

Short and Variable lags

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Long and Variable Lags



*“Monetary actions affect economic conditions **only** after a lag that is both long and variable” (Friedman, 1961).*

Long and Variable Lags



"We're, of course, taking into account long and variable lags, and we're thinking about that." (J Powell, 2023).

The dynamics of transmission at short and long lags

- Increasing availability of high-frequency and rich data creates new opportunities for placing hypothetical short lags “under the microscope”.
 - It is now possible to study dynamics of key real and financial variables at both short *and* long lags, from days to years.
- We leverage from a data-rich environment in Spain and couple novel high-frequency data with standard high frequency shock identification of monetary policy shocks.
- i.e., a measurement study of high-frequency monetary transmission patterns.

This paper

Analysis of the response of aggregate (i) household consumption, (ii) corporate sales and (iii) employment (in Spain) to contractionary monetary shocks:

- At aggregate level, all three variables start to contract at very short lags
 - within a week for consumption
 - within a month for sales;
 - employment decline meaningful only at long lags
 - sales respond by more
- Time aggregation at lower frequencies hides short lags—leaving only “long lags” detectable
- At disaggregate level, response is heterogeneous—in economic meaningful ways—across categories of consumption and sectors of activity.

Short Lags in the Literature

- Monthly Industrial Production: Jarociński and Karadi (2020), Miranda-Agrippino and Ricco (2021)
- Housing prices and mortgage rates: Gorea, Kryvtson and Kudlyak (2022)
- Financial markets: Swanson (2021)
- Public confidence in the state of the economy: Lewis, Markridis and Mertens (2019)
- Credit card: Grigoli and Sandri (2023)
- No Price Puzzle with Daily Data: Jacobson, Matthes and Walker (2022)

Plan of Talk

1. Data and Methodology
2. Baseline Results: Consumption, Gross Output and Employment
3. Time Aggregation: Why did we fail to see this before?
4. Further Short Lag Characterization: How do short lags unfold?
5. Robustness and Further Extensions

Data: Daily Aggregate Consumption

- Daily consumption series built from individual bank transactions of 1.8 million Spanish adult retail customers of BBVA Bank in Spain
 - Weighted to provide representative sample of Spanish population
- All means of payment (card, cash, one off transfers, direct/recurrent debits)
 - Metadata allows classification of transaction according to National Accounting (NA) principle and construction of COICOP (Classification of Individual Consumption by Purpose) disaggregates
 - Deflated using Spanish CPI (aggregate, disaggregated at COICOP level)
- Daily counterpart of the quarterly version Buda et al. (2022): 0.987 correlation with NA quarterly consumption
- 1st April, 2015 — 31st December, 2021

Data: Daily Aggregate Gross Output

- Spanish Tax Authority compiles the series from daily Value Added Tax (VAT) declarations by firms
 - 60K large firms accounting for 70% of domestic sales
- Final sales to Spanish Households (and tourists), Sales of investment goods to Spanish firms and households, Sales of intermediate goods to firms
 - Available with NACE breakdown
 - Deflate appropriately with PPI/CPI for each NACE
- 1st July, 2017 — 31st December, 2021

Data: Daily Aggregate Employment

- Near universe of all labor contracts reported as active on a given day to Spanish Social Security
- Netting out job destruction (labor contracts ending on the day) from job creation (new labor contracts registered with the social security system)
- 1st April, 2015 — 31st December, 2021

Methodology: Identification

- External instrument using **high-frequency changes in asset prices around ECB policy announcements**, borrowed from Altavilla et al. (2019) EA-MPD database
 - Asset price: Swaps on future overnight interbank credit rates, OIS.
- 1-year yield changes, capturing all the different policy actions available in the monetary policy toolkit: changes in short-term interest rates, forward guidance and QE
- Controlling for the CB information channel: “poor’s man” sign restrictions (Jarociński and Karadi (2020))

Methodology: Local Projections

- **Daily IRFs** are constructed from the sequence of $\hat{\beta}_h$ from:

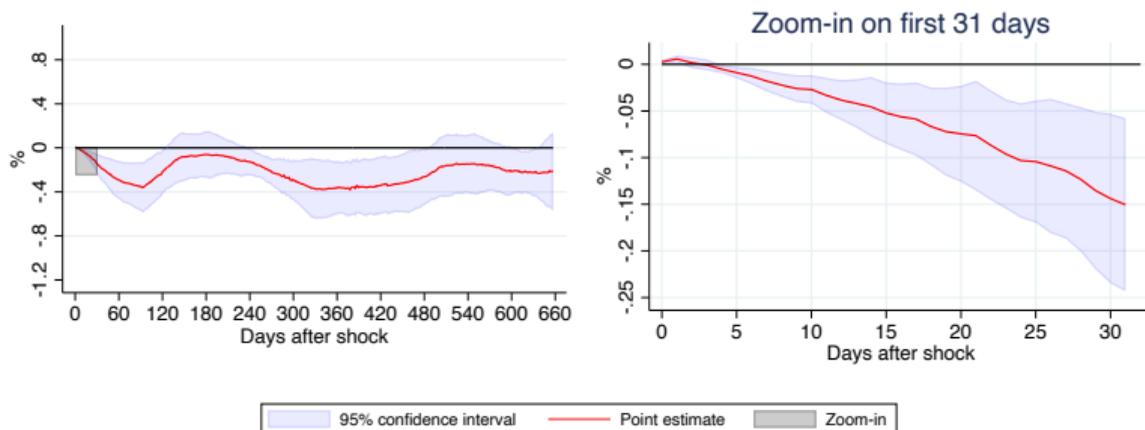
$$y_{t+h} = \alpha_h + \beta_h shock_t + \sum_{\ell=1}^p \varphi_{h,\ell} y_{t-\ell} + \theta_h cases_t + \delta_h stringency_t + \varepsilon_{h,t}, \quad (1)$$

- y_{t+h} is the year-on-year consumption, sales or employment measures
 - Dependent variables are 90-days moving averages before computing yoy growth rates
 - including control for $p = 90$ lags
- $shock_t$ is the MP shock
- controls for COVID-19: $cases_t$ is the log of new confirmed cases, and $stringency_t$ is the log of the stringency index

Plan of Talk

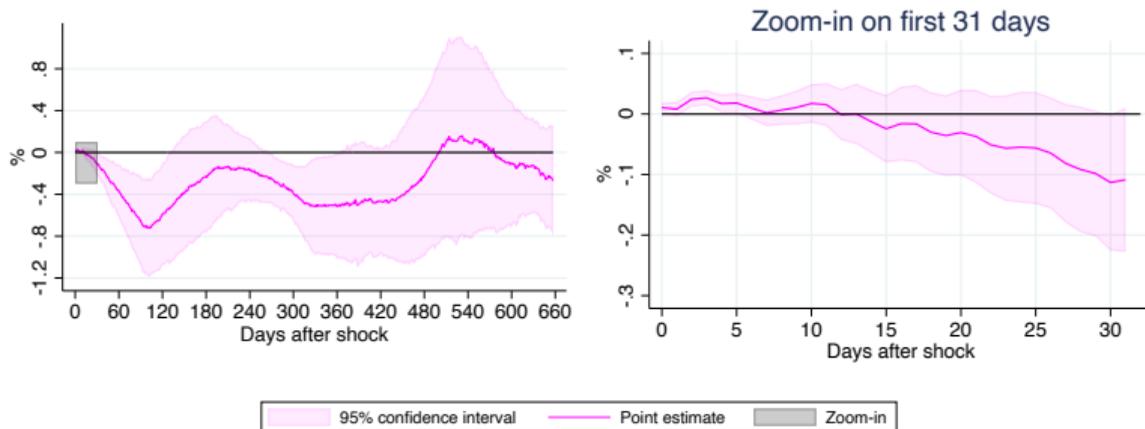
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Short and Variable Lags: Consumption



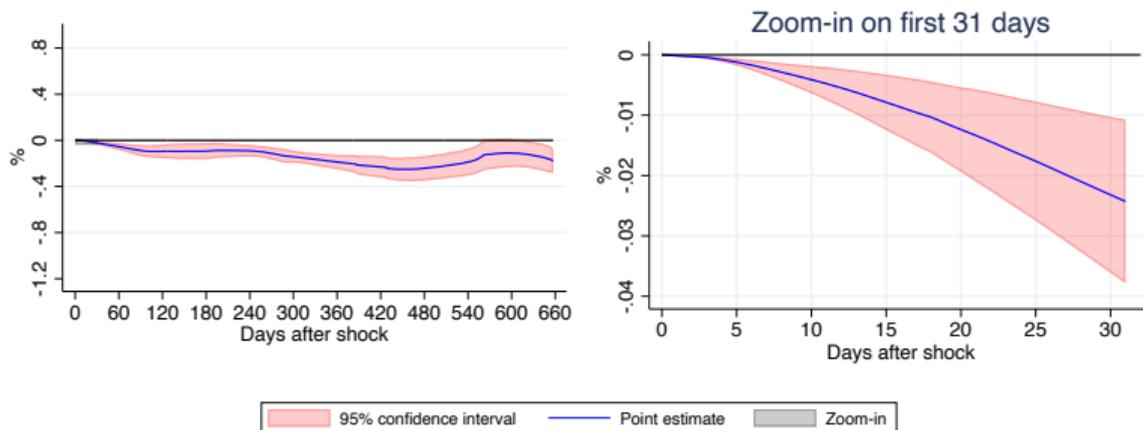
- Statistically significant response **five days after the shock**
- Local trough in one quarter (short lags) and more persistent decline after three quarters (long lags)

Short and Variable Lags: Sales



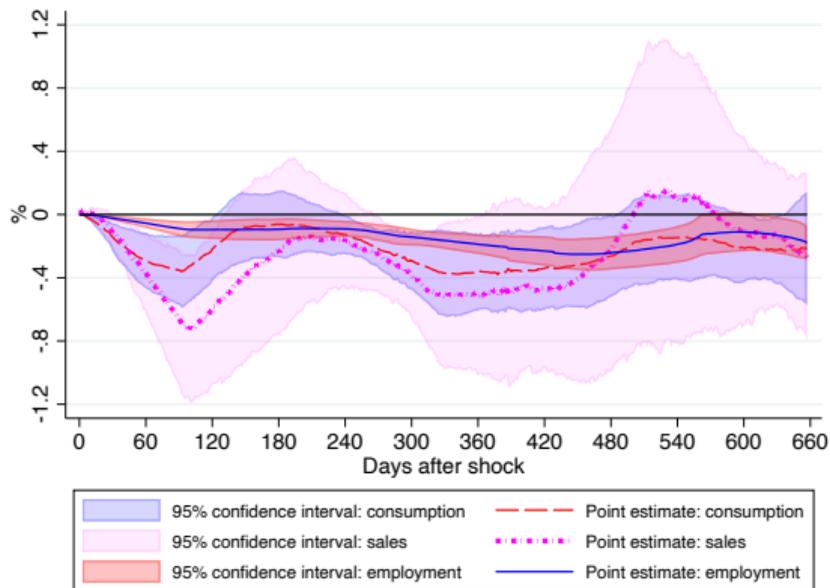
- Broadly similar pattern, with **delayed but deeper response**
- Sales also cover investment goods and intermediates to other firms, which are more volatile

Short and Variable Lags: Employment



- Relative to consumption, **much smoother and more persistent**
- Short lag is not economically significant

So far



- We have shown that monetary policy shocks transmit to the economy at **both short and long lags**
- The three series in our study by and large **align at long lags**

Plan of Talk

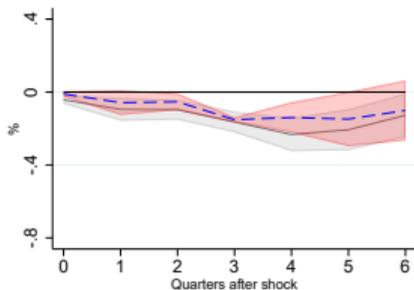
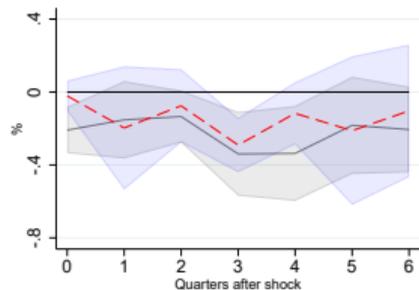
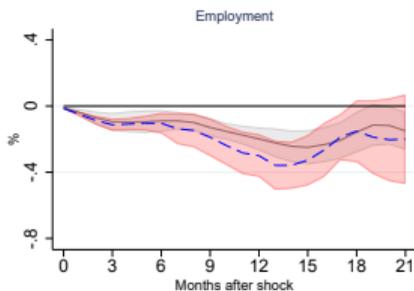
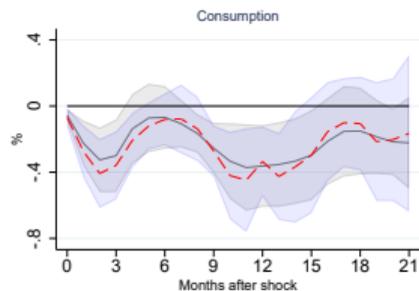
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Time Aggregation

Question: Suppose researcher only has access to quarterly data. Would she find an impact of MP shocks on impact (1st quarter)?

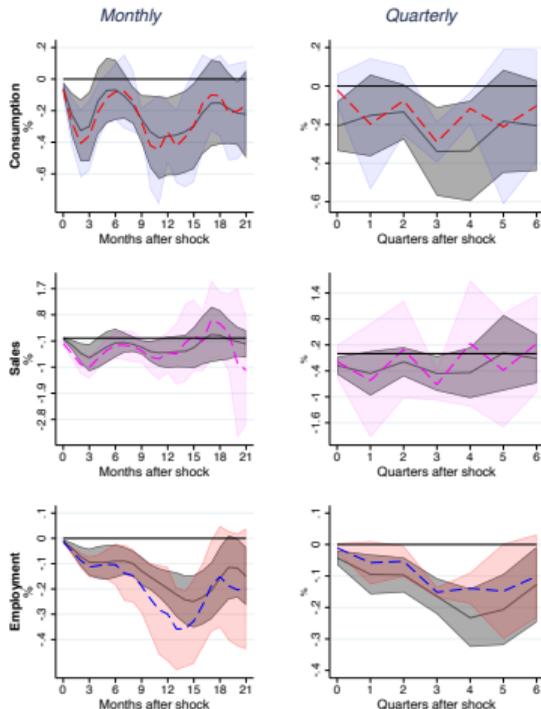
- Time Aggregation Bias
- Rich early 80s literature: Sims, Marcet, Christiano and Eichenbaum and many others; still ongoing
 - Christiano and Eichenbaum (1987): *“temporal aggregation bias can be quantitatively important in the sense of significantly distorting inference”*
 - Jacobson, Matthes and Walker (2022): find that *time aggregation exacerbates the perverse response of inflation to MP shocks*

Time Aggregation



- Solid-grey: averaged daily IRF;
Red-dash: source data aggregated to lower frequency and then IRF
- Weekly and Monthly Aggregation: preserves short and variable lags;
Quarterly: Short lags disappear

Time Aggregation (same for Employment)



- Solid-grey: aggregated daily IRF aggregated;
Red-dash: source data aggregated to lower frequency and then IRF
- Weekly and Monthly Aggregation: preserves short and variable lags;
Quarterly: Short lags disappear

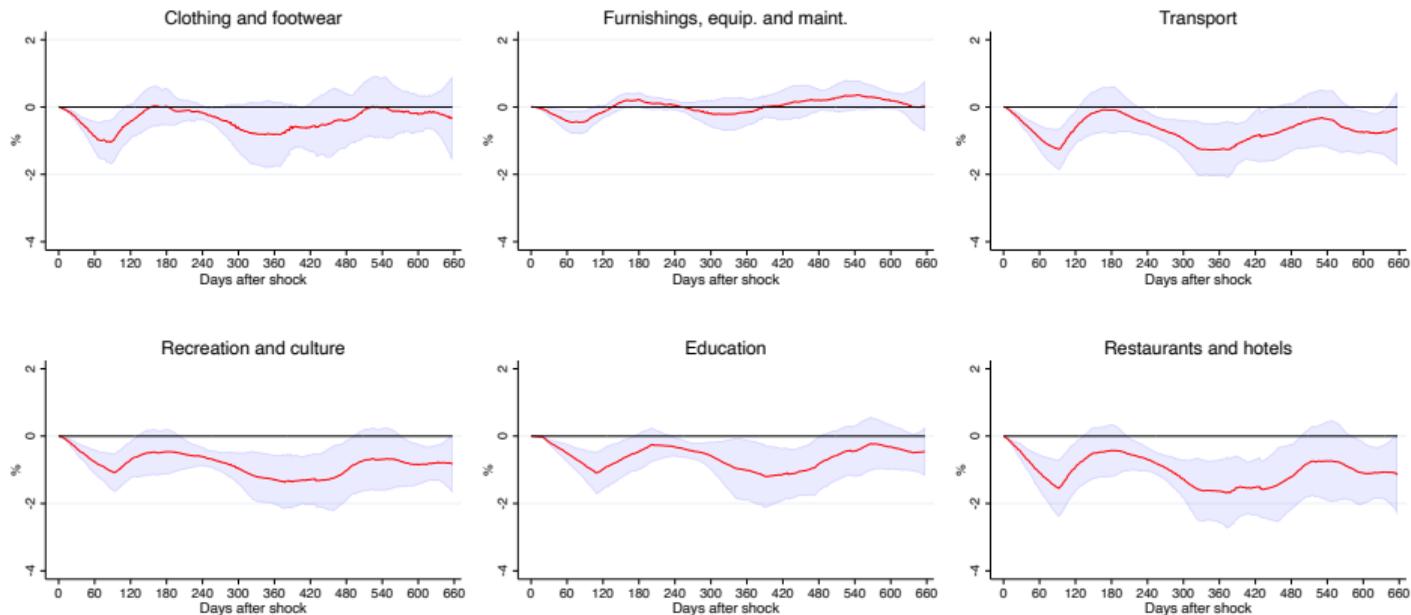
Plan of Talk

1. Data and Methodology
2. Baseline Results: Consumption, Gross Output and Employment
3. Time Aggregation: Why did we fail to see this before?
4. How do short lags unfold?
 - Heterogeneous daily responses of Consumption and Sales, by broad categories
 - Prices, quantities and expectations in the background
5. Robustness and Further Extensions

Heterogeneous responses of consumption and sales

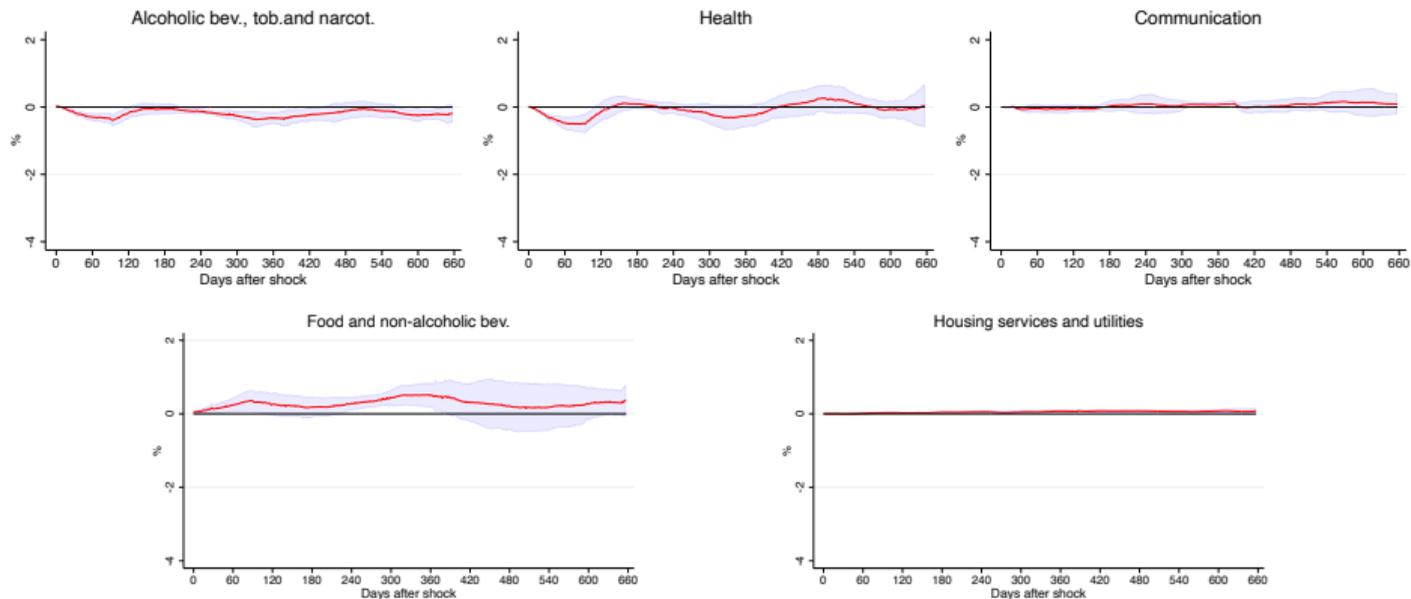
- **Consumption:** Transaction data dense enough in the cross-section to allow finer disaggregated cuts
 - Each individual transaction classified into (10) COICOP consumption categories
 - Aggregates well to annual breakdown of national accounts consumption; but daily!
- **Sales:** Daily VAT data available with breakdown of broad sectors of activity

Response of consumption by category (purpose) I



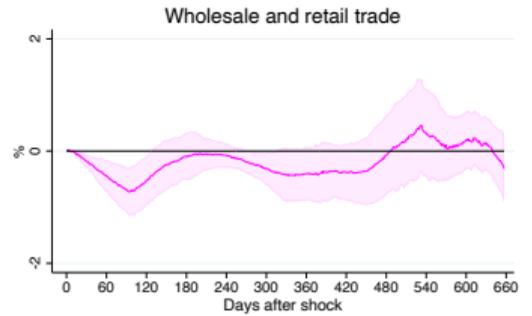
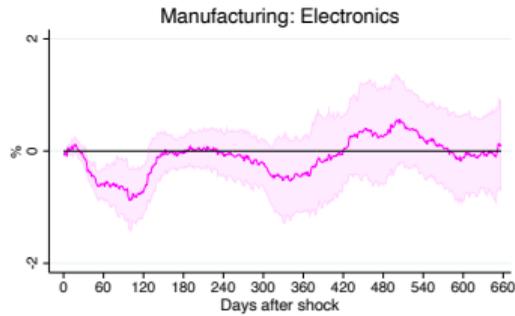
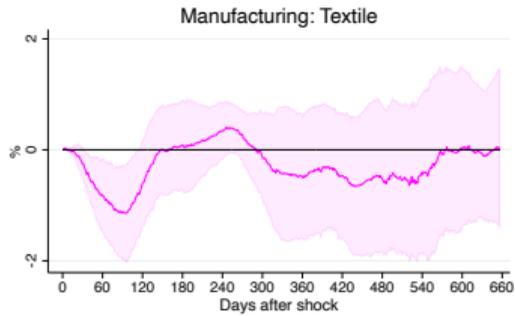
- Significant short lags in durable/semi-durable and discretionary/luxury goods

Response of consumption by category (purpose) II



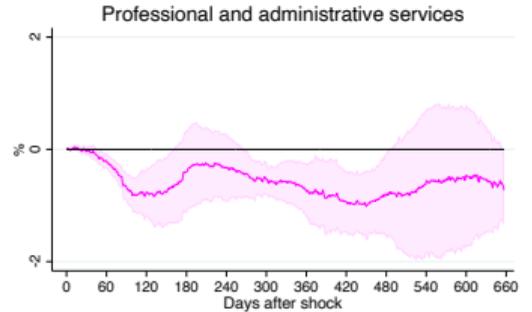
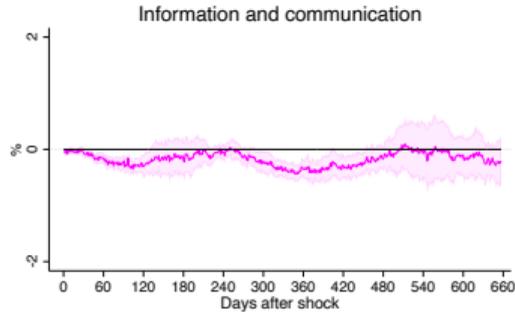
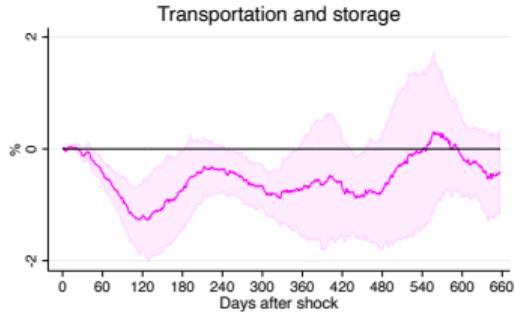
- No/negligible response in essential goods and consumption commitments

Response of sales by sector I



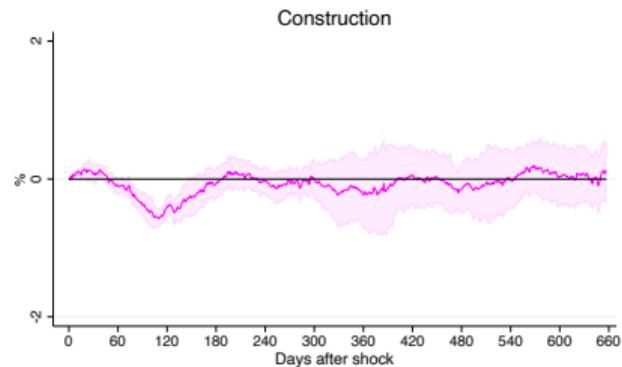
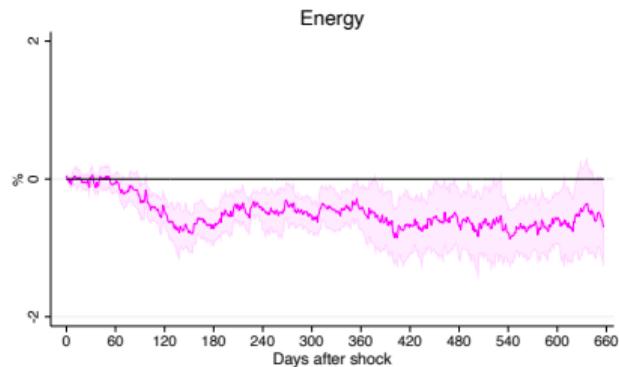
- Sectors closer to final demand react faster (35, 37 and 16 days, respectively)

Response of sales by sector II



- Relatively less downstream sectors with activities that are more business to business react later (50 days)

Response of sales by sector III



- Upstream sectors drive the slower response of aggregate sales (70 days)

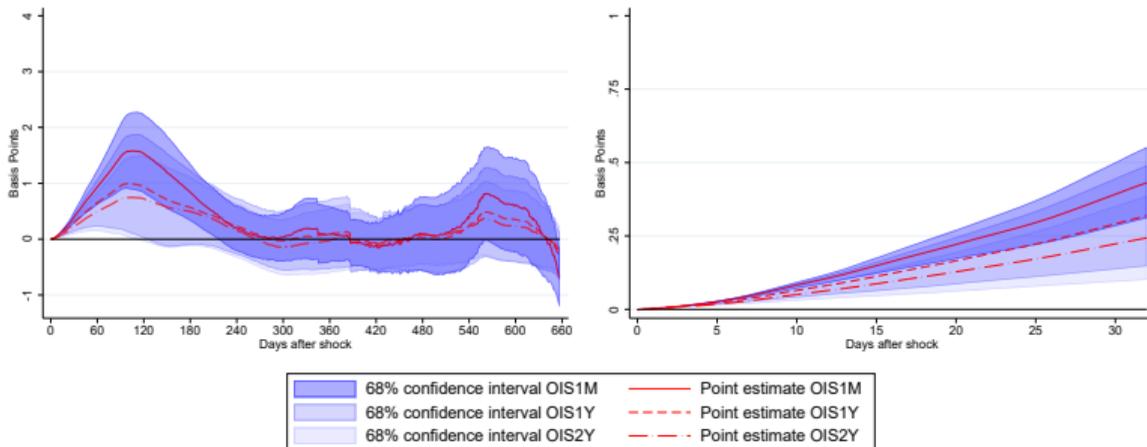
Heterogeneous responses by consumption categories and sales sectors

- Consumption response to MP shocks is **mostly driven by the consumption of durable goods** (Erceg and Levin (2006), Monacelli (2009), Sterk and Tenreyro (2018), and McKay and Wieland (2021))
- In **downstream sectors**, such as wholesale and retail trade, **the response of sales is fast**: after just 16 and 34 days, respectively. The **delayed response of aggregate sales relative to consumption is driven by upstream sectors**

What else is going on?

- Are these results “sensible” more broadly? Inspect response of:
 - Key prices and rates of return on wealth (Stock market, housing prices)
 - Evolution of key rate (Euribor) for Adjustable Rate Mortgages (Big in Spain!)
 - Evolution of consumer sentiment (as proxied by consumer surveys)
 - NB: We’ve already seen employment risk goes up

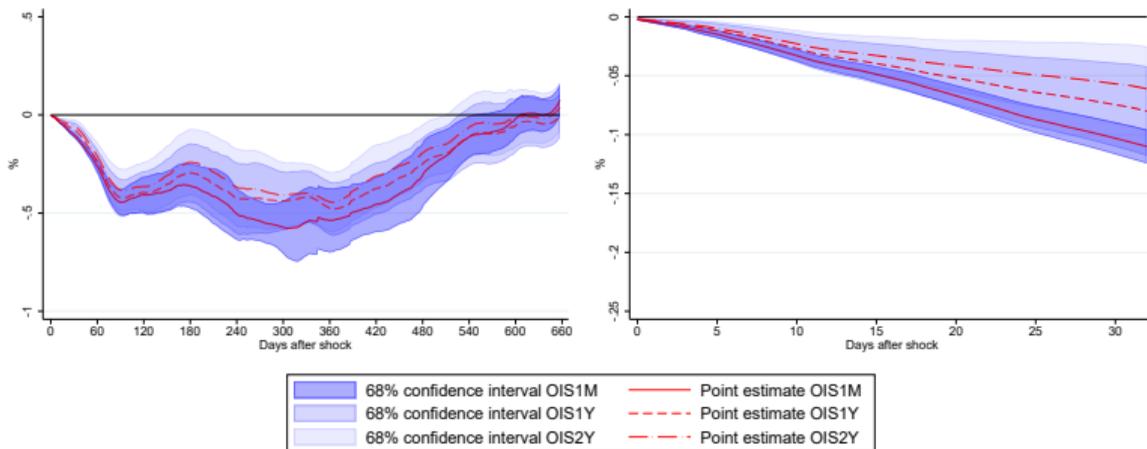
Short and Variable Lags: EURIBOR



- *Daily* EURIBOR Interbank Loan Rate 1 year (Most ARM contracts in Spain written on EURIBOR1Y+Spread)
- Statistically significant response in first few days after the shock

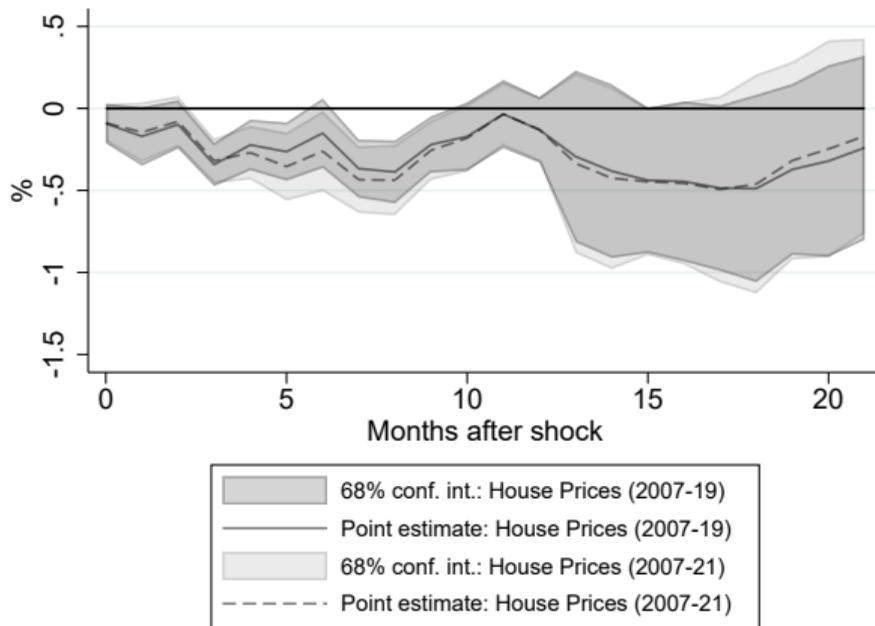
Consumption IRFs

Short and Variable Lags: Stock Market



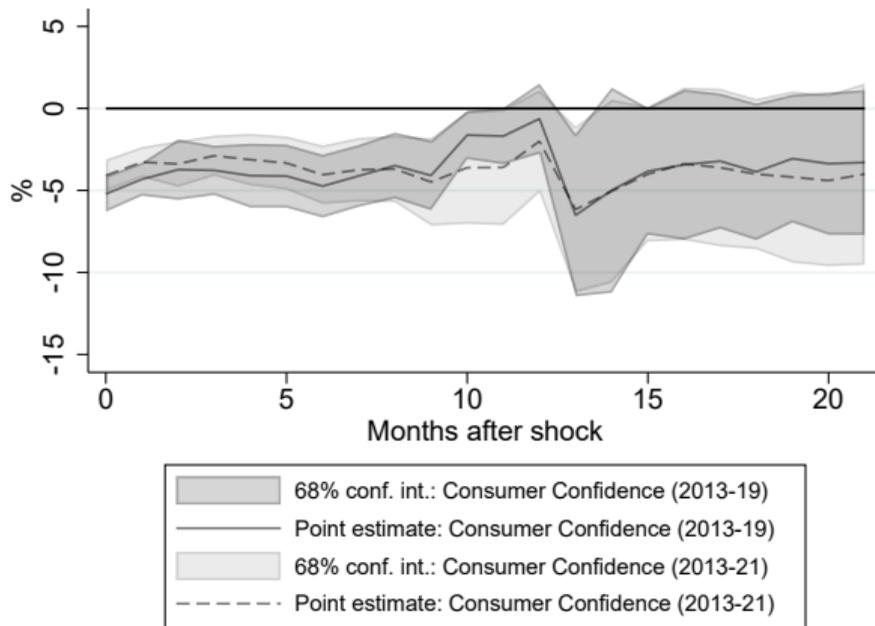
- *Daily* Spanish IBEX 35 Share Index
- Statistically significant response in the first few days after the shock

Short and Variable Lags: House Prices



- *Monthly House Price Index*
 - Price per sq. meter of houses sold on the month;
Source: General Council of Spanish Notaries
- Statistically **significant response in the 3rd month** after the shock

Short and Variable Lags: Consumer Confidence



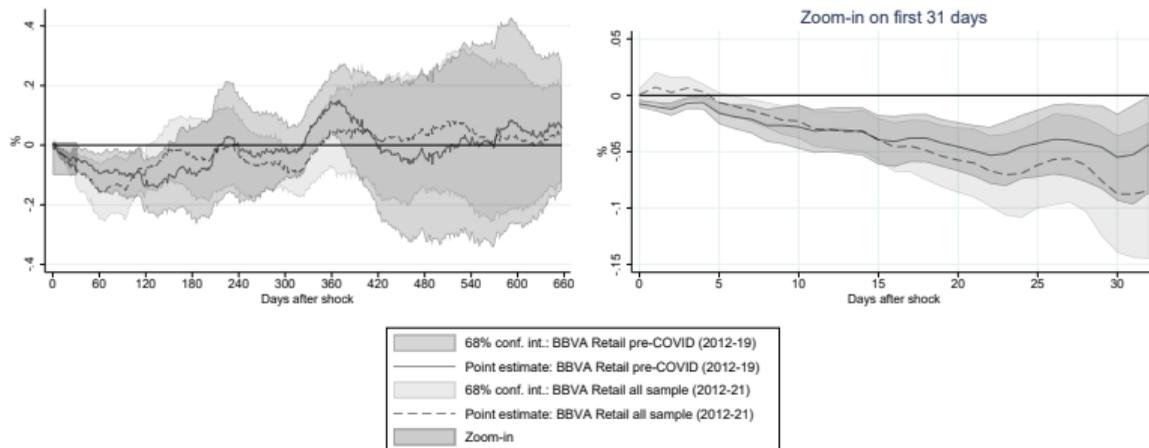
- **Monthly IPSOS Consumer Confidence Index**
 - % of sample with positive replies across 11 questions (e.g. state of economy 6 months ahead; personal finances 6 months ahead; consumption prospects; job security)
- Statistically **significant response on impact**, in the 1st month after the shock

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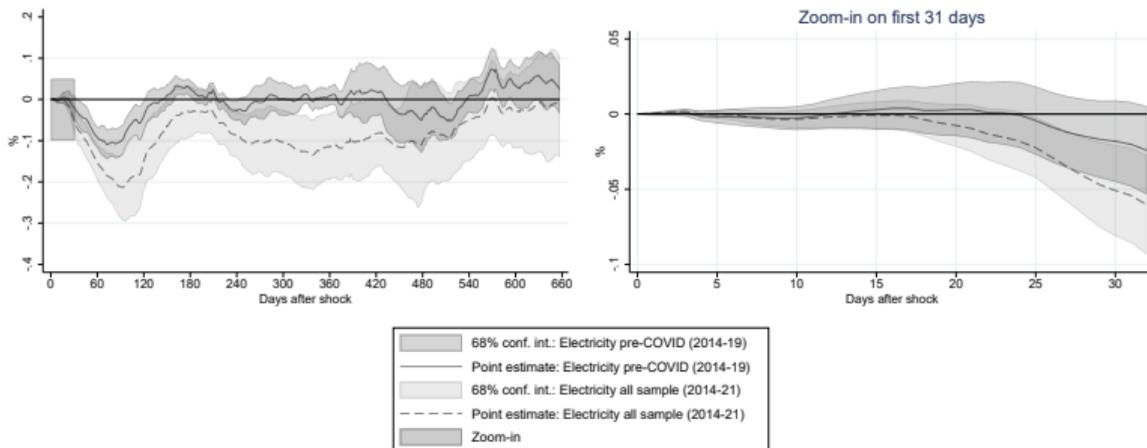
1. COVID is weird, what happens outside pandemic?
 - Daily BBVA Retail Index and Daily Electricity Consumption (only long daily series available)
 - Monthly Industrial Production & Monthly Retail Index (official series)
2. Monetary Shocks are weird in your sample, what happens with others?
 - Include very different 2022–23 period (only 90 days responses)
 - Robustness to variations on methodologies
3. Daily data has all kinds of weird day of the week and seasonality effects
 - Weekly IRFs
 - 30 days MA, no MA
4. Many others in paper...

Pre-COVID Daily Retail Index Series



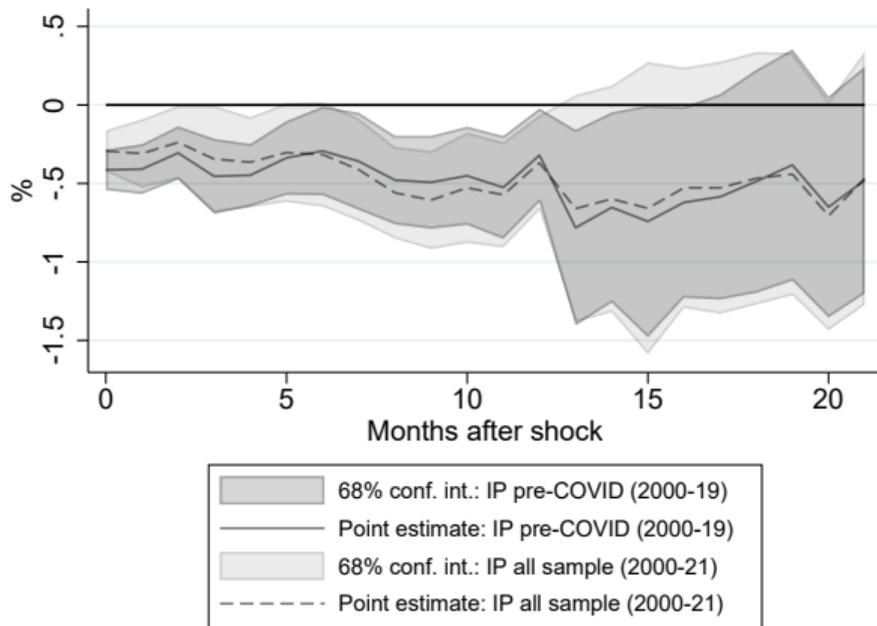
- Longer *Daily* Retail series based on BBVA point of sales terminals, 2012-19
- Highly correlated with INE monthly retail index; Garcia et al (2021)
- Statistically significant response seven days after the shock

Pre-COVID Daily Electricity Consumption Series



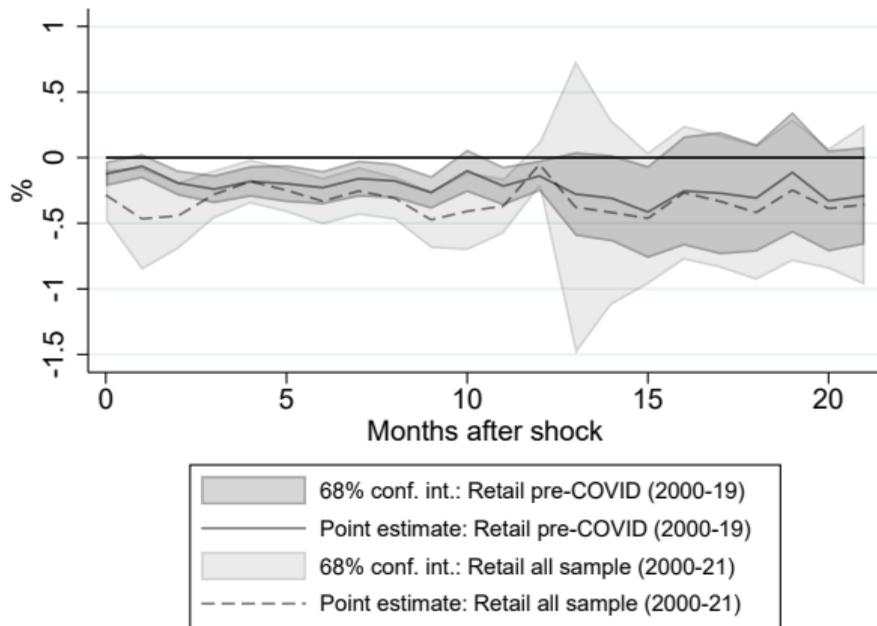
- Longer *Daily* Electricity consumption by Spanish households and firms 2012-19
- Source: Red Electrica (National Electricity Grid Operator)
- Statistically significant response in the second month after the shock.

Pre-Covid Monthly Industrial Production



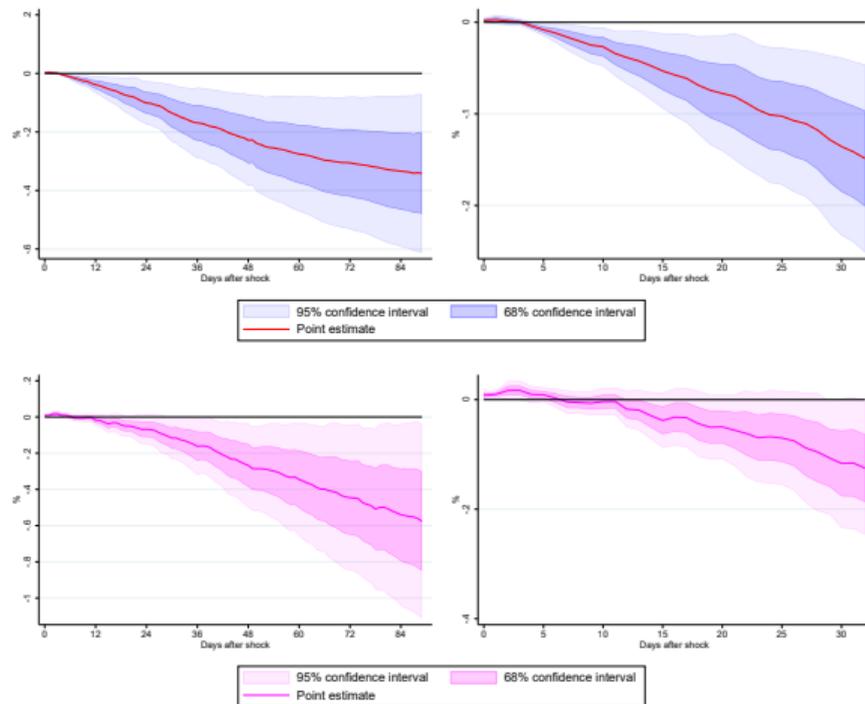
- Monthly Spanish IP available from 2000
- If we go further back in time and exclude the COVID period, short lags are also present

Pre-covid Retail Index



- Monthly Retail Sales Index available from 2000
- And, as IP, if we go further back in time and exclude the COVID period, short lags are also present

MP Shocks: Including 2022/23 with conventional MP shocks

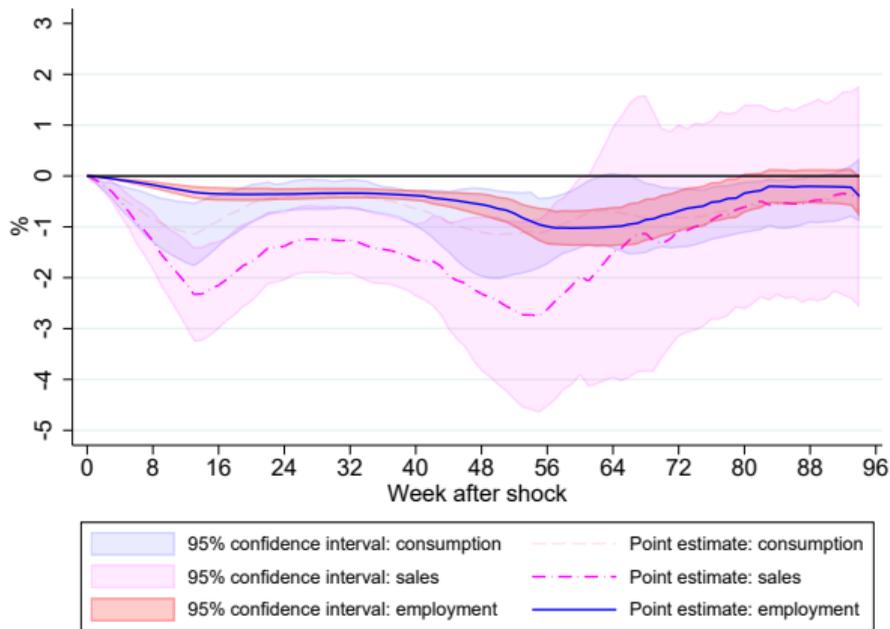


- Extend baseline sample to March 2023 with MP shocks till late 2022; IRFs at 90 days
- 2022 MP shocks were again conventional shocks to short-term rates
- Baseline based on OIS 1-year rate is noisier but there; If we instead use shocks to OIS 1-month (conventional end), sharp short lags are present.

In paper:

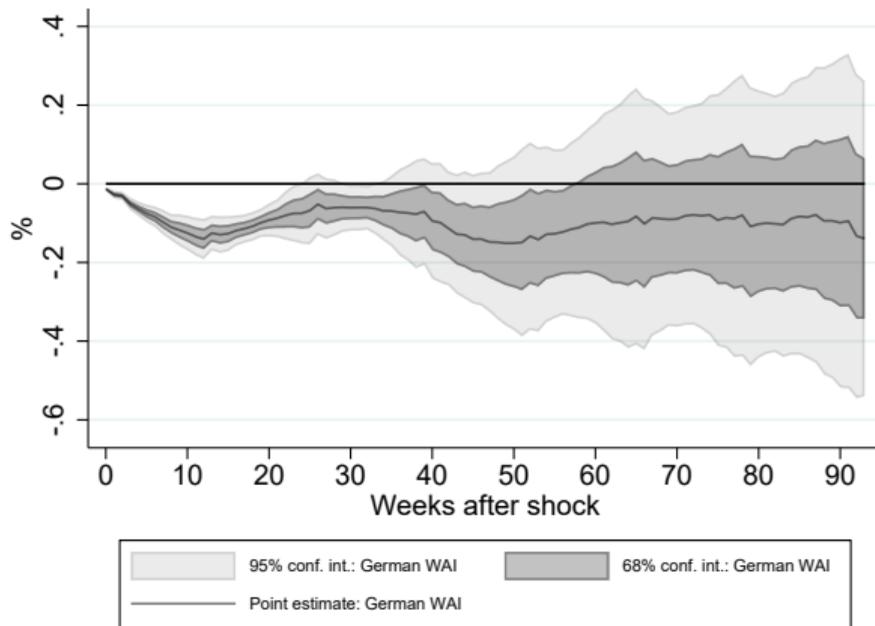
1. Baseline uses innovations to OIS-1Y yield.
 - Robust results using 1-month, 3-month, or 2-year yields in same baseline sample.
2. Baseline uses 'poor man's' approach to sign restrictions
 - Robust results when using sign restrictions as in Jaroncinski and Karadi (2020)
 - Robust results when keeping all shocks and making no attempt to 'clean the information channel'

Seasonality and Day Effects



- Concerns about day of the week effects, daily measurement error and unaddressed seasonality can be addressed with aggregation to weekly data
- Can run weekly data with week-of-the-year dummies
- Statistically significant response of consumption (sales) in the first (fifth) week after the shock

External Validity: German WAI



- German Weekly Activity Indicator (WAI), compiled by the Bundesbank (Eraslan and Götz (2021))
- IRF displays a **similar pattern** to the IRFs of consumption and sales we report in the paper
- Short lags (and long, at lower confidence intervals)

Conclusion

Advantages of working with rich, high-frequency economic activity data

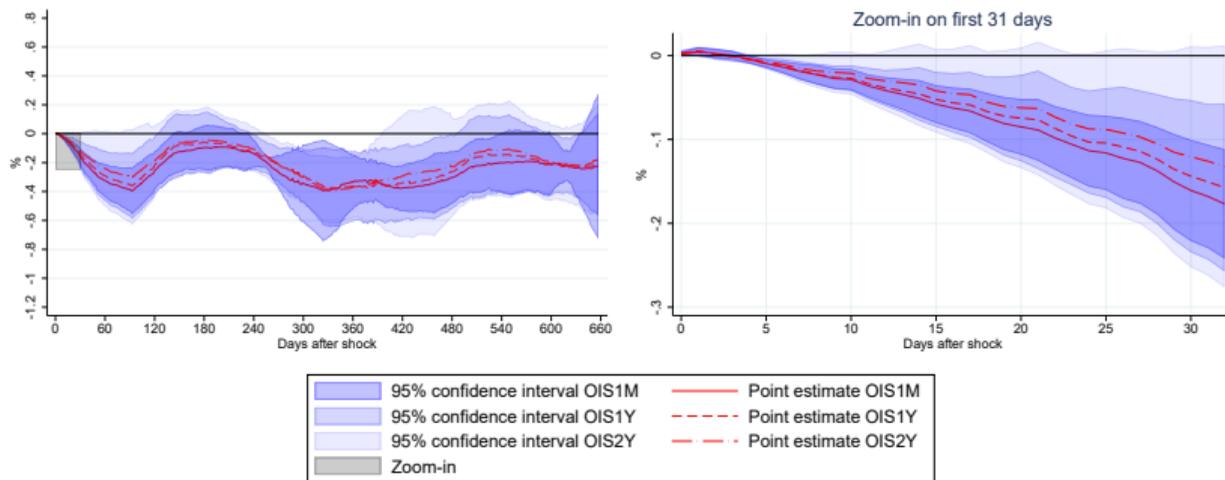
- Study how shocks drive economic dynamics at variable time horizons
- Explore data at a very disaggregated level

Our findings:

- Mp shocks significantly impact real economic activity already at short lags
 - within a week for consumption
 - within a month for corporate sales
 - employment also reacting quickly but less strongly at these short horizons
- In line with Friedman's dictum, the effects of MP shocks peak at long and variable lags

- Time aggregation shifts the empirical response to longer lags
 - relevant for a large body of literature that routinely aggregates identified MP shocks to quarterly or yearly frequencies
- Heterogeneous responses across consumption and sales categories
 - Final demand adjustments via discretionary/luxury goods and durable goods
 - Overall delayed response of sales relative to consumption driven by upstream sectors

Appendix: Consumption responses for different maturity OIS



- Consumption and Euribor respond more to shorter-term OIS shocks. This suggests the adjustable-rate mortgage plays a role in the transmission of MP shocks to aggregate consumption [Back](#)