Monetary Policy, Firm Exit and Productivity

Benny Hartwig[1,2] Philipp Lieberknecht[3]

Goethe University Frankfurt[1], European Central Bank[2], Deutsche Bundesbank[3]

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Motivation

Firm dynamics shape business cycle fluctuations
(Ghironi and Melitz (2005) and Bilbiie et al. (2012))

- Firms' entry and exit decision depend on expected profitability
  $\Rightarrow$ crucial for monetary transmission mechanism

What do we know?

- Monetary policy and entry of homogeneous firms
  (Bergin and Corsetti, 2008; Lewis and Poilly, 2012; Bilbiie et al., 2014)
- But little discussion of exit and heterogeneity of firms

Research aim:

- Investigate importance of firm exit and heterogeneity in productivity for transmission of monetary policy

Contributions and Results

Empirical evidence

- Estimate effects of a monetary policy shock on firms' extensive margin and aggregate productivity measures using a macro-finance SVAR with high-frequency surprises in the spirit of Jarociński and Karadi (2020)
  - Firm exit decreases and overshoots in medium-run
  - Aggregate TFP increases, but TFPu and LP insignificant

Rationalize responses via NK-DSGE model

- Build a model with heterogeneous firms, endogenous entry and exit as well as account for nominal frictions

  $\Rightarrow$ aggregate demand stimulus lowers productivity threshold, low-productive firms survive and avg. productivity falls

▸ Related Literature

Empirical Analysis

Data for US, sample 1993Q2-2017Q4

- Entry and exit proxied by establishment series (BLS)
- After-tax real corporate profits (BEA)
- TFP, util. adj. TFP and labor productivity (Fernald, 2014)
- Updated intra-daily asset price changes around FOMC meetings from Gürkaynak et al. (2005)

Model and identification in spirit of Jarociński and Karadi (2020)

- VAR with FOMC announcement surprises
  - Surprises: FF4 and S&P500
  - Controls: 1y gvt, GDP, GDP Deflator, EBP, S&P500, Wages
  - Variables: Profits, Entry, Exit, TFP, TFPu, LP
- Monetary policy shock := negative co-movement of interest rate and stock price at high-frequency and low-frequency (otherwise monetary impulse less precise or implausible!)

▸ Data ▸ Empirical Model ▸ Identification ▸ Macro-Finance IRFs

Effects of Expansionary Monetary Policy (I)

Corporate profits

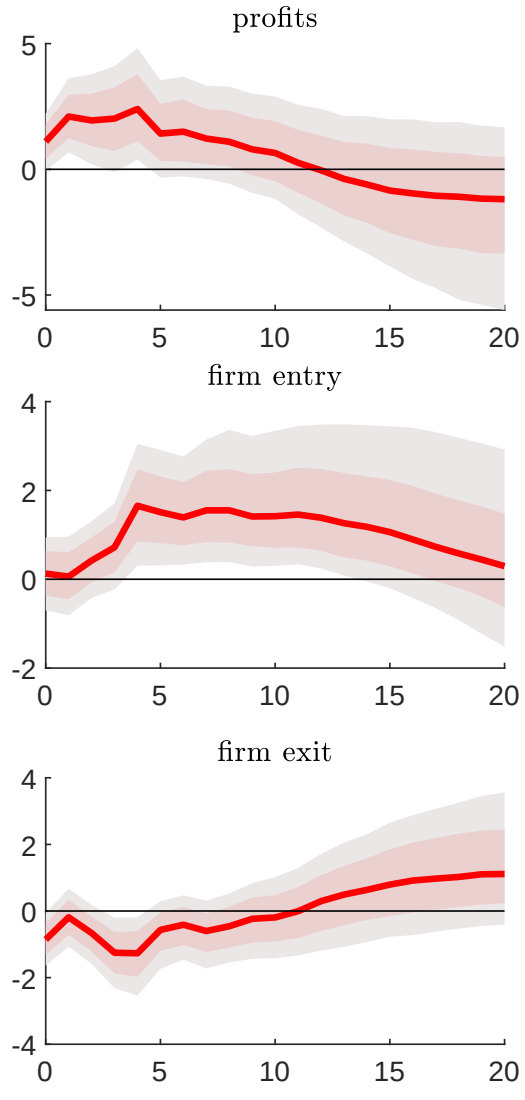
- increases after a monetary easing
- consistent with Lewis and Poilly (2012)

Firm entry

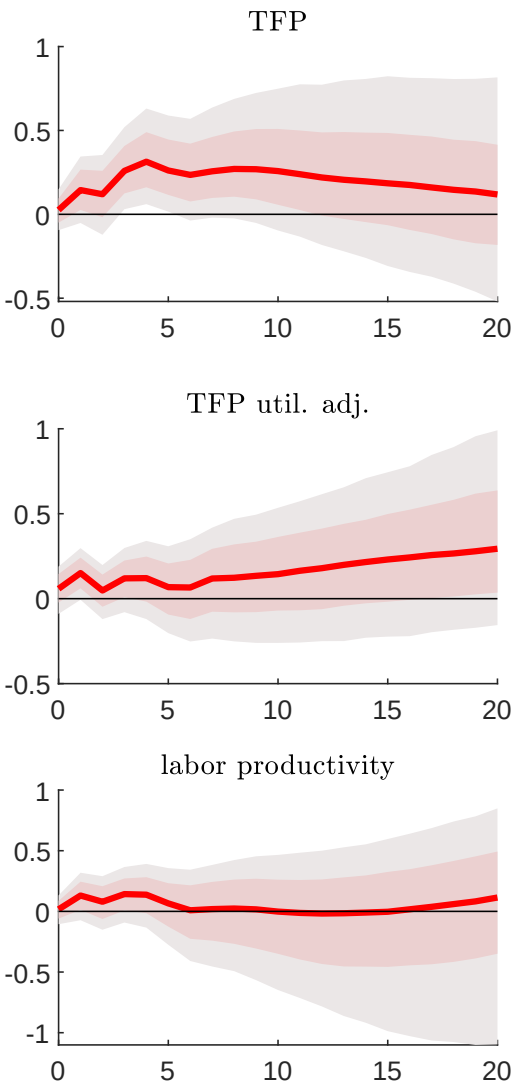
- increases persistently and last 3–4 years
- consistent with Lewis (2009); Lewis and Poilly (2012); Bergin and Corsetti (2008); Hamano and Zanetti (2021)

Firm exit

- declines but overshoots after 2 years
- firms remain active as profits increase, but exit as soon as stimulus fades
- technology shock similar in Rossi (2019)



Effects of Expansionary Monetary Policy (II)



Aggregate TFP

- persistent increase and lasts for 2 years
- resource utilization increases as number of active firms surge, while average firm productivity declines (model)

TFP util. adjusted and labor productivity

- insignificant, monetary neutrality
- util. adj. drives pro-cyclicality of TFP
- inconsistent with Moran and Queralto (2018); Christiano et al. (2005); Meier and Reinelt (2020); who document significant booms but use different identification strategies

Robustness

Empirical results for key variables of interest are robust to...

- ... different identification assumptions (sign restrictions on high-frequency variables only, poor man's proxy)
- ... VAR specifications (zero restrictions, local projections)
- ... surprises from scheduled FOMC announcements only
- ... sample splits (until 2008, exclude apex of GFC)
- ... alternative macro and policy variables (IP, CPI, FFR, ...)

▸ Robustness Checks

Theoretical Analysis

DSGE model with endogenous entry and exit

(Hopenhayn (1992) and Ghironi and Melitz (2005))

+ nominal price and wage rigidities (Rotemberg, 1982)

+ working capital channel (Ravenna and Walsh, 2006)

Heterogeneity in firm productivity:

- Firms enter if expected firm value exceeds entry costs
- Upon entry, firms draw idiosyncratic productivity z from Pareto distribution $G(z)$
- Firms exit if profits non-positive
- Only relatively more productive firms active

▸ More details about the model

Transmission of a Monetary Policy Shock

Real average profits

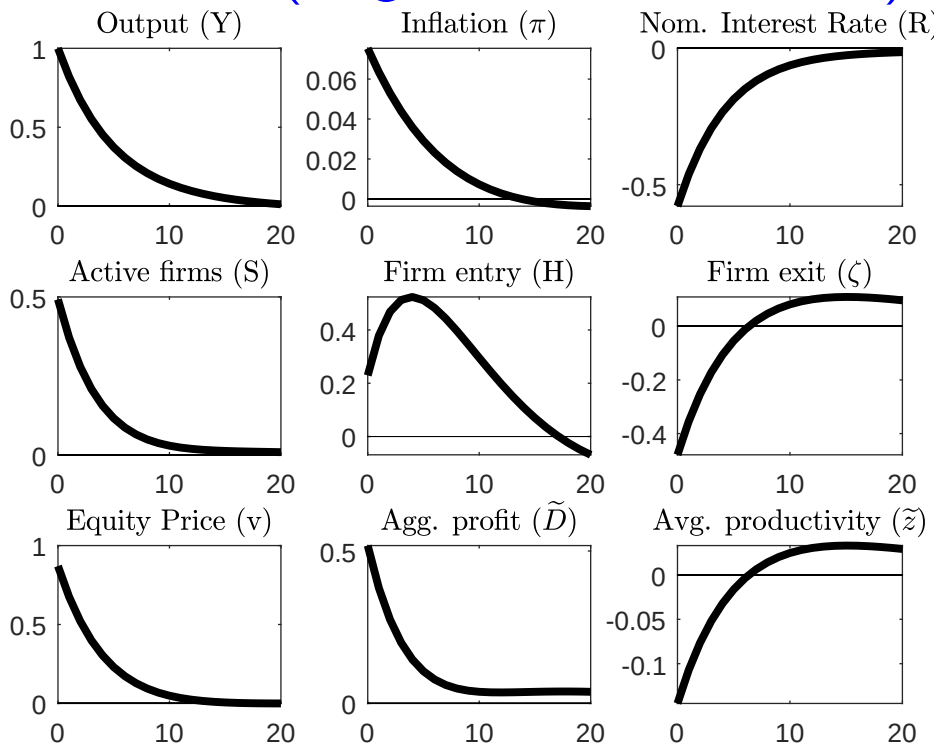
$$\widetilde{d}_t = \underbrace{\frac{Y_t^C}{S_t}}_{\text{(1) revenues}} - \underbrace{\frac{\tau}{2}\left(\frac{\widetilde{p}_t}{\widetilde{p}_{t-1}} - 1\right)^2 \frac{Y_t^C}{S_t}}_{\text{(2) price adjustment cost}} - \underbrace{w_t \widetilde{l}_t^C}_{\text{(3) labor cost}} - \underbrace{f \frac{w_t R_t^{\vartheta}}{A_t}}_{\text{(4) fixed cost}}$$

Revenues dominate cost channels: (wage-stickiness crucial!)

- profits increase
- more firms enter
- less exit, more unproductive firms
- productivity down

  $\Rightarrow$ overshooting!

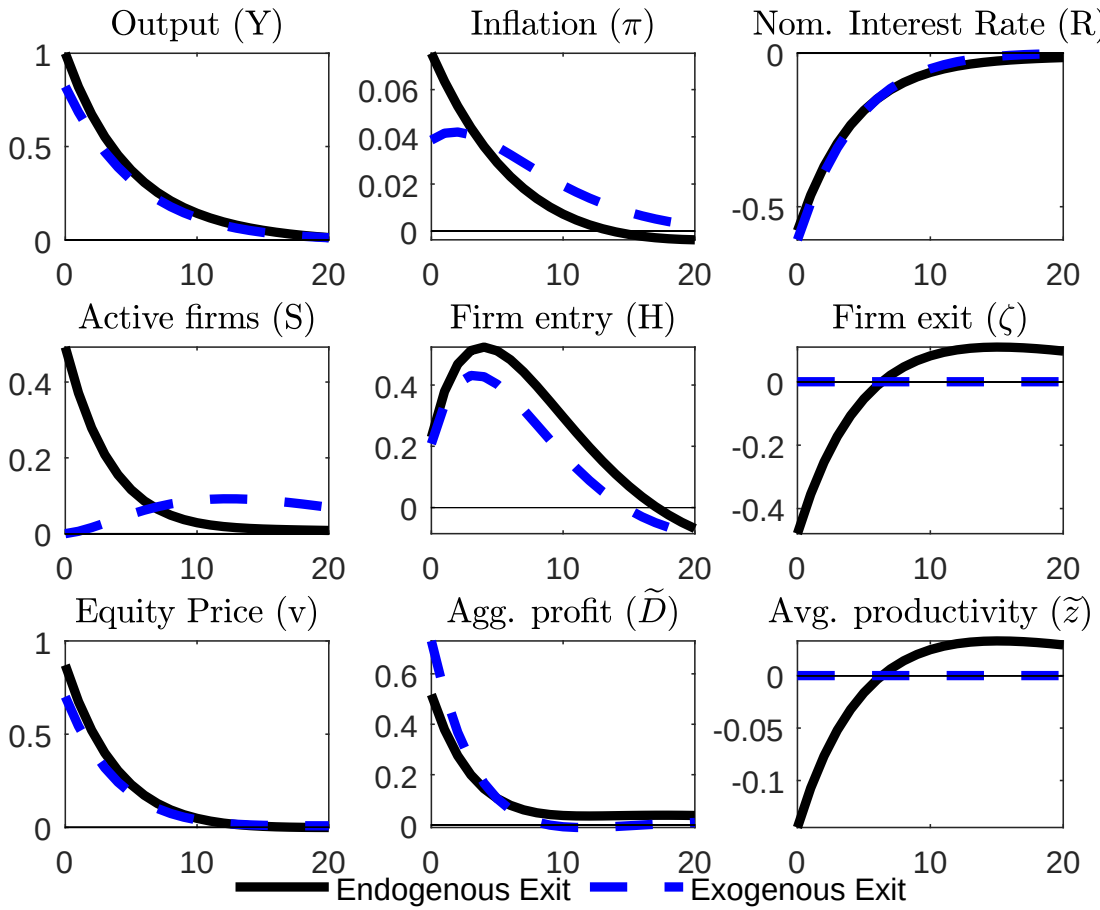
SVAR: muted TFPu!
$\Rightarrow$ offsetting channels?



Exit Channel = Flatter Aggregate Supply Curve

New Keynesian Phillips curve and firm dynamics:

$$\widehat{\pi}_t = \frac{\theta - 1}{\tau}(\widehat{w}_t - \widehat{A}_t - \widehat{\widetilde{z}}_t) - \frac{1}{\tau}\widehat{S}_t + \beta(1-\delta)E_t[\widehat{\pi}_{t+1}]$$



Conclusion

- Structural VAR evidence

  $\Rightarrow$ Expansionary monetary policy stimulates corporate profits, raises entry, decreases exit, but exit overshoots in medium-run

  $\Rightarrow$ Aggregate TFP increases, but TFPu and LP insignificant (other counteracting channels?)

- DSGE predictions

  $\Rightarrow$ Firm dynamics at extensive margin driven by change in firm-level productivity

  $\Rightarrow$ Exit channel of monetary policy implies altered macroeconomic transmission and survival of unproductive firms following stimulus

Some Speculation About Policy Implications

- Expansionary monetary policy implies survival of unproductive firms = *sclerosis* (Caballero and Hammour, 2005) or *zombification*
- Easier monetary conditions during demand-driven recessions hamper *cleansing effect* (Caballero and Hammour, 1994) of less productive firms
- Exit channel = side effect of expansionary monetary policy, implications for optimal policy design?
- Relationship between monetary conditions, firm exit, productivity and growth/inflation in the long-run?

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Appendix

Related Literature (I)

1. Firm dynamics over the business cycle with endogenous exit
   (Hopenhayn, 1992; Melitz, 2003; Ghironi and Melitz, 2005)
   - Endogenous entry but exogenous exit
     - business cycle fluctuations
       (Jaimovich and Floetotto, 2008; Bilbiie et al., 2012)
     - transmission of monetary policy
       (Lewis, 2009; Lewis and Poilly, 2012)
     - optimal monetary policy (Bergin and Corsetti, 2008; Lewis, 2013; Bilbiie et al., 2014; Cacciatore et al., 2016)
   - Aggregate TFP shocks with endogenous entry and exit
     (Clementi and Palazzo, 2016; Hamano and Zanetti, 2017, 2018; Rossi, 2019)

This paper:

- Study transmission of monetary policy with endogenous entry and exit and the role of productivity

◂ Contributions and Results

Related Literature (II)

2. Zombification
   - Zombie lending & lost decade in Japan (Hoshi and Kashyap, 2004; Peek and Rosengren, 2005)
   - Misallocation (Caballero et al., 2008; Kwon et al., 2015)
   - Zombie lending in the euro area (Adalet McGowan et al., 2018; Andrews and Petroulakis, 2019; Schivardi et al., 2017; Storz et al., 2017)
   - Monetary policy (Acharya et al., 2019; Antoni et al., 2019; Bittner et al., 2021; Banerjee and Hofmann, 2018; Acharya et al., 2020)

This paper:

- Macro perspective on firms' extensive margin
- Zombification does not require credit misallocation

◂ Contributions and Results

Related literature (III)

3. Monetary policy and aggregate productivity
   - Evans (1992) documents aggregate productivity increases after expansionary MP shocks
   - Explanations:
     - Capital utilization (Christiano et al., 2005)
     - R&D (Moran and Queralto, 2018; Garga and Singh, 2021)
     - Heterogeneous price pass-through (Meier and Reinelt, 2020)

This paper:

- No significant empirical effect on utilization-adjusted TFP
- Theoretical model suggests decline of average firm productivity $\Rightarrow$ counteracting other channels?

◂ Contributions and Results

Data and Sample

Macro-finance block

(Gertler and Karadi, 2015; Jarociński and Karadi, 2020; Caldara and Herbst, 2019)

- real activity: **real GDP** and industrial production
- price level: **GDP deflator**, CPI, CPI core
- financial frictions: **EBP** and BAA spread
- equity: **S&P500 index**
- wages: **wages and salaries per employment**
- monetary policy: **1y gvt**, 2y gvt, FFED w/o shadow short rate of Wu and Xia (2016)

Sample

- 1993:Q2 to 2017:Q4 due to data availability (surprises)
- sample splits: 1993:Q2 - 2008:Q2 and 1993:Q2 - 2017:Q4 ex 2008:Q3 - 2009:Q2 as in Nakamura and Steinsson (2018)

◂ Empirical Analysis

VAR with FOMC Announcement Surprises

We estimate the VAR of Jarociński and Karadi (2020)

$$\begin{pmatrix} m_t \\ y_t \end{pmatrix} = \begin{pmatrix} 0 \\ c_Y \end{pmatrix} + \sum_{p=1}^{4} \begin{pmatrix} 0 & 0 \\ A_{p,YM} & A_{p,YY} \end{pmatrix} \begin{pmatrix} m_{t-p} \\ y_{t-p} \end{pmatrix} + \begin{pmatrix} u_t^m \\ u_t^y \end{pmatrix},$$

where

$$\begin{pmatrix} u_t^m \\ u_t^y \end{pmatrix} \sim \mathcal{N}(0, \Sigma).$$

Estimation details

- flat prior (comparability with local projections, estimates similar under mildly tight Minnesota prior)
- add firm entry and exit, as well as, productivity measure on a one-by-one basis (estimates are similar when estimated at once and under mildly tight Minnesota prior)

◂ Empirical Analysis

Identification with sign restrictions

Variable	Shock		
	MP (neg. co-mov.)	CBI (pos. co-mov.)	Other
m_t, high frequency			
Interest rate	+	+	0
Stock price index	−	+	0
y_t, low frequency			
Interest rate	+	+	0
Stock price index	−	+	0
Other	•	•	•

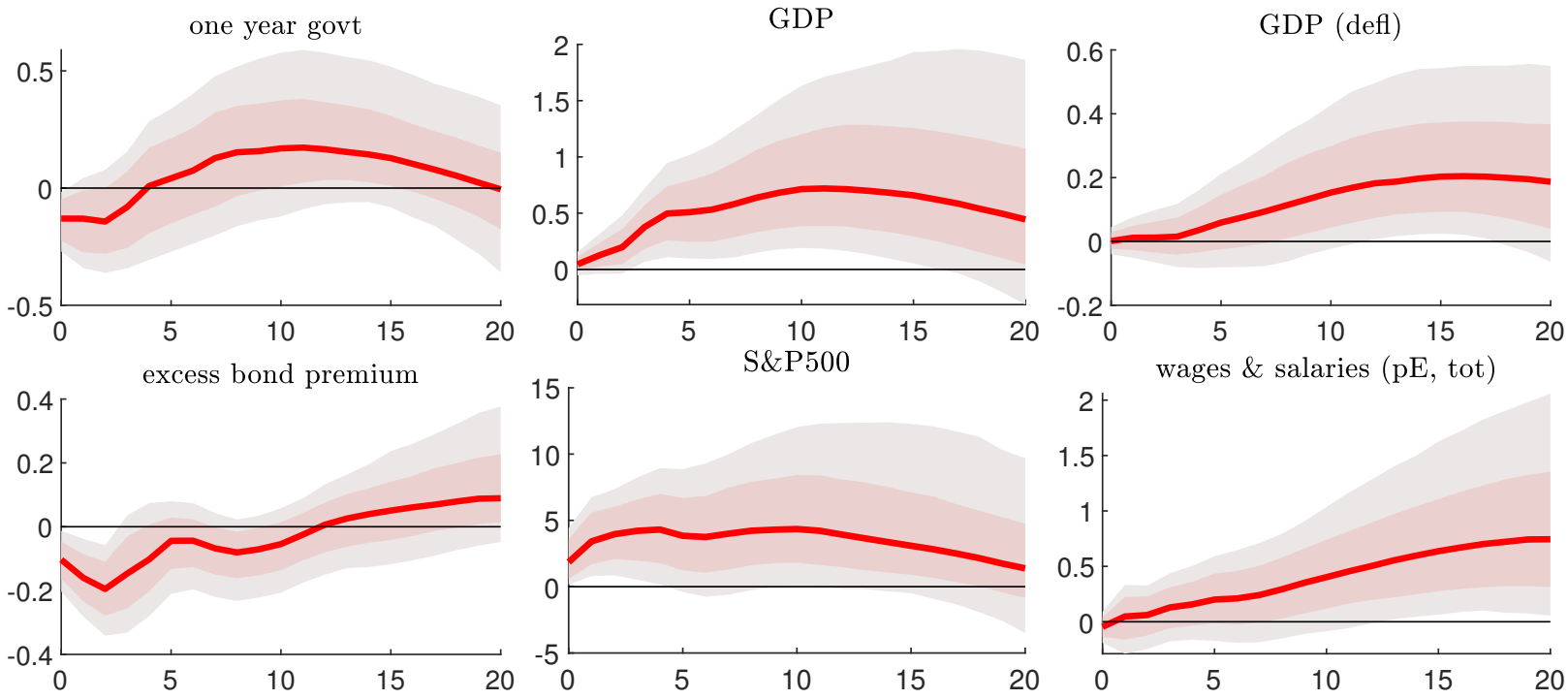
- We follow Jarociński and Karadi (2020) and impose sign restriction on high-frequency variables (JK)

  + sign restriction on low-frequency variables (HL)

◂ Empirical Analysis

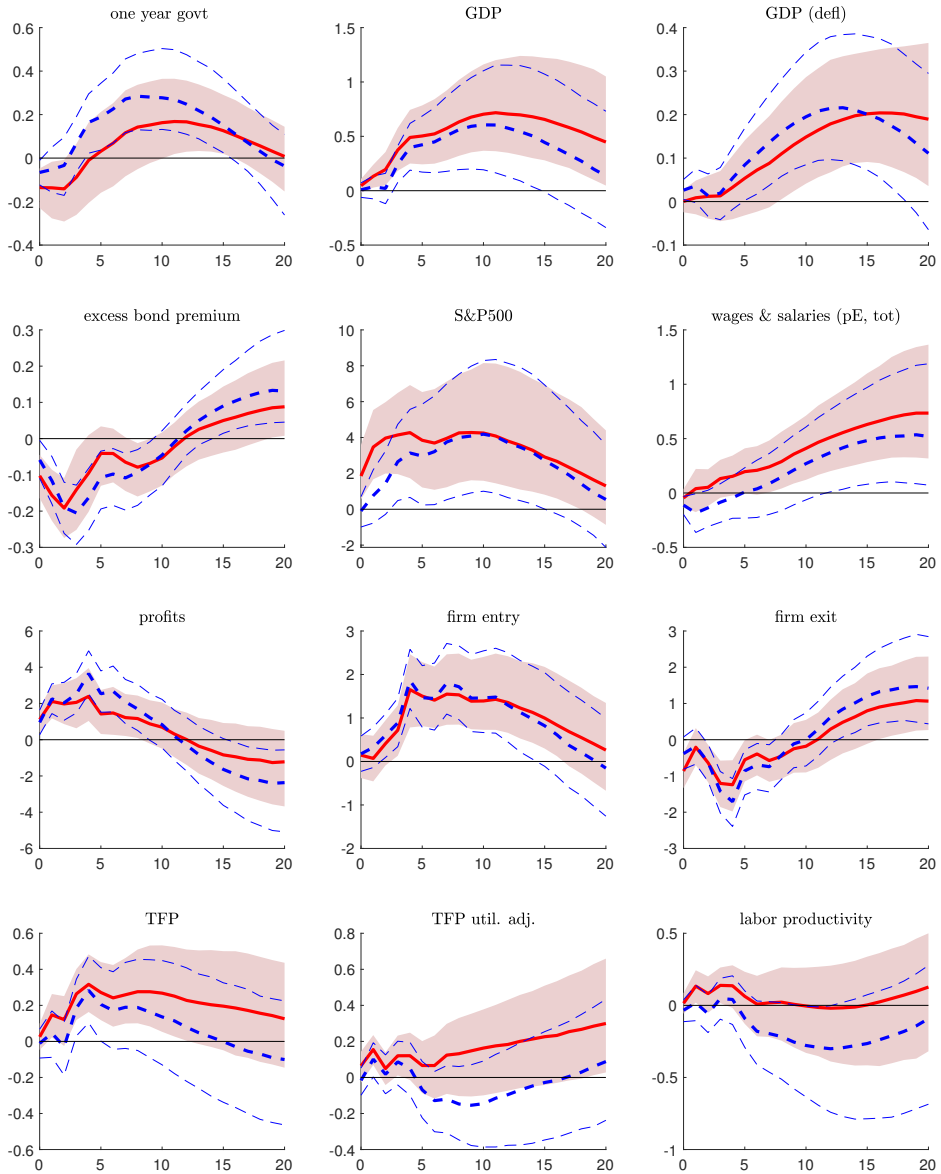
IRFs for Macro-Finance Variables

IRFs of key variables are exhibit plausible dynamics and are similar to those reported in the literature, see Gertler and Karadi (2015); Miranda-Agrippino and Ricco (2020); Caldara and Herbst (2019) and Jarociński and Karadi (2020)

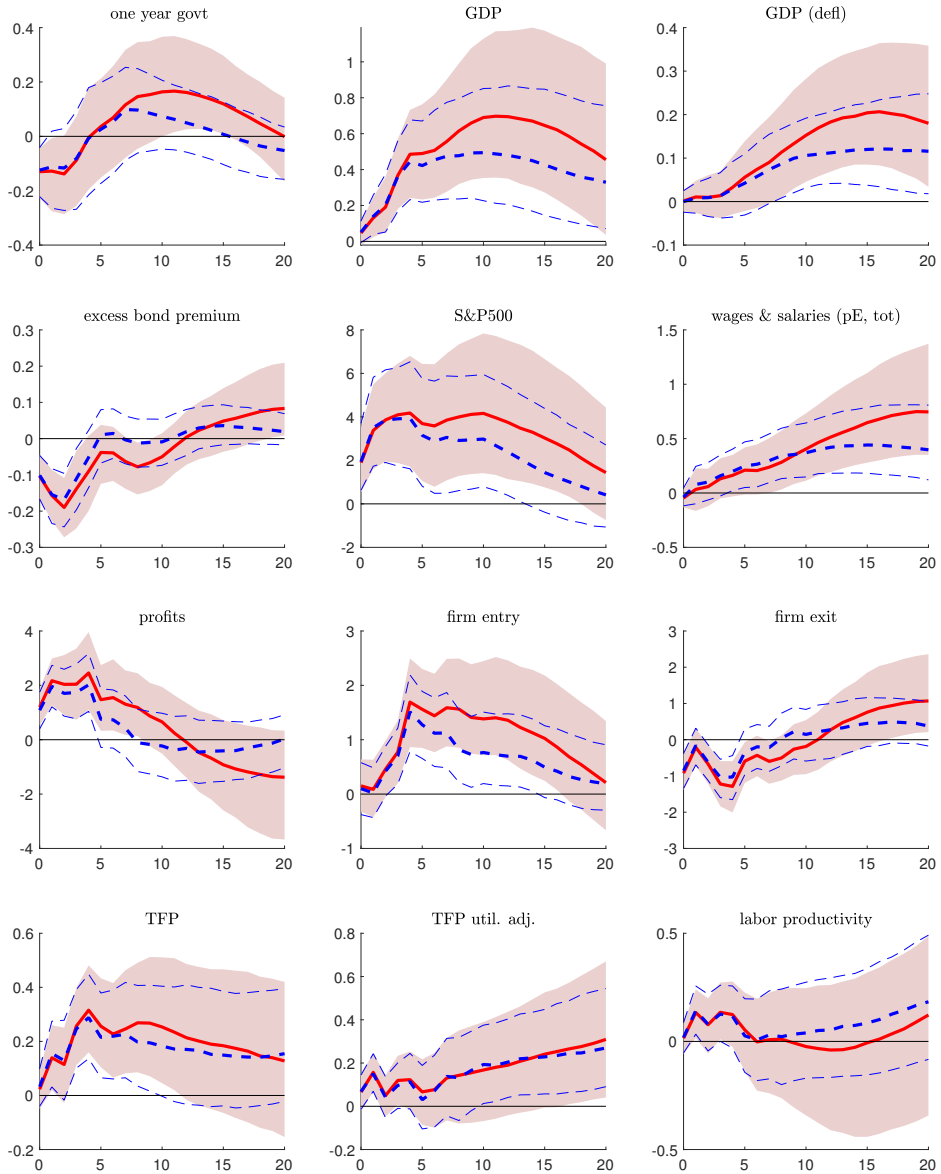


◂ Empirical Analysis

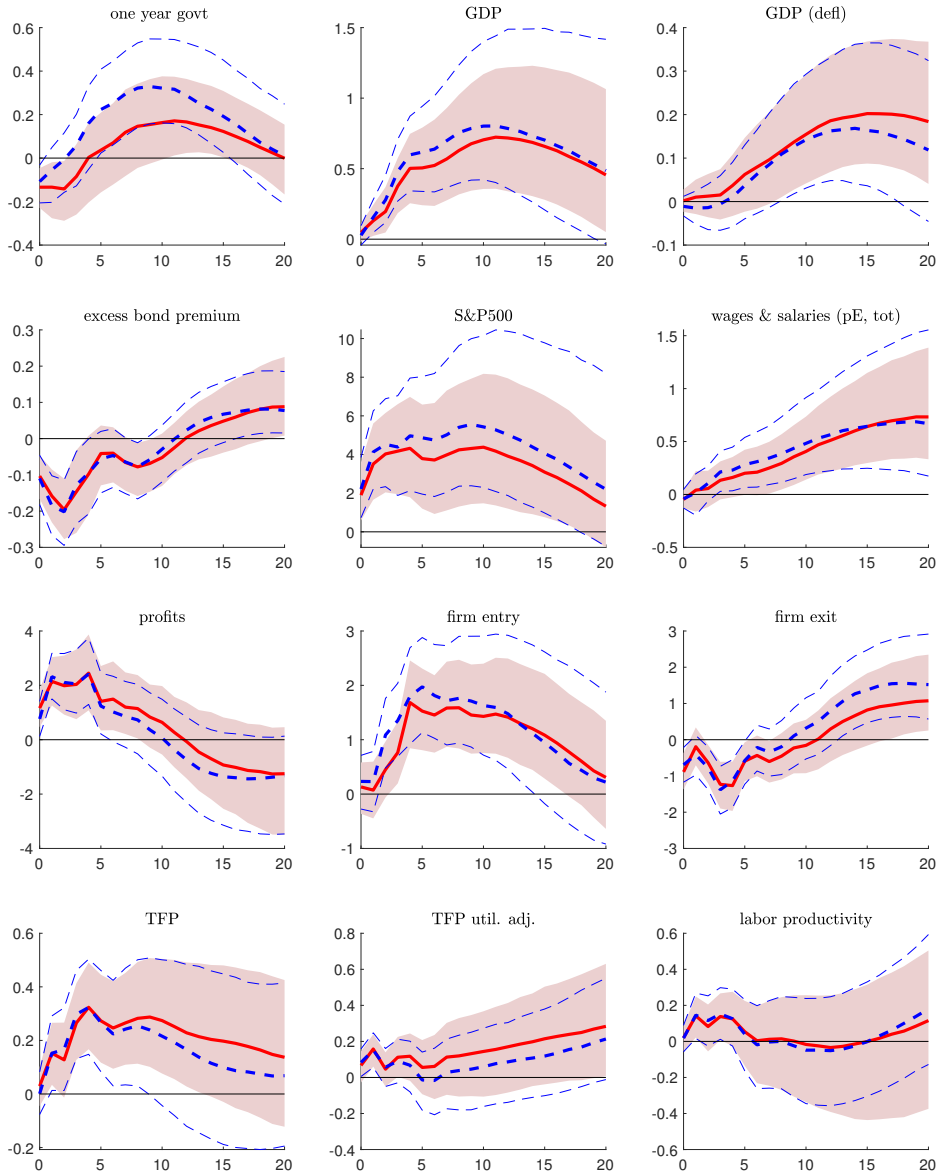
VAR with alternative sign restrictions



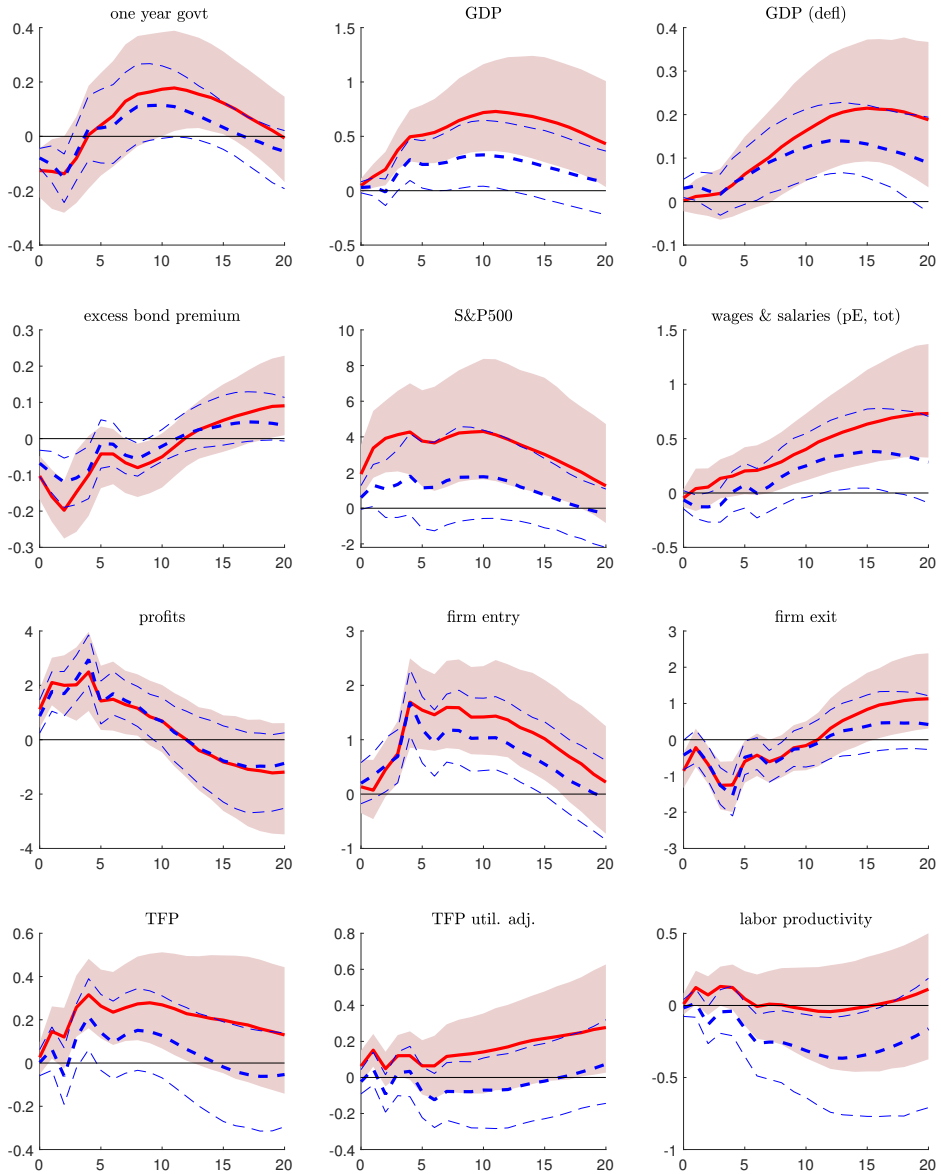
Unrestricted VAR



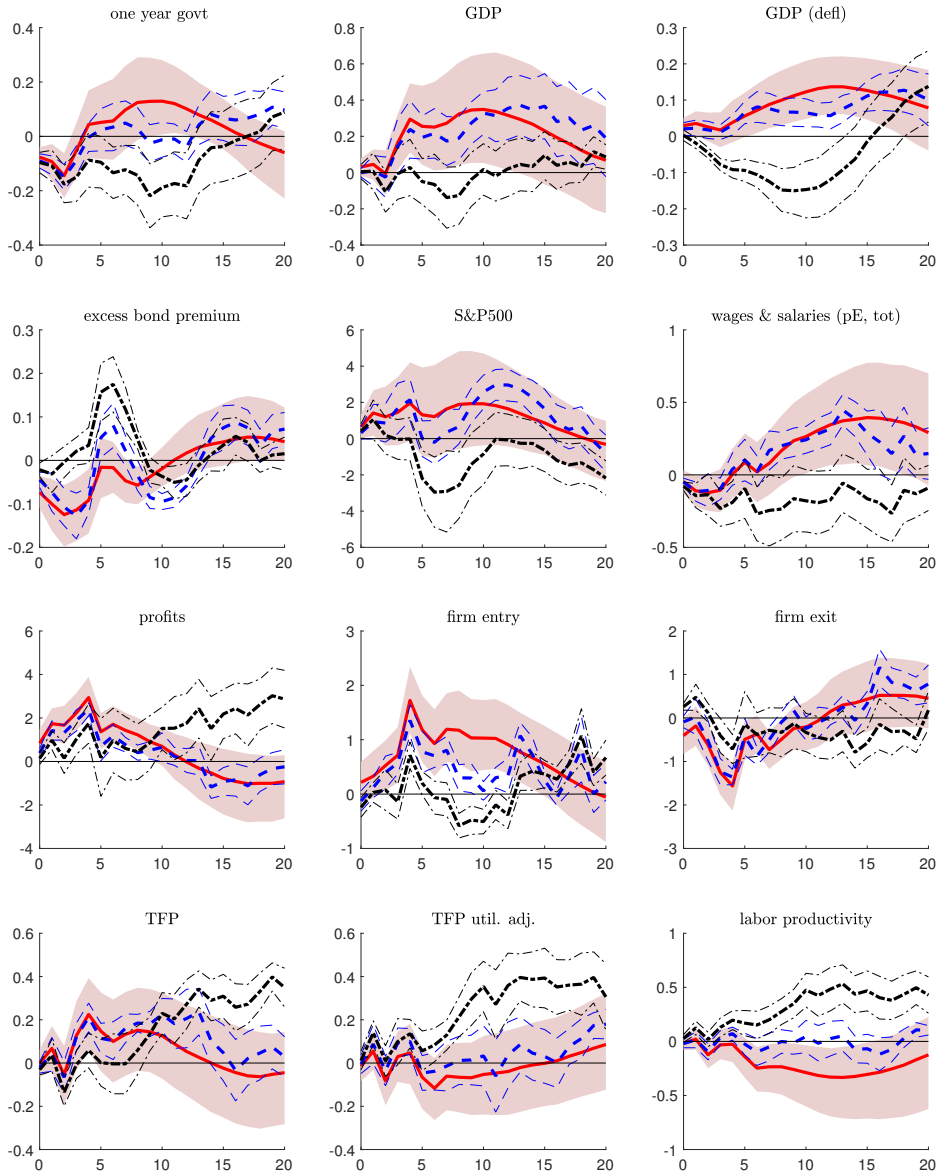
Surprises only from scheduled FOMC meetings



VAR with poor man's proxy



Poor man's proxy: VAR and local projections



Firms: Production

- Continuum of firms with idiosyncratic productivity z
- Linear production function in labor:

$$y_t^C(z) = A_t \, z \, l_t^C(z)$$

- Fixed operational costs f each period, covered by loans
- Rotemberg (1982) price adjustment costs
- Idiosyncratic productivity (Melitz, 2003; Ghironi and Melitz, 2005)

$$G(z) = 1 - \left(\frac{z_m}{z}\right)^{\kappa}$$

◂ DSGE Model

Firms: Entry

- Unbounded mass of prospective entrants
- Upon entry, firms draw idiosyncratic productivity z from Pareto distribution $G(z)$
- Some firm entries unsuccessful (Lewis and Poilly, 2012)
- Entry if expected firm value (v_t) exceeds entry costs (f_E)
- Free entry condition:

$$f_E \frac{w_t}{A_t} = v_t(\Psi_t + \Psi'_t H_t) + \beta E_t \left[\left(\frac{C_{t+1}}{C_t} \right)^{-1} v_{t+1} \Psi''_{t+1} H_{t+1} \right]$$

◂ DSGE Model

Firms: Exit

- Firm remains in market if profits $d_t(z) > 0$, exits otherwise
- Cut-off level of productivity $\bar{z}_t$ (zero profit condition):

$$\bar{d}_t \equiv d_t(\bar{z}_t) = 0$$

- Exit decision depends on firms' idiosyncratic productivity: Firms with $z > \bar{z}_t$ remain, firms with $z \leq \bar{z}_t$ exit
- Subset of firms $\Omega_t \in \Omega$ actively producing in any given period

◂ DSGE Model

Households

- Decide on intertemporal consumption allocation $\Rightarrow$ standard Euler equation
- Can invest in equity shares in a mutual funds of firms
- Optimality condition for share holdings:

$$v_t = E_t \left[\Lambda_{t+1} \left(v_{t+1} + \frac{S_t}{N_t} \widetilde{d}_{t+1} \right) \right]$$

- Supply labor, price-setters due to wage stickiness

◂ DSGE Model

Aggregation

- Average productivity across active firms:

$$\widetilde{z}_t \equiv \left[\frac{1}{1-G(\bar{z}_t)}\int_{\bar{z}_t}^{\infty} z^{\theta-1}dG(z)\right]^{\frac{1}{\theta-1}} = \bar{z}_t\left[\frac{\kappa}{\kappa-(\theta-1)}\right]^{\frac{1}{\theta-1}}$$

- Endogenous exit probability:

$$\zeta_t \equiv 1-G(\bar{z}_t) = 1-\left(\frac{z_m}{\bar{z}_t}\right)^{\kappa}$$

- Average markup (non-linear Phillips curve)

$$\widetilde{\mu}_t = \frac{\theta}{(\theta-1)\left(1-\frac{\tau}{2}(\pi_t-1)^2\right)+\tau\left(\pi_t(\pi_t-1)-E_t\left[\Lambda_{t+1}\frac{Y^C_{t+1}}{Y^C_t}\frac{S_t}{S_{t+1}}(\pi_{t+1}-1)\pi_{t+1}\right]\right)}$$

◂ DSGE Model

Monetary Policy

- Interest rate rule:

$$
\begin{aligned}
log\left(\frac{R_t}{R}\right) =& \phi_R \, log\left(\frac{R_{t-1}}{R}\right) \\
&+(1-\phi_R)\left[\phi_\pi \, log\left(\frac{\pi_t}{\pi}\right) + \phi_y \, log\left(\frac{Y_t}{Y_{t-1}}\right)\right] \\
&+\varepsilon_t^M
\end{aligned}
$$

◂ DSGE Model