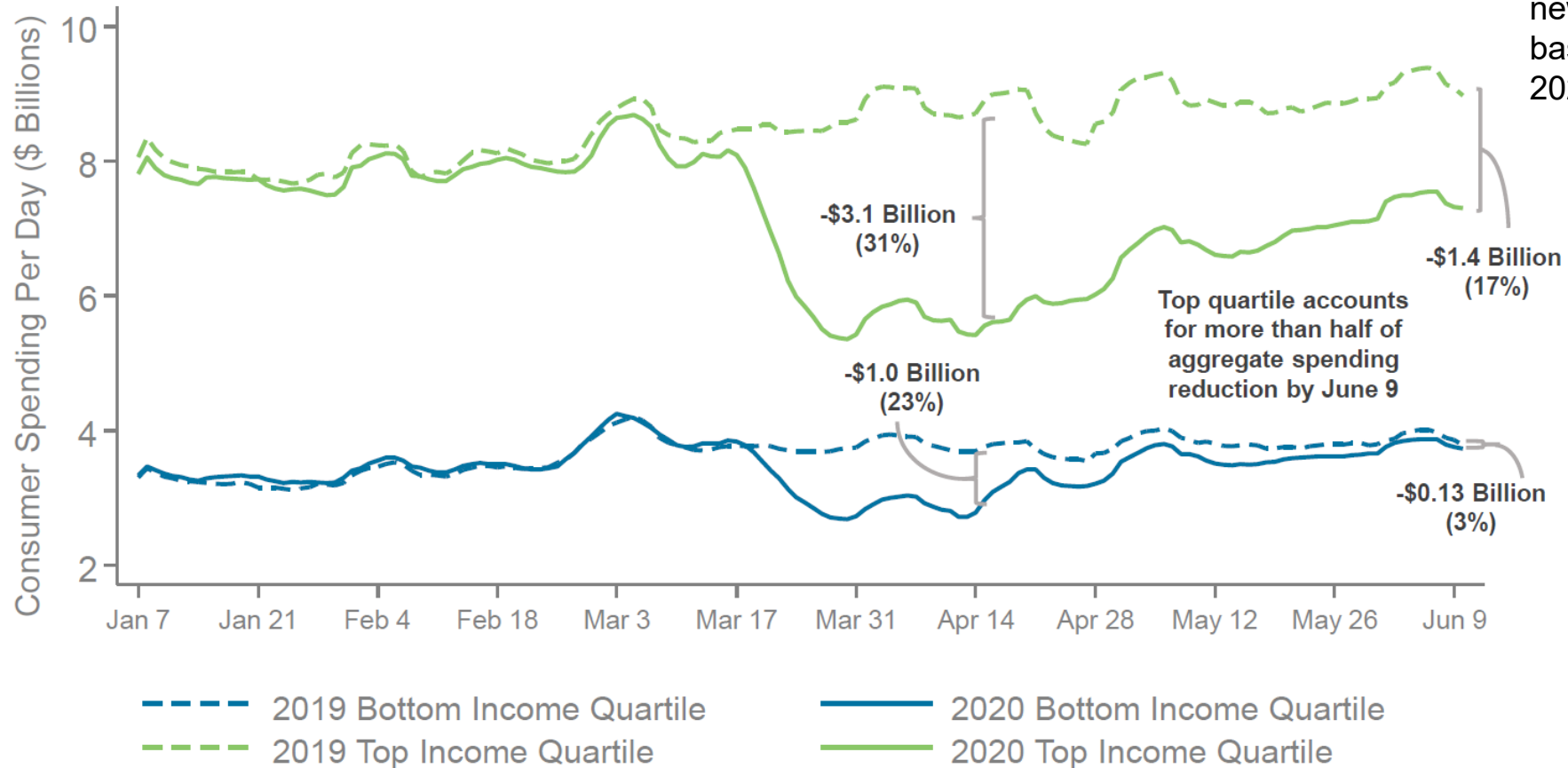
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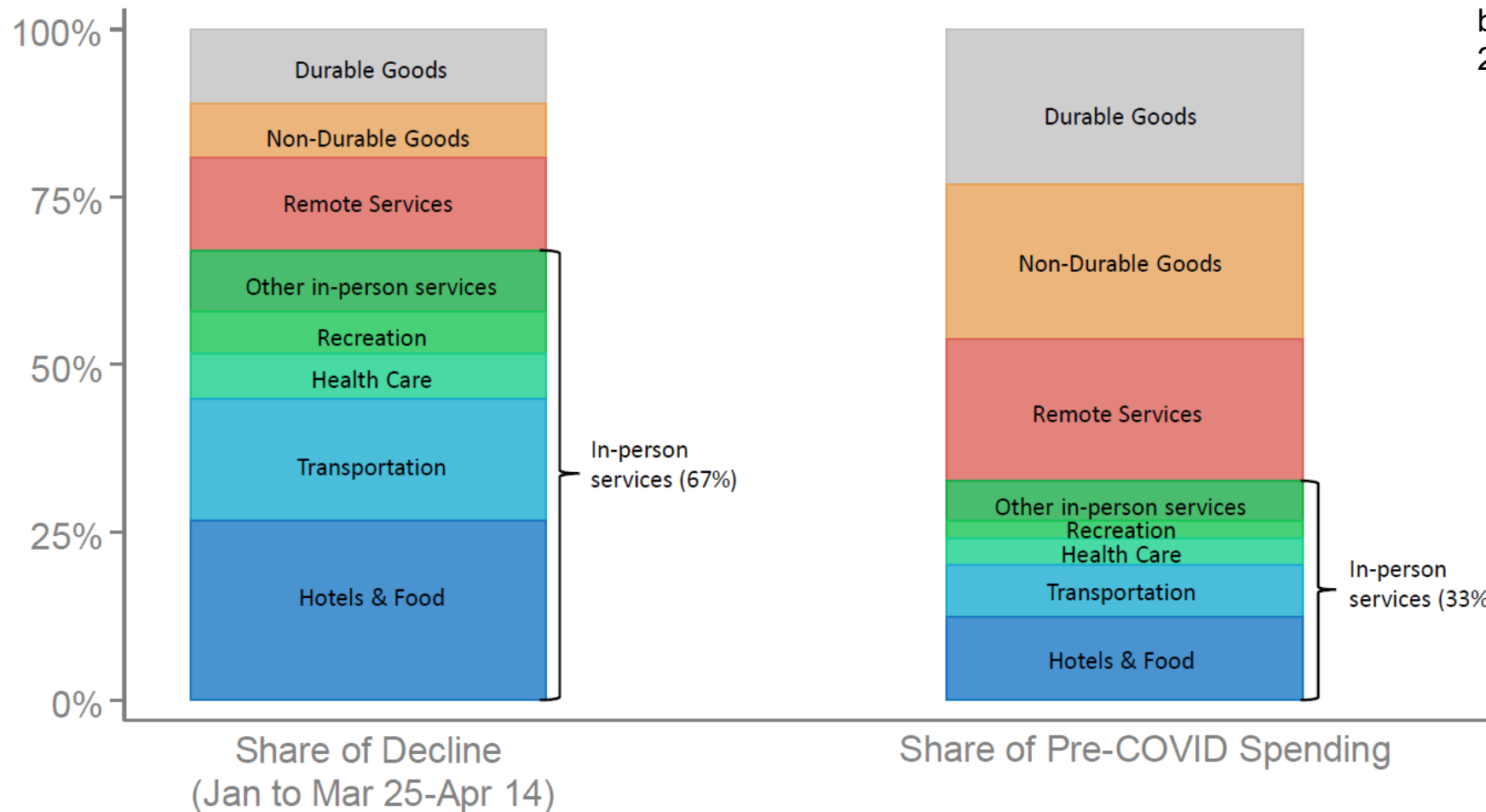


Consumer spending by income quantile



Source: Chetty et al, How did COVID-19 and stabilization policies affect spending and employment? A new real-time economic tracker based on private sector data, June 2020 @MarcusAcademy

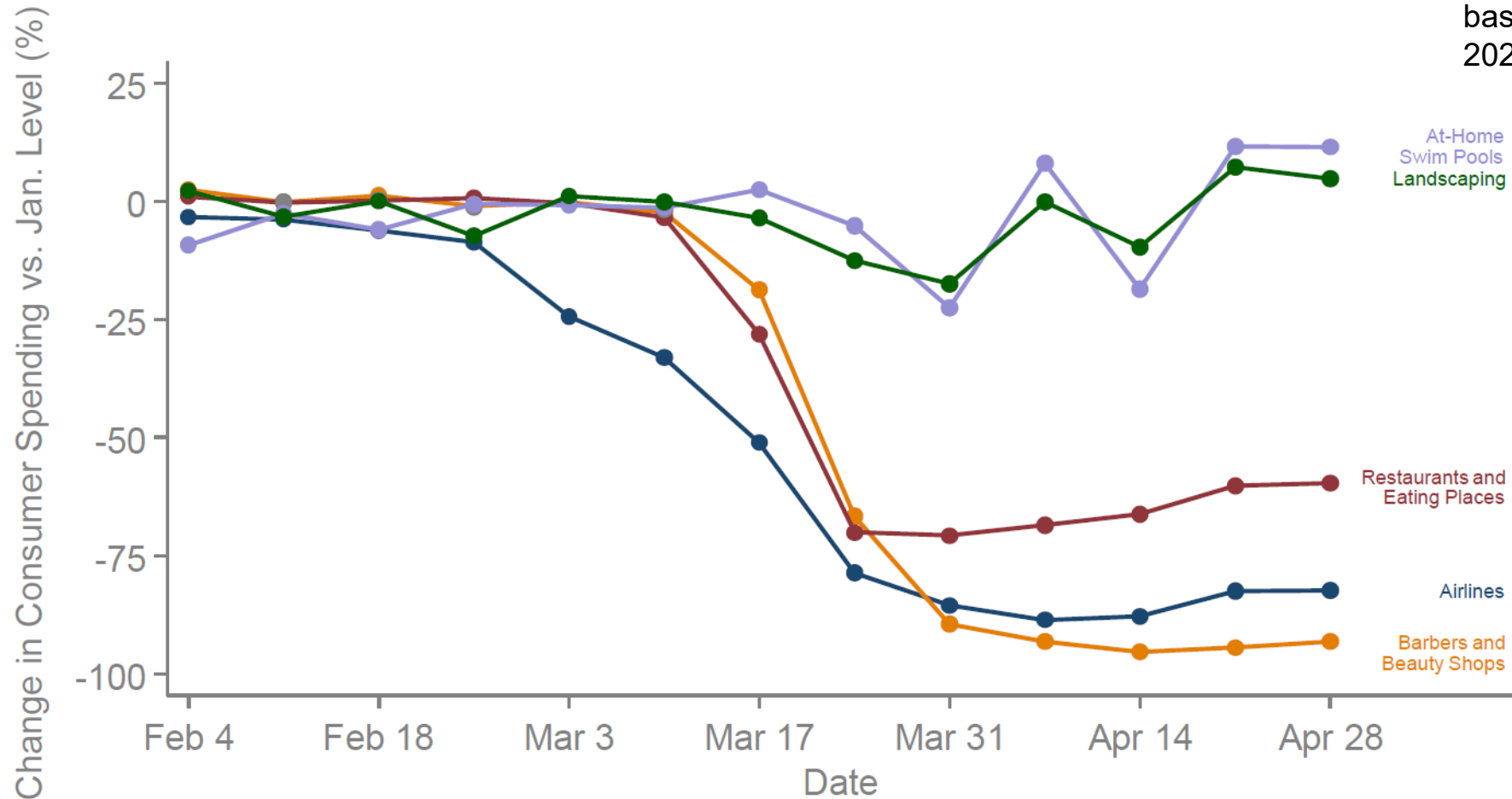
Changes in consumer spending by sector



Source: Chetty et al, How did COVID-19 and stabilization policies affect spending and employment? A new real-time economic tracker based on private sector data, June 2020 @MarcusAcademy

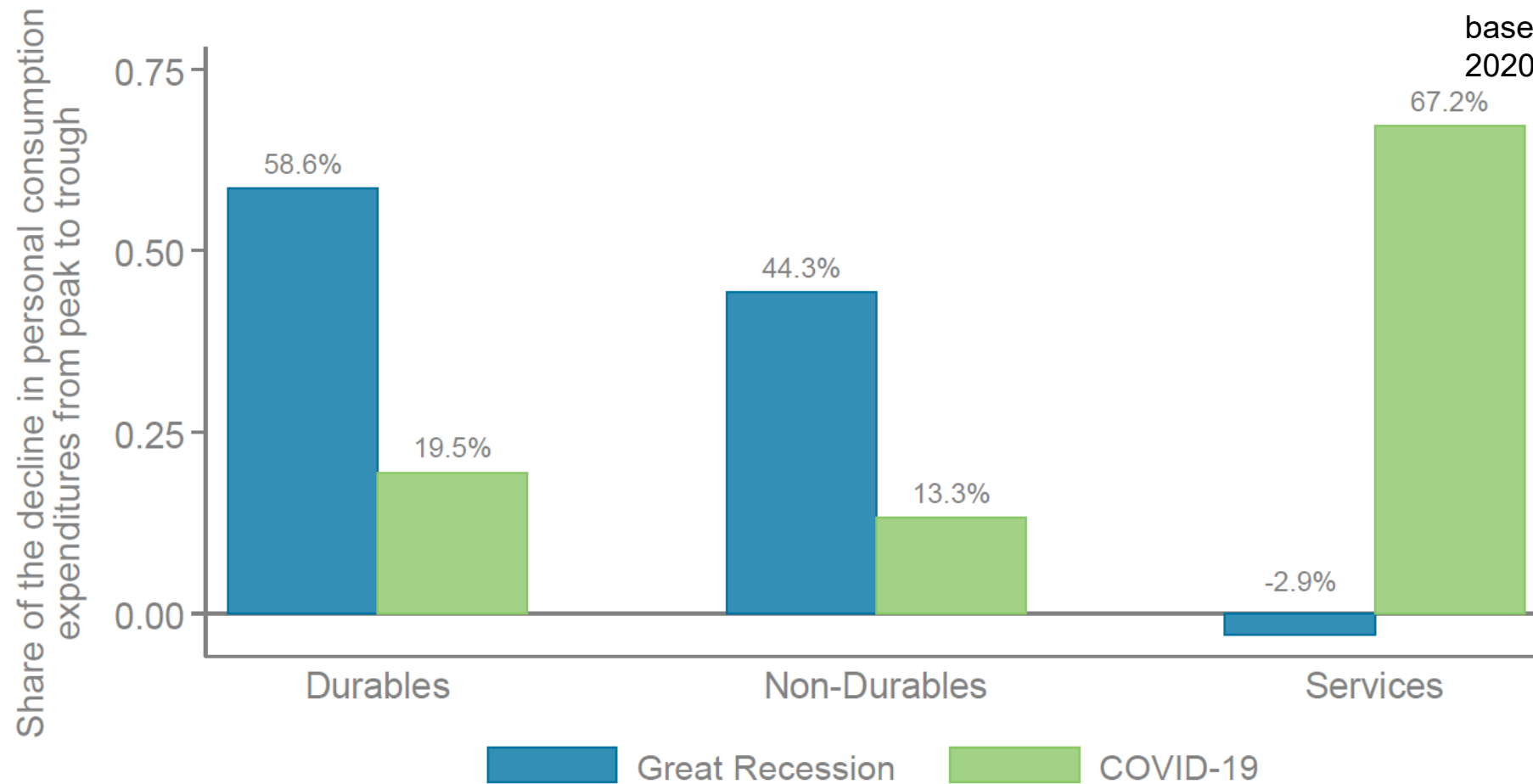
Changes in consumer spending by sub-category

Source: Chetty et al, How did COVID-19 and stabilization policies affect spending and employment? A new real-time economic tracker based on private sector data, June 2020 @MarcusAcademy



Covid-19 vs Great Recession

Source: Chetty et al, How did COVID-19 and stabilization policies affect spending and employment? A new real-time economic tracker based on private sector data, June 2020 @MarcusAcademy



Pandemic insurance contract

- A contract designed to compensate the loss of income to individuals employed in sectors that require in-person physical interaction

- **Contract terms**
 - up-front premium P
 - trigger: declaration of an epidemic/pandemic by a national or a supranational authority, or a shut-down mandated by the government
 - Payout: a monthly payment of C for T months

- **Hypothetical contract calibration**
 - C equals to \$2000, \$1500 and \$1000
 - T is 12 month

Estimating the loss distribution of the pandemic insurance contract

➤ Severity of losses

1. Model the impact of infection rates on economic activity, using county level infection rates and the data on economic activity in 2020
2. Estimate the predicted new unemployment cases caused by the rise of the infection rate in each county in the US
3. Estimate the total new claims and the claim costs as a function of the infection rate

➤ Frequency of losses

- Growing frequency of emerging infection diseases that originate in wildlife and enter human population
- Ebola, HIV/AIDS, SARS
- In terms of the global impact, COVID-19 has 1-in-100 frequency

Impact of infection rates on initial unemployment insurance claims

| | [01.02 -28.03] | [29.03 -27.06] | [28.06 – 30.09] | [01.02 -30.09] |
|----------------------------------|----------------|----------------|-----------------|----------------|
| Covid-19 New Case Rate weekly | 29.0734*** | 0.9153*** | -0.0536 | 0.6937*** |
| | (6.2932) | (0.2834) | (0.0738) | (0.1511) |
| R ² | 0.27 | 0.78 | 0.91 | 0.62 |
| N | 10,779 | 17,974 | 16,538 | 45,291 |

- Higher infection rates lead to a rise of new unemployment claims
- Economically significant effect: the rise of the infection rates similar to the New York first wave of COVID-19 in March-April 2020 leads to around 1.2 million new unemployment claims and reduces employment in the bottom quantile by 7%

Characteristics of (industry-wide) losses of the hypothetical contract

| Contract Payout | SD | ES _{1%} | Market Beta |
|-----------------|-------------------|------------------|-------------|
| 2000 USD | 1.77 trillion USD | 4.6 trillion USD | .992 |
| 1500 USD | 1.32 trillion USD | 3.5 trillion USD | .992 |
| 1000 USD | 0.88 trillion USD | 2.3 trillion USD | .992 |

At what price insurers would be willing to provide pandemic insurance?

- How insurers price catastrophe risk exposures depending on the characteristics of loss distributions?
- Insurance pricing model based on three-moment CAPM of Kraus and Litzenberger
 - Including the third central moment of the loss distribution allows to adequately map low frequency – high severity nature of pandemic risk
 - The price also depends on the covariance between pandemic risk and all other insured pandemic risks
 - The risk charge reflects the cumulative feature of pandemic risks that affect many policyholders at the same time

Pricing model for catastrophe insurance market

$$\ln(1 + \lambda)_{it} = \beta_{vol} \ln(\sigma_{vol}^2)_{it} + \beta_{FT} \ln(\sigma_{FT}^2)_{it} + \beta_M \ln(\sigma_M^2)_{it} + \gamma_i + \theta_t + \varepsilon$$

Variables

- $(1 + \lambda)_{it}$ the markup of insurer i in year t
- σ_{vol}^2 the volatility of the loss distribution of insurer i in year t
- σ_{FT}^2 the fatness of tail of the loss distribution of insurer i in year t
- σ_M^2 correlation of insurer's i stock market performance and the market portfolio in year t ;
- γ_i insurer fixed effect
- θ_t year fixed effect

Data on the US catastrophe insurance market

- NAIC annual regulatory filings
 - Direct premiums written in NatCat exposed lines of business at the state level
 - Schedule P data on losses paid on NatCat lines of business
 - Initially using data on Homeowners and farmownwers, and now extending to all NatCat lines

- Frequency and severity of natural catastrophes across geographic areas in the US
 - based on Froot and O'Connell (2008), now extending to SHELDUS

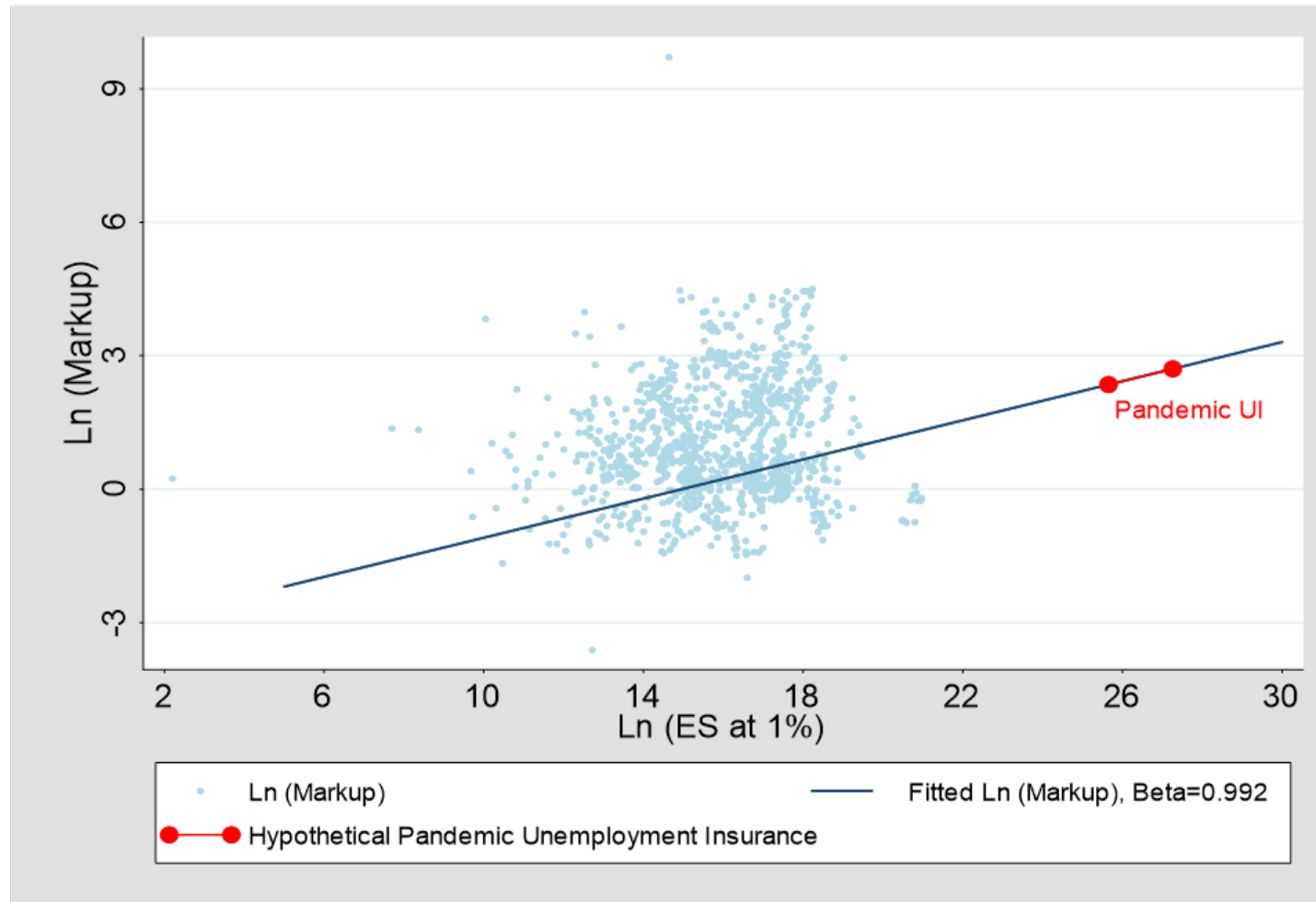
- Market data from Bloomberg
 - insurers' stock return, stock market indices and interest rates

Pricing of Catastrophe Insurance

| | Ln (Markup) |
|------------------------|---------------------|
| Ln (ES _{1%}) | 0.2200*** 0.0428 |
| Ln (Beta) | -0.0127 0.0319 |
| Constant | 1.2682*** 0.2512 |
| R ² | 0.83 |
| N | 1,058 |

- Markup for NatCat coverage is higher for losses with higher expected shortfall
- A 10% increase in expected shortfall translates in 2.2% increase in markup

Estimated pandemic insurance markup compared to NatCat markup



- Expected shortfall of the pandemic insurance contract is higher than for NatCat risks
- The markup of an insurer would correspond to the top 15% of the markup in the NatCat market
- There is scope for private market but it may be limited

Extensions

Modelling the NatCat insurance market pricing

- Estimate NatCat loss distribution across regions using SHELDUS data
- Include insurance market data for all ten lines of business affected by NatCat
- Include insurers' rating in the markup regression
- Include a portfolio correlation term in the markup regression
 - correlation of the loss from one line of business with loss of the entire liability portfolio

Comparing NatCat and Pandemic insurance

- Analysis of the contribution of various pricing factors

Conclusions and further questions

- Insurance for interruption of businesses based on in-person interaction could contribute significantly to economic resilience to pandemics
- However, the markup that would be charged by insurers for this contract would be higher than the markup for coverage of natural catastrophe risks
- There could be limited private market for the pandemic insurance
- What is the size of the risk transfer support that is required to bring the insurance prices in line with prices for other catastrophic risks?