Price Setting Under Financial Stress

Edvin Ahlander (Stockholm University)
Mathias Klein (Sveriges Riksbank)
Evi Pappa (Universidad Carlos III de Madrid and CEPR)

CRETE 2026: 24th Conference on Research on Economic Theory and Econometrics
July 11th, 2026

The opinions expressed in this presentation are the sole responsibility of the authors and should not be interpreted as reflecting the views of Sveriges Riksbank.

What we do:

1. Compile unique monthly firm-level data set on prices and sales, covering Swedish firms for more than 20 years (including recent surge in inflation).

2. Estimate short and medium run responses of prices and quantities (supply curve) to exogenous demand shocks.

3. Large cross-sectional variation allows to study non-linearities. Document state-dependent nonlinearities during periods of financial stress and as a function of firm-level financial conditions;

4. Develop a heterogeneous-firm New Keynesian model featuring working capital constraints, inventory holdings, and endogenous customer loyalty through advertising to rationalize the joint behavior of prices and sales to demand shock emphasizing the role of inventories and customer loyalty in a structural model.

Contribution I

- *On the slope of the supply curve:* The average elasticity estimate at 12 months is 0.35 broadly consistent with Shea (1993), Boehm and Pandalai-Nayar (2022), and Hoeck and Renkin (2025),
  Contribution our data allows to estimate elasticities at shorter horizons using external and internal instruments.
- *On state-dependence of the supply curve:* Previous studies Boehm and Pandalai-Nayar (2022) and Comin et al. (2023) on capacity utilization; Balleer and Noeller (2023) on input constraints; Blanco et al. (2024) and Klein et al. (2024) on inflation regimes.
  Contribution Rich data to explore non-nonlinearities with respect to financial conditions.

Contribution II

- *On pricing under financial frictions:* Chevalier (1995) and Chevalier and Scharfstein (1995, 1996), Borenstein and Rose (1995), Busse (2002), Gilchrist et al. (2017), Phillips and Sertsios (2013), Kim (2020), and Lenzu et al. (2025) establish that aggregate or idiosynchratic financial shocks induce financially fragile firms to lower prices.
  Contribution Under demand shocks, financially constrained firms instead increase prices, while stronger firms reduce them to capture market share.
- *On inventories, advertising and prices (and financial frictions):*
  Contribution inventories as key mechanism enabling financially constrained firms to expand sales despite binding financing constraints (as in Gertler and Gilchrist (1994) and Hendel (1996)) and new ingredient advertising expenditures key for behavior of strong firms and market competition. Bhandari and McGrattan (2021) and Gourio and Redanko (2014) spending in advertisement as investment in customer capital.

Why Stay Awake?

- Rich, high-quality data
- Puzzling empirical patterns
- A model with new features which is relevant and explains the data
- A new policy trade-off:
  - output dispersion vs inflation stability under financial stress

Table of Contents

1. Data
2. Empirical approach
3. Results - linear case
4. Price Setting Under Financial Stress
5. Model with working capital, inventories and strategic competition with investment in customer loyalty
6. Policy Insights
7. Conclusion

Data

Data

- **Price data**
  - Micro price data underlying official producer price index (1992M1-2022M9).
  - Product-level data, manufacturing sector, several multi-product firms.
  - Prices on domestically sold goods, imported goods, and exported goods.
  - Roughly 1.75 million product-month observations.

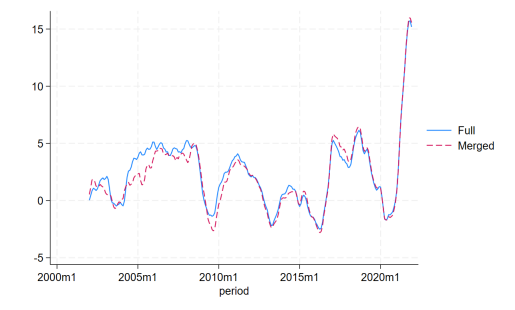
- **Output data**
  - Micro data underlying official industrial production index (1998M1-2022M9).
  - Firm-level sales, manufacturing sector, deflated with aggregate index.
  - Total sales = sales in the domestic market + sales in export market.
  - Roughly 550,000 firm-month observations.

- Construct firm-level price index using (annual) data on delivered quantities (IVP).

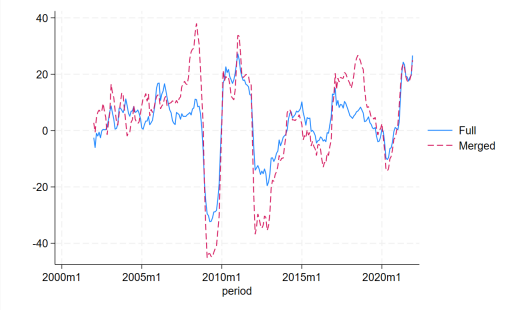
- Can be merged with other (annual) administrative dataset to get information on firms' balance sheet items and real variables (assets, debt, employment, wage bill,...).

Details merging

Aggregate inflation and output



(a) PPI ($\rho = 0.98$)



(b) IPI ($\rho = 0.89$)

Empirical approach

Empirical approach

- Local projections at the firm-level i:

$$\sum_{j=0}^{h} \pi_{i,t+j} = \alpha_{i,h} + \alpha_{m,h} + \boldsymbol{P_h} \sum_{j=0}^{h} \Delta sales_{i,t+j} + \gamma_h \sum_{p=1}^{6} X_{i,t-p} + \theta_h \sum_{l=0}^{6} Z_{t-l} + u_{i,t,h}.$$

- $X_{i,t}$: $\pi_{i,t}$ and $\Delta sales_{i,t}$, 3-months MA. Z_t: unit labor cost, commodity prices.
- Focus on *domestic* sales and prices, $\approx 50,000$ firm-month observations (2001M1-2021M12).
- State-dependencies:

$$\begin{aligned}\sum_{j=0}^{h} \pi_{i,t+j} =& I_{i,t-1} \left[\boldsymbol{P_h^A} \sum_{j=0}^{h} \Delta sales_{i,t+j} + \gamma_h^A \sum_{p=1}^{6} X_{i,t-p} + \theta_h^A \sum_{l=0}^{6} Z_{t-l} + \alpha_{i,h}^A + \alpha_{m,h}^A \right] \\ &+ (1 - I_{i,t-1}) \left[\boldsymbol{P_h^B} \sum_{j=0}^{h} \Delta sales_{i,t+j} + \gamma_h^B \sum_{p=1}^{6} X_{i,t-p} + \theta_h^B \sum_{l=0}^{6} Z_{t-l} + \alpha_{i,h}^B + \alpha_{m,h}^B \right] + u_{i,t,h}.\end{aligned}$$

- Aggregate: $I_{i,t} = I_t$, individual: $I_{i,t} = I_{i,t}$

Identification

- Estimates using OLS might be biased (confounding supply shocks).

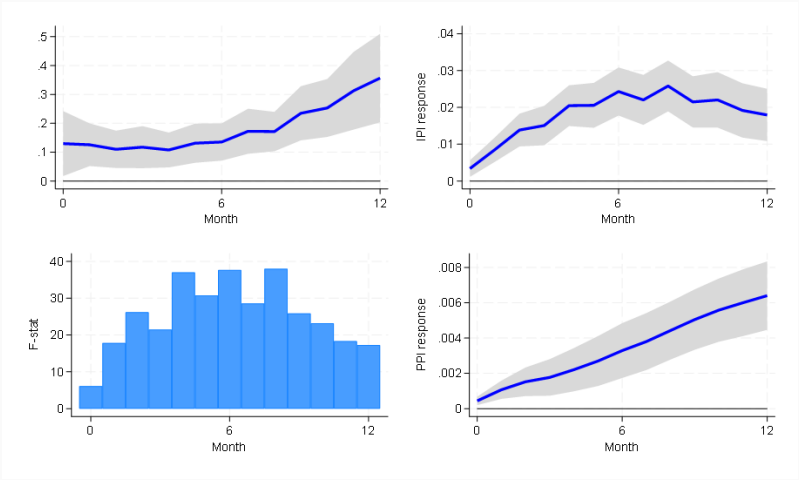
- We rely on an external instrument that drives world industrial production:
  - Baumeister Hamilton (2019, AER): shock to global demand for industrial commodities.
  - Bayesian oil market VAR: $Y^{Oil} \uparrow$, $Y^{World} \uparrow$, $P^{Oil} \uparrow$.

- Increase in world industrial production raises firms' export sales.
- Through domestic input-output links, this increases the demand for *domestic* goods and leads to higher *domestic* prices.

- Could still include supply components but:
  1. Results robust to controlling for firm-level import prices (ULC/oil price interacted with firm FE).
  2. Similar results when relying on alternative instruments (Swedish and ECB MP shocks).
  3. Similar results when using time fixed effects (Bartik instrument)

Results - linear case

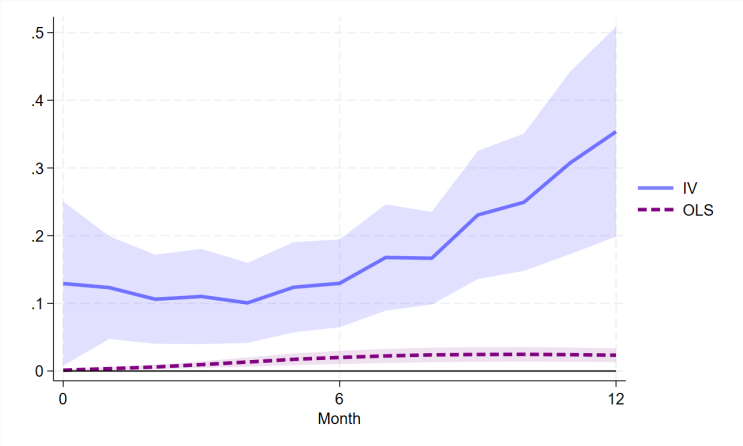
Baseline results



- Boehm and Pandalai-Nayar (2022): slope 0.24; Hoeck and Renkin (2025): slope 0.5

MP shocks | import prices | labor costs | oil prices | expectations | Bartik instrument | weak instruments bands | cluster firm/ time | Weighted Regressions

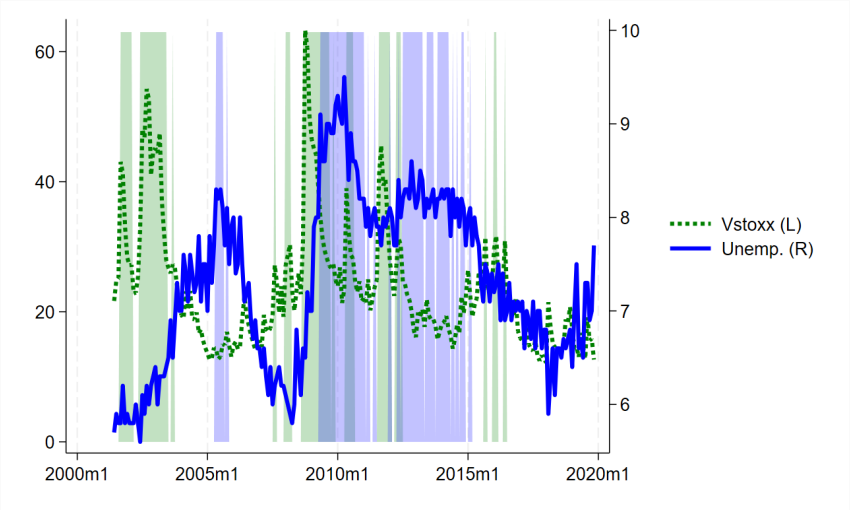
Identification is key



micro vs. macro data

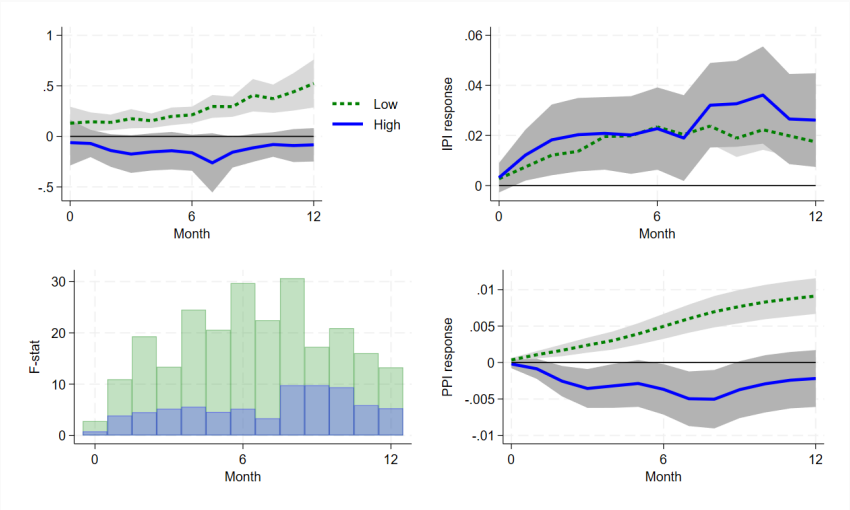
Price Setting Under Financial Stress

Financial stress versus recessions



- Financial stress and recessions do not coincide.

State-dependency, financial uncertainty (VSTOXX volatility)



alternative financial stress measure | continuous financial constraints | other state dependencies

Defining Financially Fragile Firms

- Also, Gilchrist and Zakrajsek (2015), using industry-level data show that financial constraints attenuate the response of inflation to demand shocks.

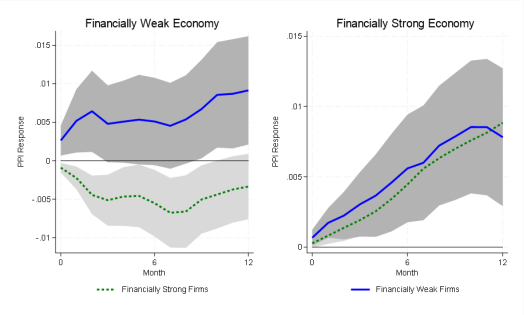
- Gilchrist et al. (AER, 2017) (GSSZ): **Liquidity** defined as cash and short-term investment over total assets. Low liquidity (constrained) firms increased prices during GR.

- We use also **leverage** to differentiate between constrained and unconstrained firms.
- In addition, we use **narratives** from financial remarks from firms' surveys for Upplysningscentralen

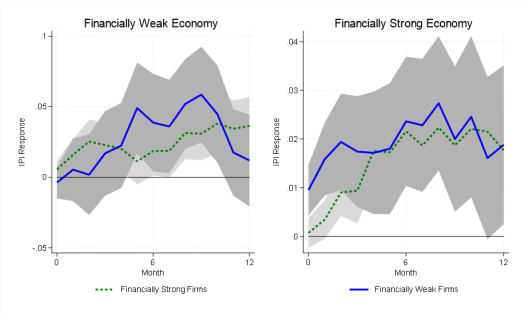
- Robust results to definition of financial conditions - using high leverage, low liquidity or remarks.

Constrained and unconstrained firms' responses during financial stress.

- **Leverage**



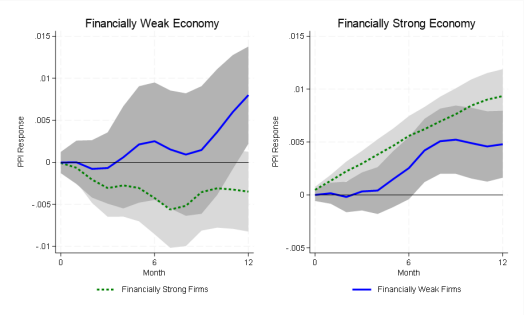
(a) Price response



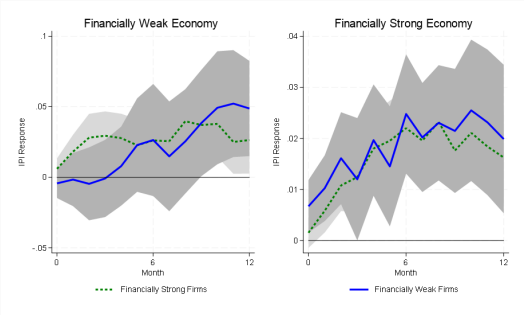
(b) Sales response

Constrained and unconstrained firms' responses during financial stress.

- **Liquidity**



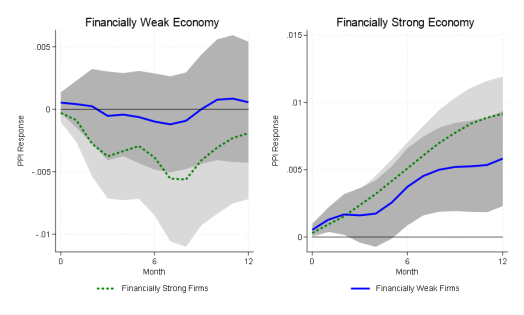
(a) Price response



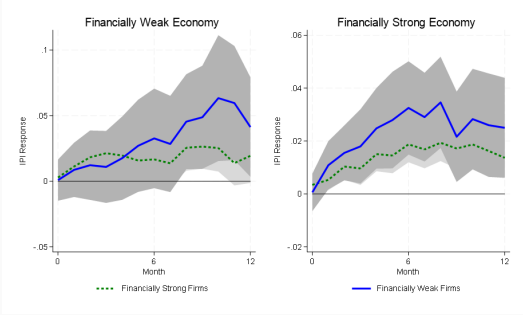
(b) Sales response

Constrained and unconstrained firms' responses during financial stress.

- **Payment remarks**



(a) Price response



(b) Sales response

EA MP shocks | Swedish MP shocks | Alternative financial constraints definition | Significance

Model with working capital, inventories and strategic competition with investment in customer loyalty

Model ingredients

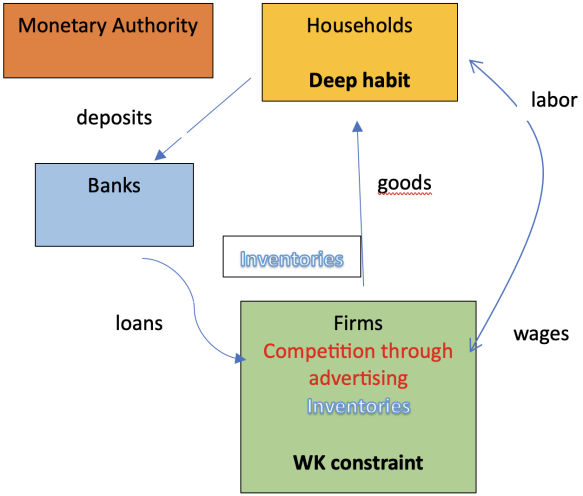
Model of GSSZ (2017):

- Costly external finance: fixed investment shock, inducing firms to increase prices with adverse financial shocks
- Strategic competition with deep habits. (Ravn et al. 2010): induce firms to set markups *below* average marginal costs whenever sales revenues are expected to grow.

Our proposed extension includes:

1. Financial constraints in the form of a **working capital constraint** (Neumeyer and Perri 2005 and recently Balleer et al. 2019) - induces firms to set markups *above* average marginal costs
2. **Investment in customer loyalty** (Bhandari and McGrattan(2021) and Gourio and Rendanko (2014)) to reinforce strategic competition and induce unconstrained firms to lower prices.
3. Output **inventories**, perfect substitutes to newly produced goods but costly to hold - Gertler and Gilchrist (1994) and Kashyap, Lamont, and Stein (1994) and Kim (2020) show liquidity-constrained firms shed inventories in response to financial shocks.

Model Environment



Households

The preferences of households are defined over a habit-adjusted consumption bundle x_t^j and labor h_t^j as:

$$E_t \sum_{s=0}^{\infty} \beta^s U(x_{t+s}^j, h_{t+s}^j)$$

We assume that habits are of the additive external type: For each good variety i, households derive utility from the difference between current consumption and a measure of lagged aggregate consumption. Specifically, household j derives utility from an object x_t^j defined by:

$$x_t^j = \left[\int_0^1 (c_{it}^j - \theta_{it} s_{it-1}^j)^{1-\frac{1}{\eta}} di \right]^{\frac{1}{1-\frac{1}{\eta}}}$$

where s_{it}^j denotes the stock of external habit in good i in period t, which the household takes as exogenously given.

Habits and consumption demand

The stock of habit is assumed to evolve according to the following law of motion:

$$s_{it}^{j} = \rho s_{it-1}^{j} + (1-\rho)c_{it}^{j}$$

For any given level of x_t^j , purchases of each variety $i \in [0,1]$ in period t must solve the problem of minimizing total expenditure, $\left(\int_0^1 P_{it}c_{it}di\right)$, subject to the aggregation constraint.
Then the optimal consumption demand for $i \in [0,1]$ is:

$$c_{it} = p_{it}^{-\eta}x_t + \theta_{it}s_{it-1}$$

where $p_{it} = P_{it}/P_t$ and $P_t = \left(\int_0^1 P_{it}^{1-\eta}di\right)^{1/(1-\eta)}$ is a price index.

Firms - endogenous advertising expenditure

The importance of the habit stock is determined by advertising expenses, denoted b_{it}, as

$$\theta_{it} = \overline{\theta} \left(\frac{b_{it}}{\overline{b}_{jt}} \right)^{\kappa_b}, \qquad \kappa_b \in (0,1)$$

where $\overline{b}_{jt} := \left(\int_{j \in \mathcal{S}_j} b_{jt}\, dj \right) / \left(\int_{j \in \mathcal{S}_j} dj \right)$ denotes the average advertising expenditures of firms in the relevant competitive set $\mathcal{S}_j$, which each firm takes as given. In other words, what matters for the habit strength is your own expenses relative to competitive firms. Strategic competition

Nominal rigidities

We assume a production function: $y_{i,t} = A_{i,t} h_{i,t}^{\alpha} \bar{k}^{(1-\alpha)}$.

To change nominal prices, firms need to pay the quadratic Rotemberg adjustment cost given by

$$\frac{\gamma_p}{2} \left(\frac{P_{it}}{P_{it-1}} \pi_t - 1 \right)^2 c_t$$

Households belong in labor unions and face a cost of changing nominal wages given by

$$\frac{\gamma_w}{2} \left(\frac{W_t^j}{W_{t-1}^j} - 1 \right)^2 W_t h_t$$

The firms' labor demand equation is given by

$$h_t^j = \left(\frac{w_t^j}{w_t} \right)^{-\eta_w} h_t$$

Working capital constraint

Firm must pay labor in advance of producing output, and finances this labor payment with an intraperiod loan. Since the loan is intratemporal (as opposed to the standard intertemporal debt), there is no interest on this loan. We assume that the amount the firm can borrow equals a fraction of the value of its capital, which is fixed:

$$w_t h_{it} \leq (\xi_i + \mathcal{F}_t) q \bar{k}_i \tag{1}$$

where $\mathcal{F}_t$ denotes an exogenous and common financial shock with mean zero and where $w_t(i)h_i(t)$ denotes total wage payments, q is the value of capital, $\bar{k}(i)$ is how much capital the firm has, and ξ is the borrowing limit.

Inventories

Finally, firms can hold inventories and are thus possibly able to increase sales without violating the working capital constraint, but at a storage cost that we assume is quadratic:

$$\frac{\gamma_I}{2}(\hat{I}_{it})^2 \tag{2}$$

where $\hat{I}_{it} := I_{it} - \overline{I}$ denotes the deviation of inventories I_{it} from critical level $\overline{I}$. The law of motion of inventories is

$$I_{it} = (1 - \delta_I)I_{it-1} + y_{it} - c_{it} \tag{3}$$

where c_{it} denotes total sales, and δ_I denotes the depreciation rate of inventories.

Profit maximization

The Lagrangian of the firm profit maximization problem can be written as

$$
\begin{aligned}
\mathcal{L} = \mathbb{E}_0 \sum_{t=0}^{\infty} m_{0,t} \Bigg\{ & p_{it} c_{it} - w_t h_{it} - \frac{\gamma_p}{2} \left(\pi_t \frac{p_{it}}{p_{it-1}} - 1 \right)^2 c_t - \frac{\gamma_b}{2} (b_{it})^2 - \frac{\gamma_I}{2} (\hat{I}_{it})^2 \\
& + \lambda_{it}^1 \left[A_{it} h_{it}^{\alpha} \overline{k}_i^{1-\alpha} - y_{it} \right] \\
& + \lambda_{it}^2 \left[(1 - \delta_I) I_{it-1} + y_{it} - I_{it} - c_{it} \right] \\
& + \lambda_{it}^3 \left[(\xi_i + \mathcal{F}_t) q \overline{k}_i - w_t h_{it} \right] \\
& + \lambda_{it}^4 \left[p_{it}^{-\eta} x_t + \theta_{it} s_{it-1} - c_{it} \right] \\
& + \lambda_{it}^5 \left[\rho s_{it-1} + (1 - \rho) c_{it} - s_{it} \right] \\
& + \lambda_{it}^6 \left[\overline{\theta} \left(\frac{b_{it}}{b_t} \right)^{\kappa_b} - \theta_{it} \right] \Bigg\}
\end{aligned}
$$

Firms' Pricing Decisions

Firms' optimal pricing decisions are characterized by

$$p_{it} = \frac{\zeta_{it}}{\zeta_{it}-1}(mc_{it} - (1-\rho)\lambda_{it}^5) + \frac{\gamma_p}{\zeta_{it}-1}\left[\mathbb{E}_t m_{t,t+1}(\pi_{it+1}-1)\frac{\pi_{it+1}}{c_{it}/c_{t+1}} - (\pi_{it}-1)\frac{\pi_{it}}{c_{it}/c_t}\right]. \tag{4}$$

1. Endogenous markups:

$$\zeta_{it} := \eta\left(1 - \theta_{it}\frac{s_{it-1}}{c_{it}}\right)$$

2. Financial constraints through marginal costs,

$$mc_{it} = \frac{w_t(1+\lambda_{it}^3)}{\alpha A_{it} h_{it}^{\alpha-1}\overline{k}_i^{1-\alpha}}.$$

   where λ_{it}^3 denotes the multiplier on the working-capital constraint.

3. Intertemporal customer acquisition through habit: operating through $(1-\rho)\lambda_{it}^5$

Monetary policy and aggregation

The central bank sets the nominal interest R_t according to the Taylor rule

$$R_t = (1 + R_{t-1})^{\phi_R} \left[(1 + \overline{R}) \pi_t^{\phi_\pi} \right]^{1-\phi_R} - 1 \tag{5}$$

Households are all identical so we drop the j notation. The market clearing conditions for the labor and asset markets are respectively given by $h_t = \int_0^1 h_{it} di$ and $a_{t+1} = 0$,

From the household budget constraint, we furthermore have that

$$\underbrace{x_t + \int_0^1 \theta_{it} p_{it} s_{it-1} di}_{c_t} = \int_0^1 p_{it} (y_{it} + (1 - \delta_I) I_{it-1} - I_{it}) di - \gamma_t$$

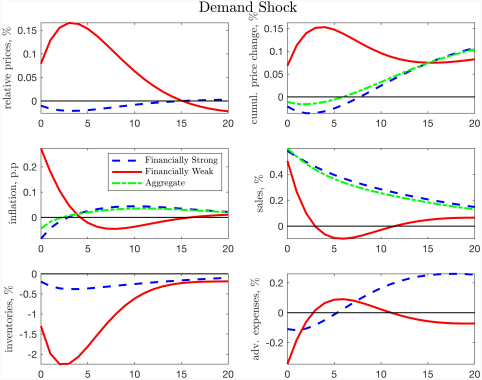
which is the aggregate resource constraint, with γ_t

$$\gamma_t = \frac{\gamma_w}{2} \left(\pi_t^w - 1 \right)^2 w_t h_t + \int_0^1 \frac{\gamma_p}{2} \left(\pi_{it} - 1 \right)^2 c_t + \frac{\gamma_b}{2} (b_{it})^2 + \frac{\gamma_I}{2} (\hat{I}_{it})^2 di$$

Parameter values

Parameter	Value	Description
β	0.996655	Time discount factor
$\bar{\theta}$	0.235	Habit constant
γ_b	40	Advertising cost
κ_b	0.40	Habit exponent
ρ	0.9	Habit stock persistence
δ_I	0.08/3	Depreciation of inventories
γ_I	1/3	Inventory adjustment cost
χ	1/5	Inverse Frisch elasticity
η	4.0	Elasticity of substitution
γ_p	8	Price adjustment cost
ξ_1	0.9	Working capital constraint
ξ_2	0.05	Working capital constraint
ω_1	0.75	Firm mass
ω_2	0.25	Firm mass
Low-volatility state: $\xi_1 = \xi_2 = 0.9$.		

Impulse responses - demand shock



Low financial stress | No advertising costs | No inventories | Monetary policy shock

- Model predictions similar to GSSZ for financial shocks GSSZ -2017 but differ for demand shocks GSSZ -demand

Different financial frictions

GSSZ 2017 assume production function: $y_{i,t} = A_{i,t} h_{i,t}^{\alpha} - \varphi$, where φ is fixed operating costs

Key friction: Firms can only raise external funds via new equity issuance, which involves dilution costs.

Implications:

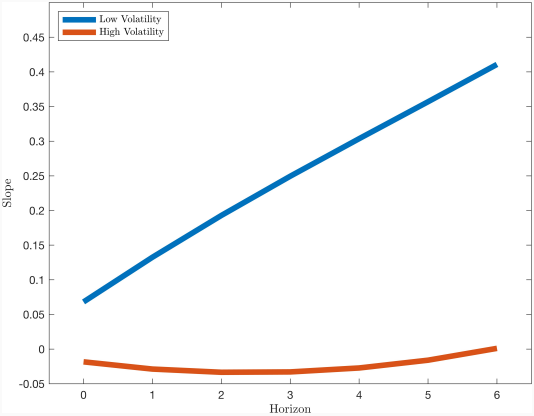
- With fixed costs, profitability is more likely during demand booms. This reduces reliance on costly external finance.
- Firms may choose to lower prices to gain market share, expecting higher future profitability.

Our framework: Firms face a working capital constraint: $w_t(i) h_i(t) \leq \xi_i q \bar{k}_i$

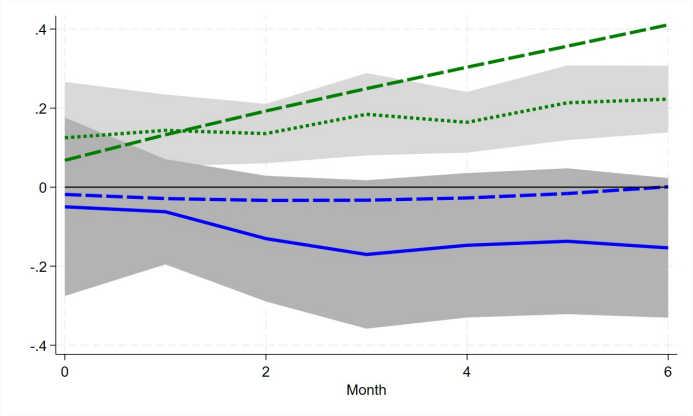
- With variable costs, when demand rises, working capital still operative. If firms choose to lower prices, increase employment and output — raises costs and reduces current profits but boosts future profits via *deep habits*. Different trade-off.
- Get price responses right but not output response! *inventories!*

Model and Data Predictions

Feed a sequence of shocks into the model always starting from the steady state, save aggregate sales and price responses, and compute the implied slope of the supply curve.



How well the model matches the data?



Validating the mechanism

- Estimate the following specification (firm i, year t):

$$y_{i,t+1} - y_{i,t-1} = \alpha_i + \alpha_t + \theta I_{i,t-1} + \beta \left(I_{i,t-1} \times D_t \right) + \gamma X_{i,t-1} + u_{i,t}$$

separately for high/low financial stress and $y \in$ (advertising, inventories) in logs, where D_t and $I_{i,t}$ are the same aggregate demand shock and dummy for financially weak firms as before.

	Inventories		Advertising expenses	
	(1) Low stress	(2) High stress	(3) Low stress	(4) High stress
Leverage$_{i,t-1}$	0.007	0.097	-0.001	-0.060
	(0.030)	(0.101)	(0.043)	(0.094)
Leverage$_{i,t-1} \times \mathcal{D}_t$	0.008	-0.059*	-0.014	-0.078***
	(0.007)	(0.032)	(0.013)	(0.027)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	2584	347	1194	210
Adj. R-squared	0.1876	0.503	0.125	0.403

Sensitivity Analysis

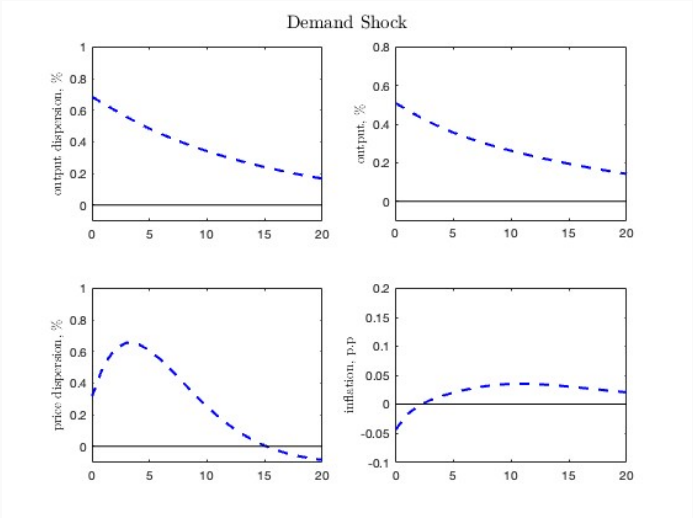
- Flexible wages and prices
- Lower elasticity of subst. for differentiated goods and habit

Policy Insights

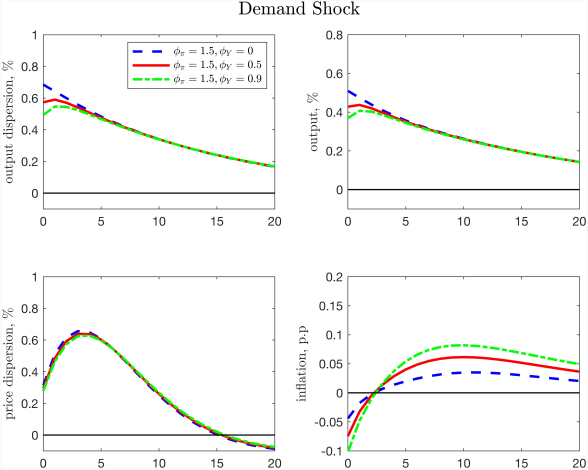
Output and Price Dispersion

- In the benchmark model MP targets aggregate inflation
- Since inflation is not moving no changes in the interest rate to correct for the demand shock
- Yet, significant price and output dispersion

Output and Price Dispersion in the benchmark Economy under Financial stress



What if monetary policy reacted to output measure?



Normal times

Conclusion

Conclusion

- Unique monthly firm-level data set on output and prices.
- **Empirical findings:** Supply curves are upward-sloping on average, flatten—and can turn negative—under financial stress.
- **Firm-level heterogeneity:** Constrained firms raise prices when demand rises under stress; unconstrained firms cut prices to expand market share.
- **Theoretical contribution:** A new model with working capital constraints, inventories and strategic competition explains firm- and aggregate-level price and sales dynamics.
- **Implications:**
  - Demand shocks have weaker effects on inflation during financial stress, suggesting limited inflationary risks when liquidity constraints bind, but bigger output and price dispersions.
  - Financial stress alters predictions for optimal policy.

Thank you!

Related Literature - Estimating supply curves

- **Industry-Level Supply Curves:**
  Boehm and Pandalai-Nayar (AER, 2022), Shea (QJE, 1993).
  Our contribution: Use firm-level data to uncover nonlinearities in supply behavior.

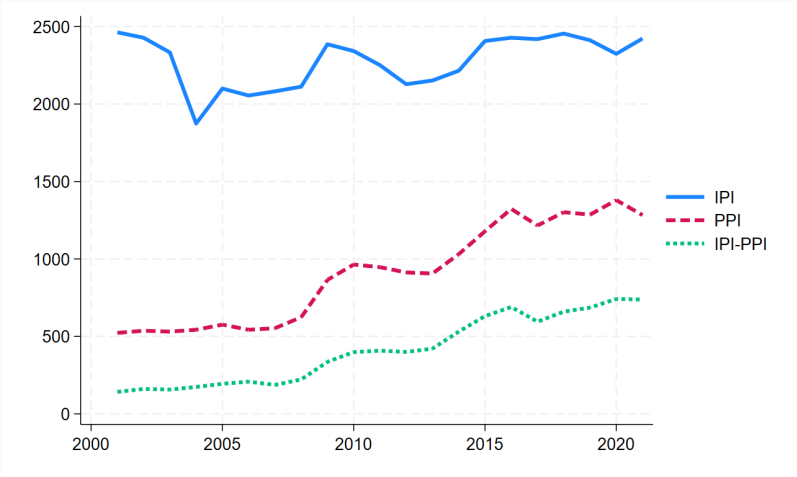
- **Firm-Level Supply Curves:**
  - Balleer and Noeller (2023) *input* versus *capacity* constraints.
    Our contribution: Representative survey of German firms vs. whole universe of Swedish firms in manufacturing.
  - Hoeck and Renkin (2024) All Danish manufacturing firms, quarterly data, different identification, similar estimated elasticities
    Our contribution: Explore non-linearities.

- **Phillips Curve Estimation Using Cross-Sectional Data:**
  Hazell et al. (QJE, 2022), Gagliardone et al. (WP, 2023).
  Our contribution: Employ granular firm-level data to estimate slope at firm level. Back

Merging sales and price data

- Problem: sales data at firm-level, price data at product-level.
- How to construct price-index at the firm-level?
- IVP dataset: annual product-level information on delivered quantities and prices to get product-weights at the firm level.
- Still some discrepancy between firm-level sales and prices, because we might not observe all product prices in the PPI.
- Keep only those firms for which we observe at least 50% of their total production value in the PPI.

Total number of firms



Summary statistics, balance sheet items

	IPI	PPI	IPI-PPI	IPI	PPI	IPI-PPI
	Assets			Sales		
Mean	18.09	19.13	19.57	18.58	19.59	20.01
Standard deviation	1.85	1.69	1.58	1.73	1.56	1.43
25th percentile	16.84	17.98	18.52	17.38	18.55	19.05
Median	17.99	18.95	19.40	18.54	19.44	19.87
75th percentile	19.21	20.12	20.45	19.66	20.53	20.82
	Employment			Productivity		
Mean	4.06	4.76	5.10	14.56	14.85	14.92
Standard deviation	1.38	1.29	1.19	0.72	0.73	0.72
25th percentile	3.09	3.85	4.26	14.10	14.39	14.48
Median	3.99	4.62	5.00	14.50	14.77	14.85
75th percentile	4.93	5.56	5.87	14.97	15.24	15.31

- **firm productivity**: ratio between annual total sales and number of employees

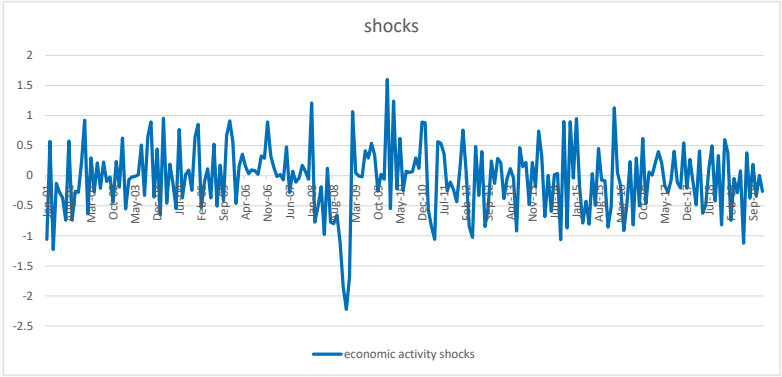
Summary statistics, prices and sales data

	PPI/IVP	IPI-PPI	PPI/IVP	IPI-PPI	PPI/IVP	IPI-PPI
	Price-change frequency		Market Share		Number of products	
Mean	4.84	5.19	0.16	0.23	3.47	3.67
Standard deviation	4.65	4.71	0.24	0.28	5.68	5.82
25th percentile	1.00	1.00	0.01	0.03	1.00	1.00
Median	3.00	3.00	0.04	0.10	2.00	2.00
75th percentile	10.00	11.00	0.18	0.34	3.00	4.00

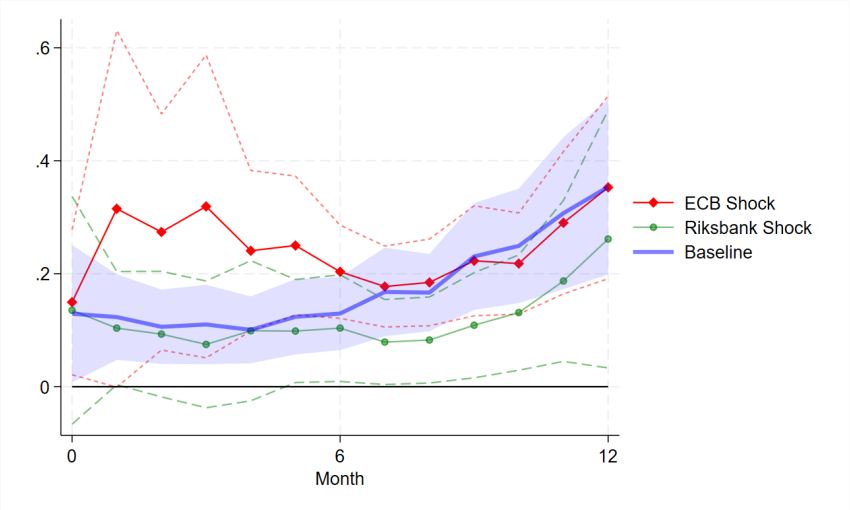
- **price change frequency**: defined as a product's total number of price changes within a year, and aggregated to the firm level
- **market share**: share of IVP production value within 4-digit CN codes

back

Shocks



Robustness, Swedish and ECB MP shocks



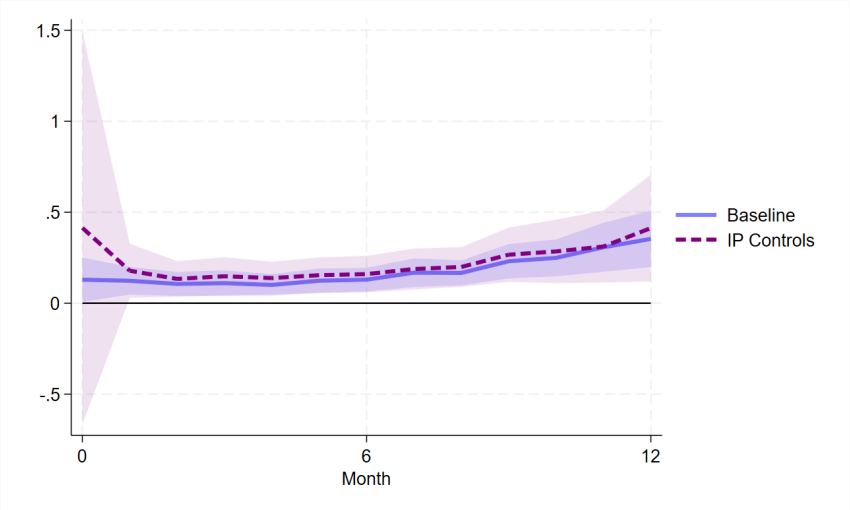
back

Exclusion restriction: import prices

- Global commodities shock might also affect costs, thereby influencing supply.
- We have information on prices of imported goods (part of PPI database).
- Caveats:
  1. No information on quantities (take simple average)
  2. Only available for part of the sample (less than 40%).

$$\sum_{j=0}^{h} \pi_{i,t+j}^{Domestic} = \alpha_{i,h} + \alpha_{m,h} + \boldsymbol{P_h} \sum_{j=0}^{h} \Delta sales_{i,t+j} + \gamma_h \sum_{p=1}^{6} X_{i,t-p} + \theta_h \sum_{l=0}^{6} Z_{t-l} + \boldsymbol{\lambda_h} \sum_{l=0}^{6} \pi_{i,t-l}^{Import} + u_{i,t,h}.$$

Controlling for import prices



back

Exclusion restriction: labor costs

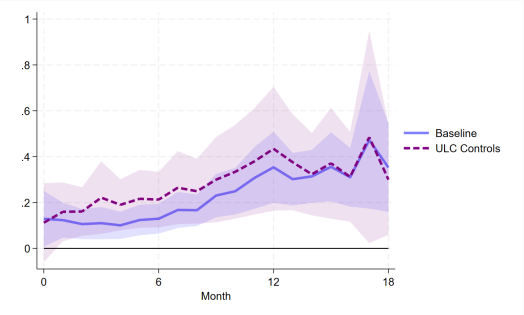
- Local projections at the firm-level i:

$$\sum_{j=0}^{h} \pi_{i,t+j} = \alpha_{i,h} + \alpha_{m,h} + \boldsymbol{P_h} \sum_{j=0}^{h} \Delta sales_{i,t+j} + \gamma_h \sum_{p=1}^{6} X_{i,t-p} + \theta_h \sum_{l=0}^{6} Z_{t-l} + u_{i,t,h}.$$

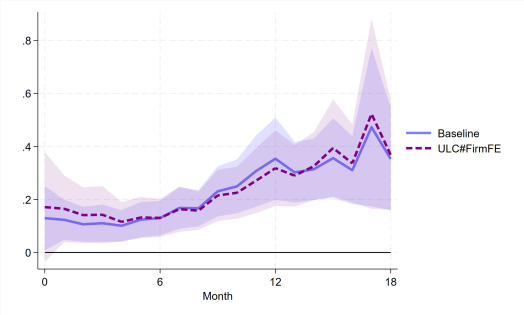
- $X_{i,t}$: $\pi_{i,t}$ and $\Delta sales_{i,t}$, 3-months MA. Z_t: unit labor cost, real oil price.

- Control firm-level labor cost. Two approaches.
  - 1) Control for firm-level unit labor cost (only annual information)
  - 2) Interact aggregate unit labor cost (quarterly frequency) with firm FE.

Control for firm level labor cost



(a) Firm level ULC

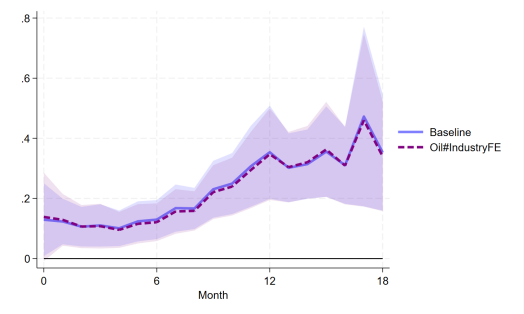


(b) Aggregate ULC x Firm FE

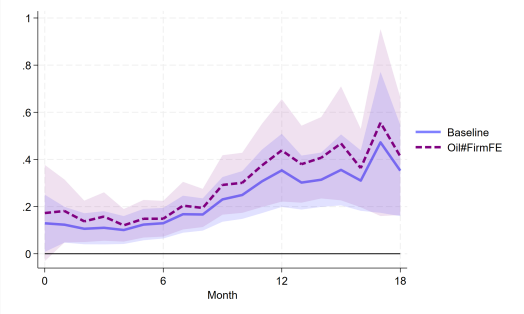
back

Differential oil price effects

- Oil price affects costs and this cost effect will likely vary at the firm level. Oil price control interacted with firm fixed effects (or with an industry fixed effect).



(a) Oil price x Industry FE

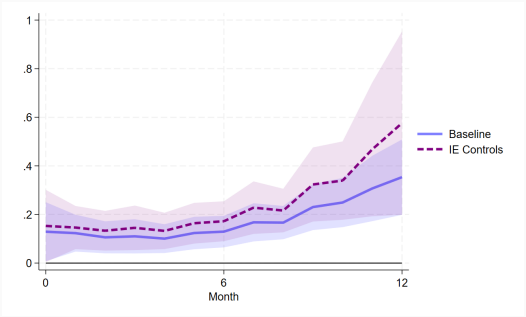


(b) Oil price x Firm FE

back

Inflation expectations

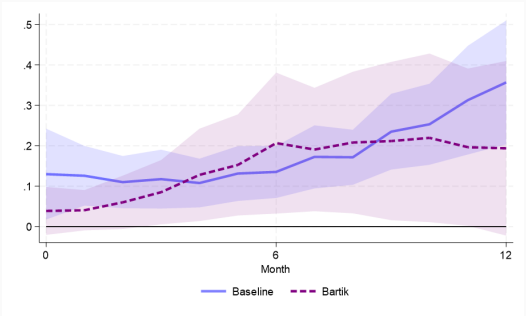
- External demand shocks could alter firms' expectations about future inflation and, hence, pricing decisions.
- Control for contemporaneous and six lags of aggregate inflation expectations from Economic Tendency Survey of the National Institute of Economic Research (Konjunkturinstitutet).



back

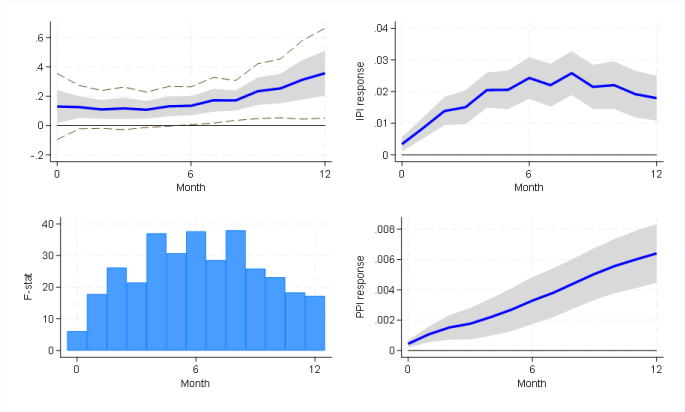
Using a Bartik instrument as in Hoeck and Renkin (2025)

- Data does not contain information on Swedish firms' export destinations
- Construct Bartik instrument as interaction between monthly growth in real total Euro Area imports (deflated by the Euro Area CPI), and export share of total sales for each firm-month in our sample
- Bartik instrument considerably weaker with lower F-statistics and wider confidence bands



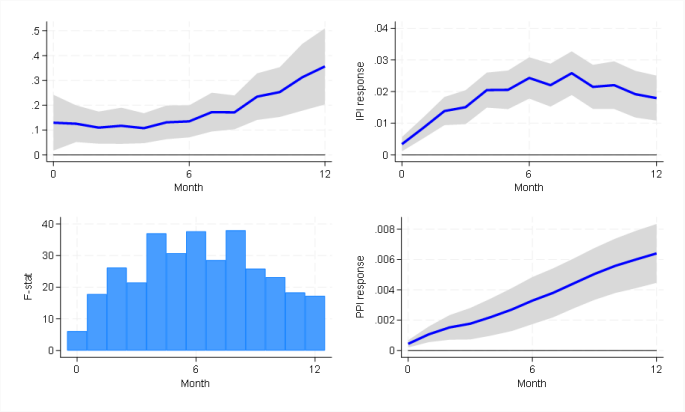
back

Accounting for weak instrument confidence bands



back

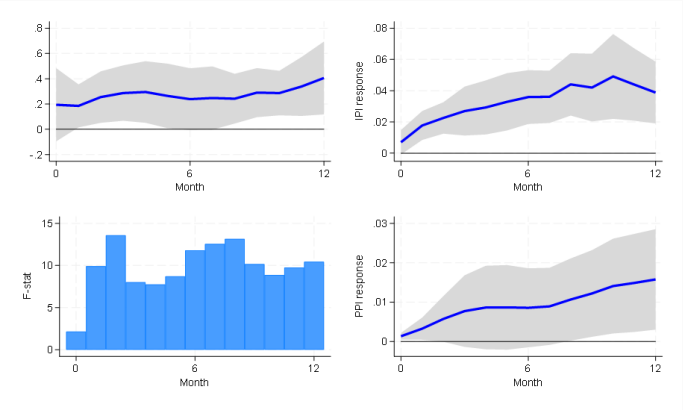
Accounting for aggregate shock instrument



back

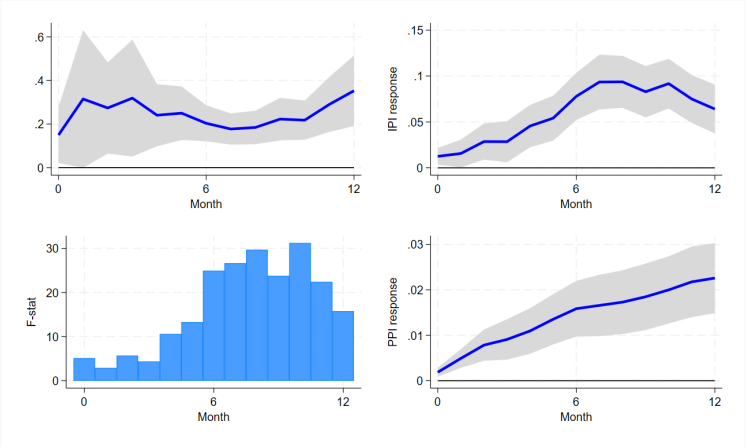
Weighted regressions

Use 1-month lag of real smoothed sales as weights

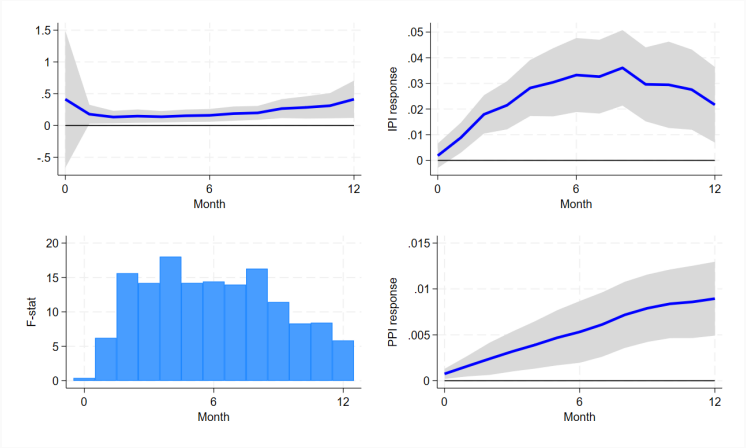


back

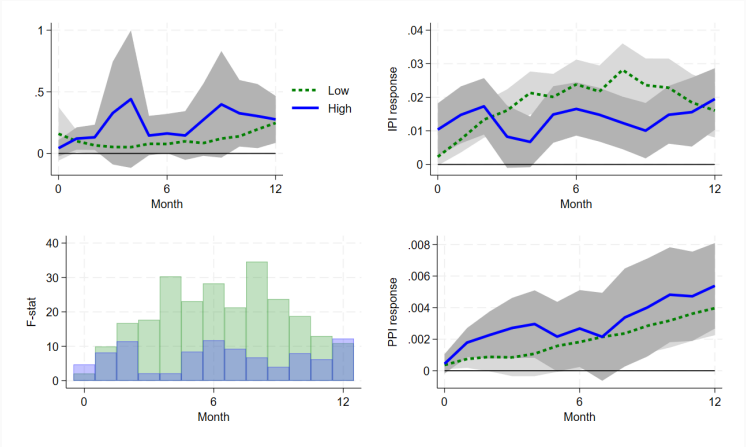
Robustness, ECB MPshock



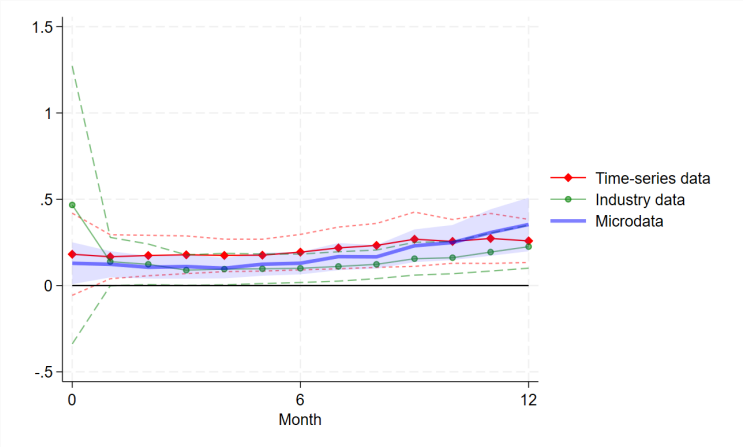
Controlling for import prices



Capacity utilization, Boehm/Pandalai-Nayar (2022)

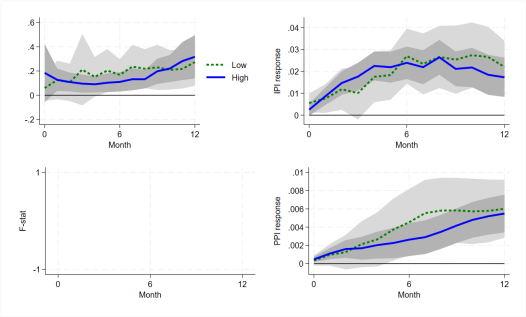


Micro versus Macro Data

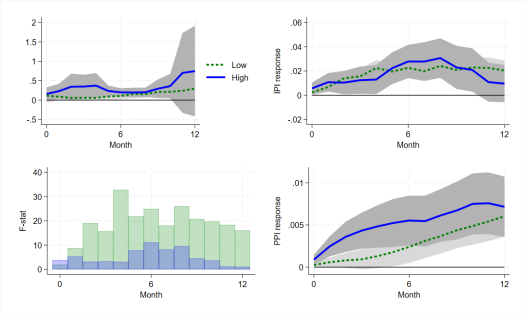


back

Leverage versus liquidity: details



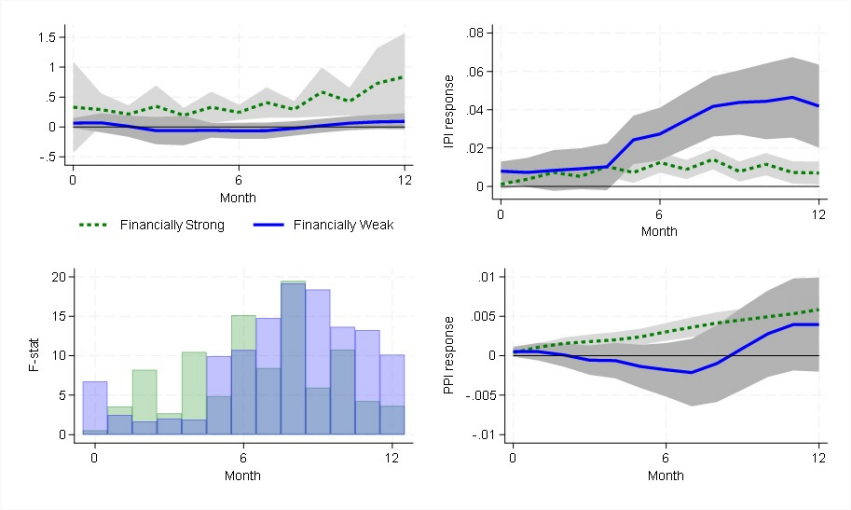
(a) Liquidity (low=constrained)



(b) Leverage (high=constrained)

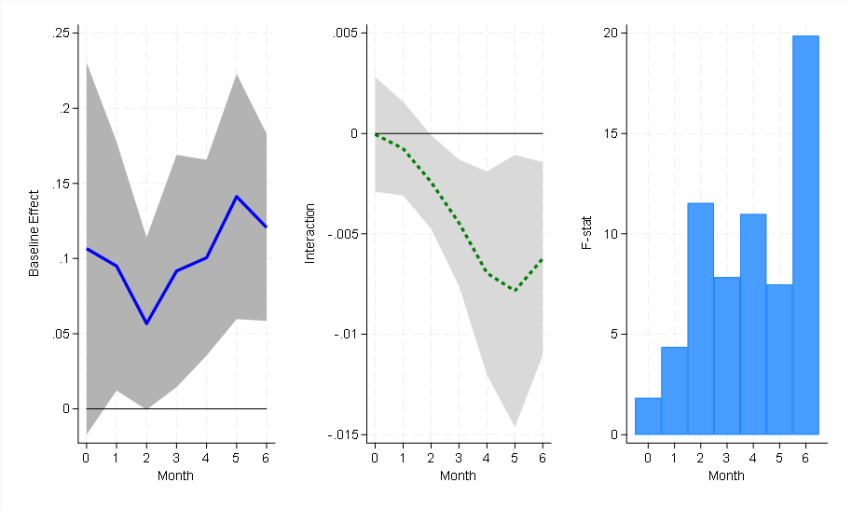
back

Financial Stress (Payment Remarks)



back

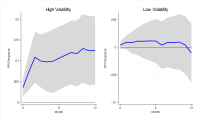
Financial Stress (Continuous financial constraints)



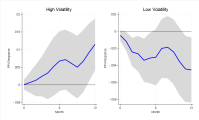
back

Price differentials responses

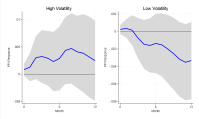
back



Leverage



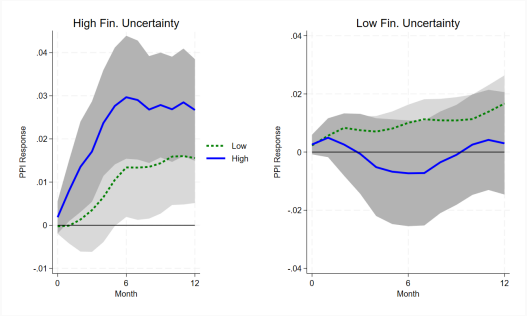
Liquidity



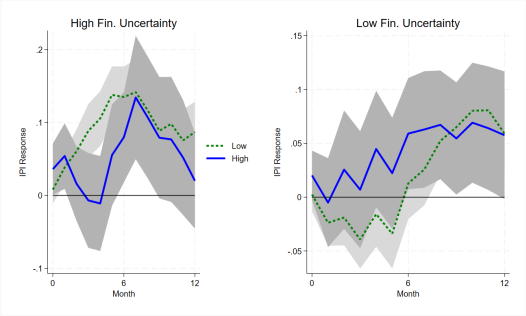
Payment Remarks

EA monetary policy shocks

- **Leverage**



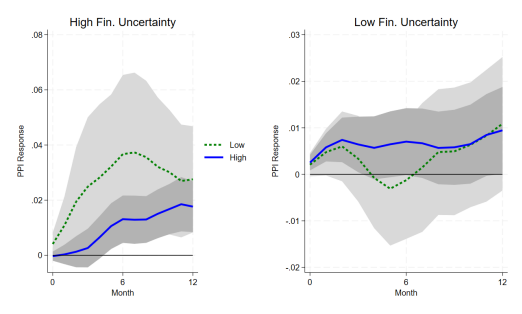
(a) Price response



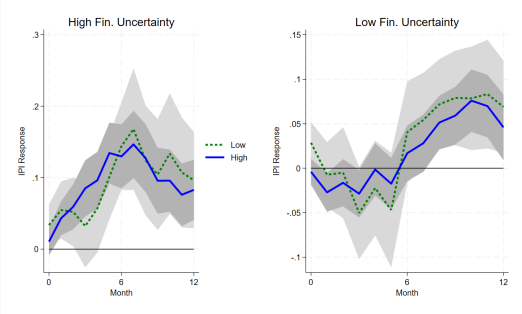
(b) Sales response

EA monetary policy shocks

- **Liquidity**



(a) Price response

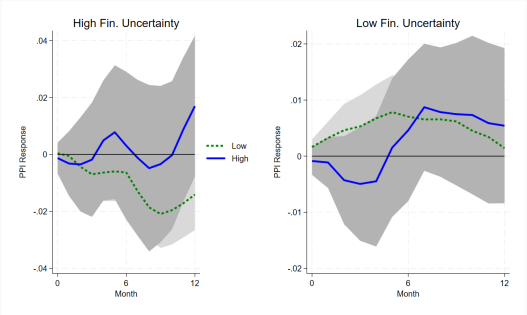


(b) Sales response

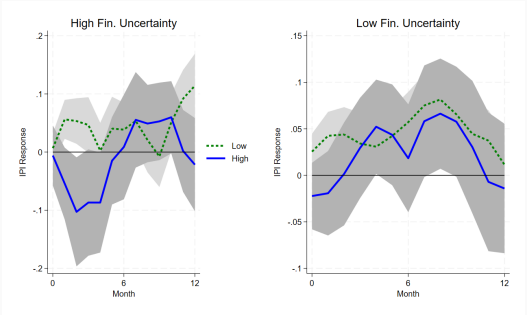
back

Swedish monetary policy shocks

- **Leverage**



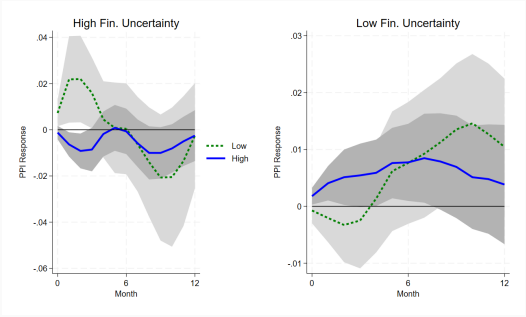
(a) Price response



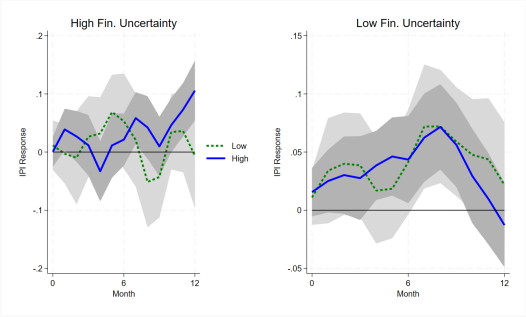
(b) Sales response

Swedish monetary policy shocks

- **Liquidity**



(a) Price response

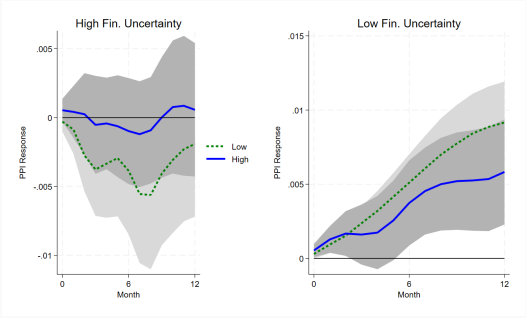


(b) Sales response

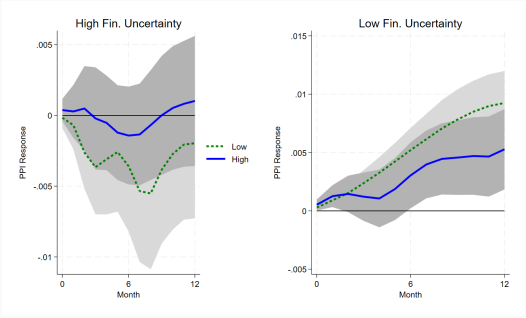
back

Alternative definition of financial stress.

- **Remarks for financial troubles**



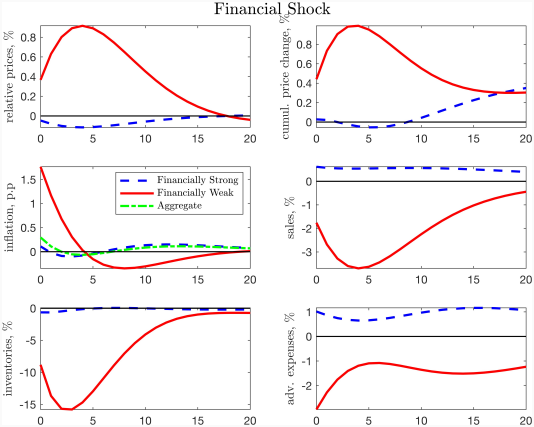
(a) Remarks concerning inability to pay



(b) Remarks of all financial troubles

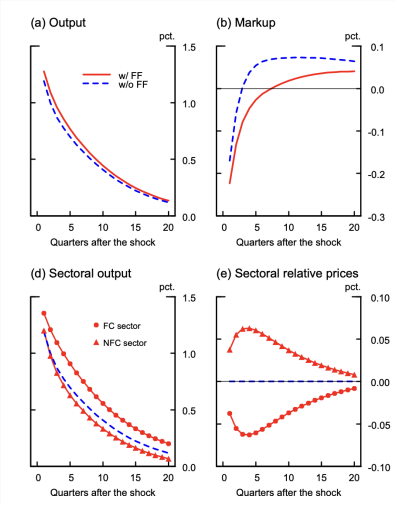
back

Responses to financial shock



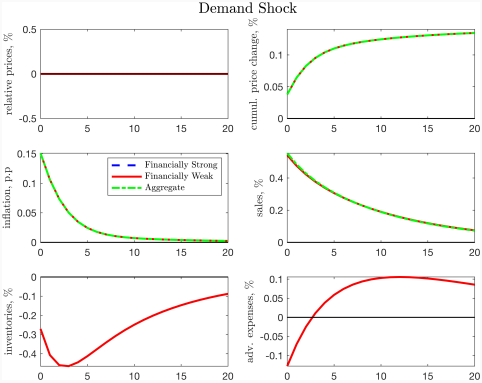
back

GSSZ responses to demand shock



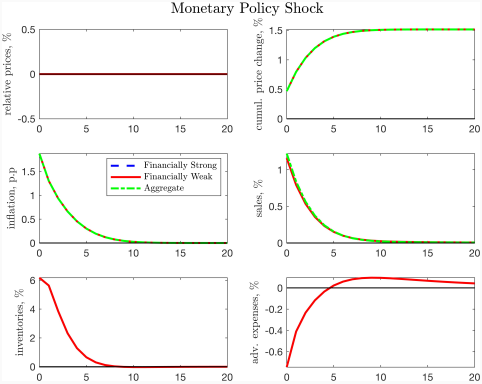
back

Low financial stress



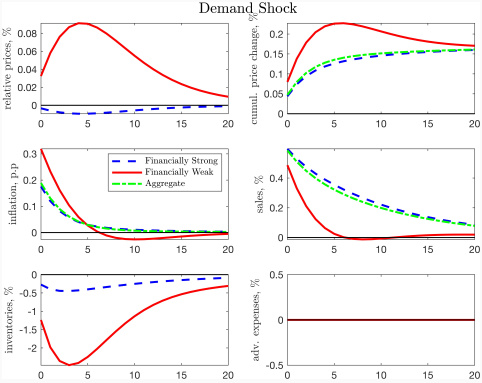
back

Low financial stress - monetary policy shock



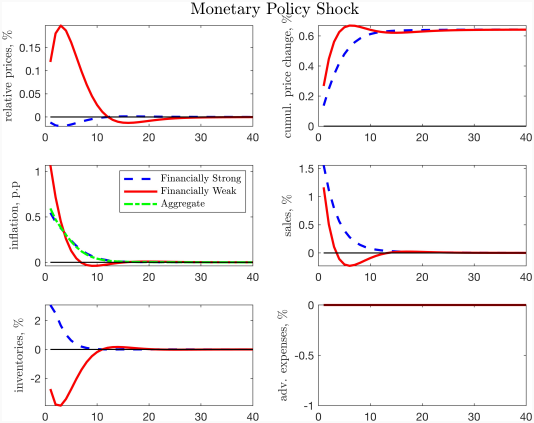
back

No advertising/marketing costs - exogenous habit



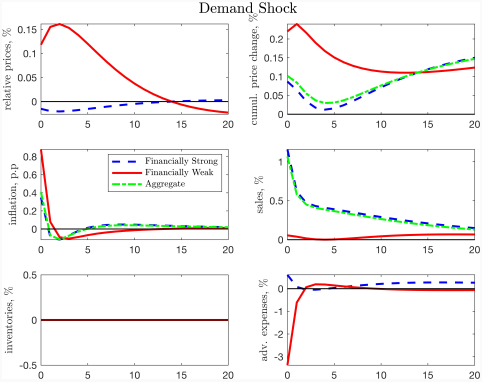
back

No advertising/marketing costs - monetary policy shock



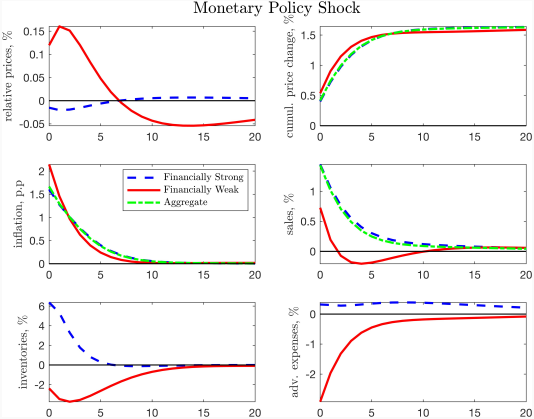
back

No inventories - demand shock



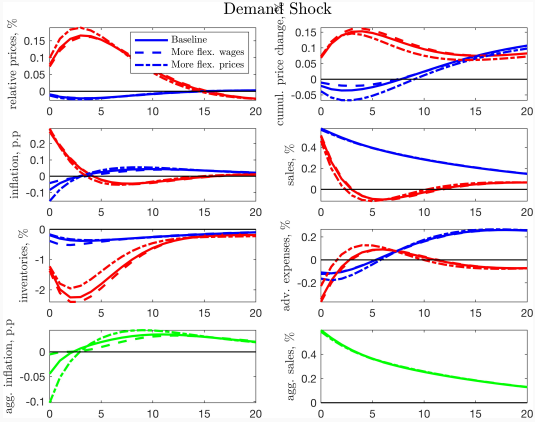
back

Impulse responses - monetary policy shock



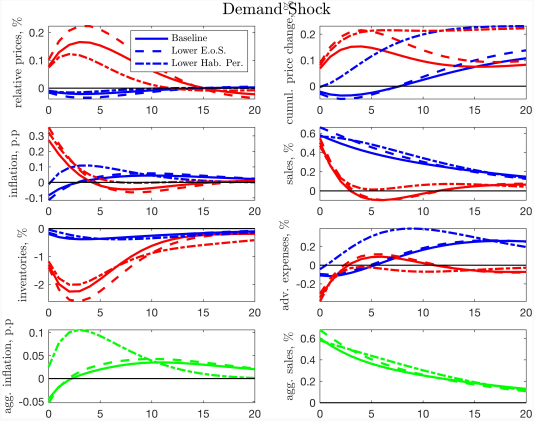
back

Flexible wages and prices



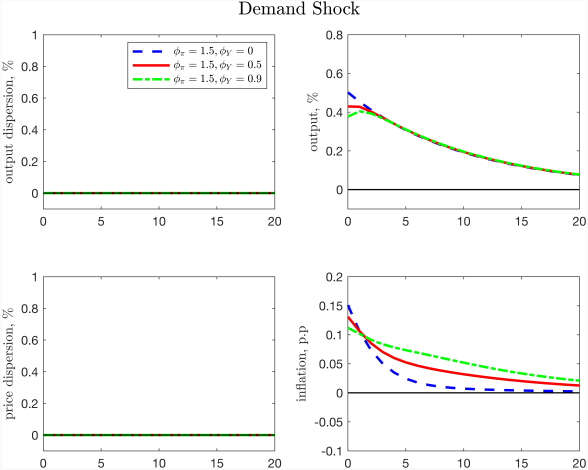
back

Lower elasticity of substitution and lower habit depreciation



back

What about normal times?



back

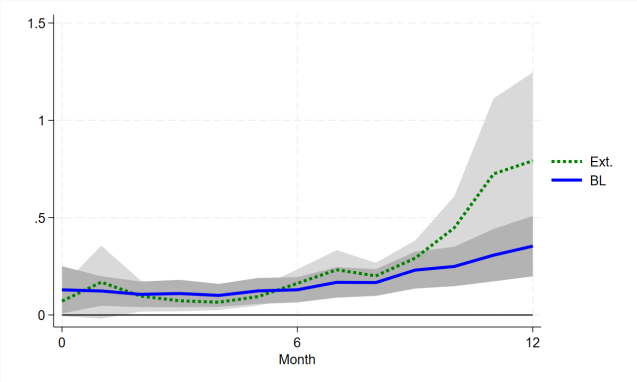
Strategic competition for customer loyalty

- Marketing
  - Empirical marketing literature on advertising highlights role of advertising in creating firm saliency, that is, the prominence of a brand or a shop in consumers' memories.
  - Psychologist B.J. Fogg's Behavior Model and Charles Duhigg's "Habit Loop" offer insight into how brands establish habitual use.
  - Firms with established brands enjoy persistent benefits over the longer term through brand loyalty, stemming from learning and taste formation (Bronnenberg et al. (2012); Bronnenberg et al. (2020); Haan and Moraga-González (EJ, 2011)) and habits and inertia in buying behavior (Keane (1997); Dubé et al. (2009); Dubé et al. (2010)).
- Macro models
  - Bhandari and McGrattan (2021) and Gourio and Redanko (2014) spending in advertisement as investment in customer capital.
  - Ravn et al. (2006) relative deep habits and incomplete pass through.

back

Including recent surge in inflation

- We stop in December 2021, because products weights not available for 2022.
- But price and sales data until Sep 2022: assume same product weights for 2022 as for 2021.

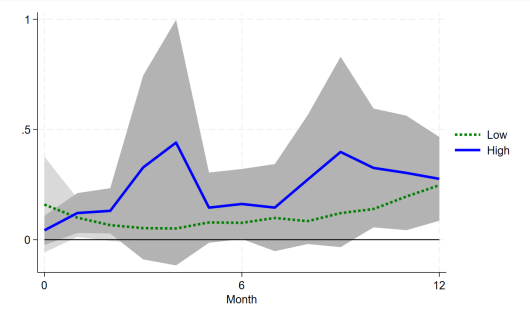


- Divergence around one-year horizon, when data from 2022 kick in.

back

Capacity utilization

Confirm findings of Boehm and Pandalai- Nayar(2022)



back