Fiscal backing, inflation and US business cycles

Frank Smets and Raf Wouters

European Central Bank/Ghent University and National Bank of Belgium

55th Annual conference of the MMF Society

4-6 September 2024

University of Manchester

The views expressed are those of the presenter and do not necessarily reflect those of the ECB or the NBB.

Outline

- Motivation and objectives
- Methodology
- Estimation results
- The post-pandemic inflation
- Conclusions and follow-up

Motivation (1)

- The fiscal-monetary policy mix is crucial for the determination of inflation
- Inflation targeting regimes are typically described as monetary-led regimes where monetary policy achieves the inflation target by actively setting policy-controlled interest rates and fiscal policy is largely passive focusing on debt sustainability.
- During the low-inflation/ELB period, there were calls for fiscal policy to play a more active role in bringing inflation up to target:
  - Lower efficacy of monetary policy, but higher fiscal multipliers
  - Favourable (r – g) creates more fiscal space
- Since then, high inflation has challenged this fiscal/monetary policy mix:
  - Debate about the role of expansive fiscal policy
  - Calls for a return to a monetary-led policy mix.

Motivation (2)

In RANK models, monetary and fiscal-led regimes (Leeper, 1991) are **extreme regimes**:

- Monetary-led regime (Taylor principle + debt feedback)

  ➡ Monetary policy controls inflation
  Fiscal policy (lump sum transfers) does not matter for economy

- Fiscal-led regime (No Taylor principle, nor debt feedback)

  ➡ Monetary policy is counterproductive (Sims (2011): “stepping on a rake”)
  Fiscal policy controls inflation

A realistic model of monetary and fiscal policy interaction should allow for **intermediate regimes** with partial fiscal backing (Cochrane (2022), Bianchi, Faccini and Melosi (2023)):

- Fiscal policy generally commits to serve current debt by running future surpluses, but may not take the full burden of adjustment
- Monetary policy is geared towards stabilizing inflation, but it may have to face the inflationary consequences of partially unfunded government debt.

Objectives of this paper

- Develop a model which allows for **intermediate** monetary/fiscal policy regimes with **partial fiscal backing**
  - The degree of fiscal backing is captured by a regime parameter, λ.
  - Assume λ is constant over time and across shocks, but in principle can be time and shock-dependent.
  - Move away from extreme regime switching assumption in Bianchi-Ilut (2017) and Bianchi-Melosi (2020).
- Estimate the Smets-Wouters (2007) model with partial fiscal backing for the US economy.
  - What is the average degree of fiscal backing?
  - Are the most important drivers of inflation monetary or fiscal?
  - How does it affect the propagation of various business cycle shocks?
- Interpret the post-pandemic inflation period through the lens of the SW model with partial fiscal backing

Related literature

Theory

- The fiscal theory of the price level:
  - Leeper (1992), Sims (1994), Woodford (2001), Cochrane (2001), ...
  - Discussed and summarized in Cochrane (2023).
- Implications of unfunded fiscal policy for monetary policy
  - Benigno and Woodford (2006), Harrison (2022), Kumhof et al (2010)
- The methodology of our paper builds on Bianchi, Faccini and Melosi (2023)

Empirical literature

- Monetary/fiscal policy regime-switching models:
  - Bianchi and Ilut (2017), Bianchi and Melosi (2022), Hinterlang and Hollmayr (2022), …
- Fiscal origins of high inflation:
  - Banerjee et al (2022), Barro and Bianchi (2024), Brandao-Marquez et al (2023), …
- Role of monetary policy reaction functions for fiscal multipliers:
  - Christiano et al (2017), Woodford (2019), Leeper et al (2017), Ramey and Zubairy (2018), Hack et al (2023), …
- Role of fiscal policy reaction functions for monetary policy transmission
  - Caramp and Feilich (2022), Kloosterman, Bonam and Vanderveer (2022), Afonso, Alves and Ionta (2023)

Outline

- Motivation and objectives
- Methodology
- Estimation results
- The post-pandemic inflation
- Conclusions and follow-up

Illustration using a simple Fisherian model (Leeper, 1991)

- An endowment economy with flexible prices and one-period nominal government debt:

  $R_t = E_t\pi_{t+1}$ (Fisher relation)

  $b_t = \beta^{-1}b_{t-1} + b(R_t - \beta^{-1}\pi_t) - \tau_t$ (Government budget constraint)

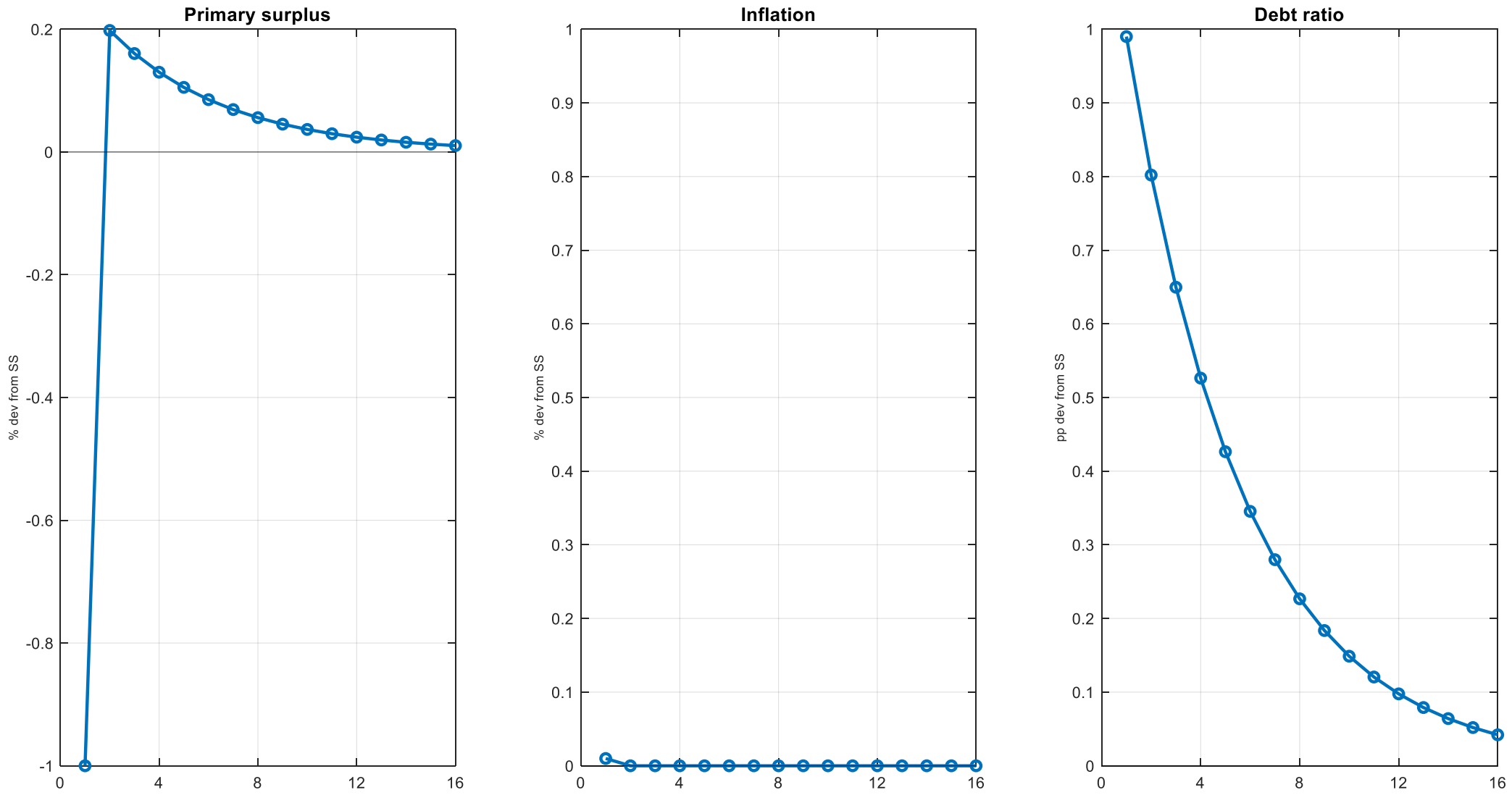
  $R_t = \psi\pi_t$ (Monetary policy reaction function)

  $\tau_t = \delta_b b_{t-1} - \varepsilon_t^{\tau}$ (Fiscal policy reaction function)

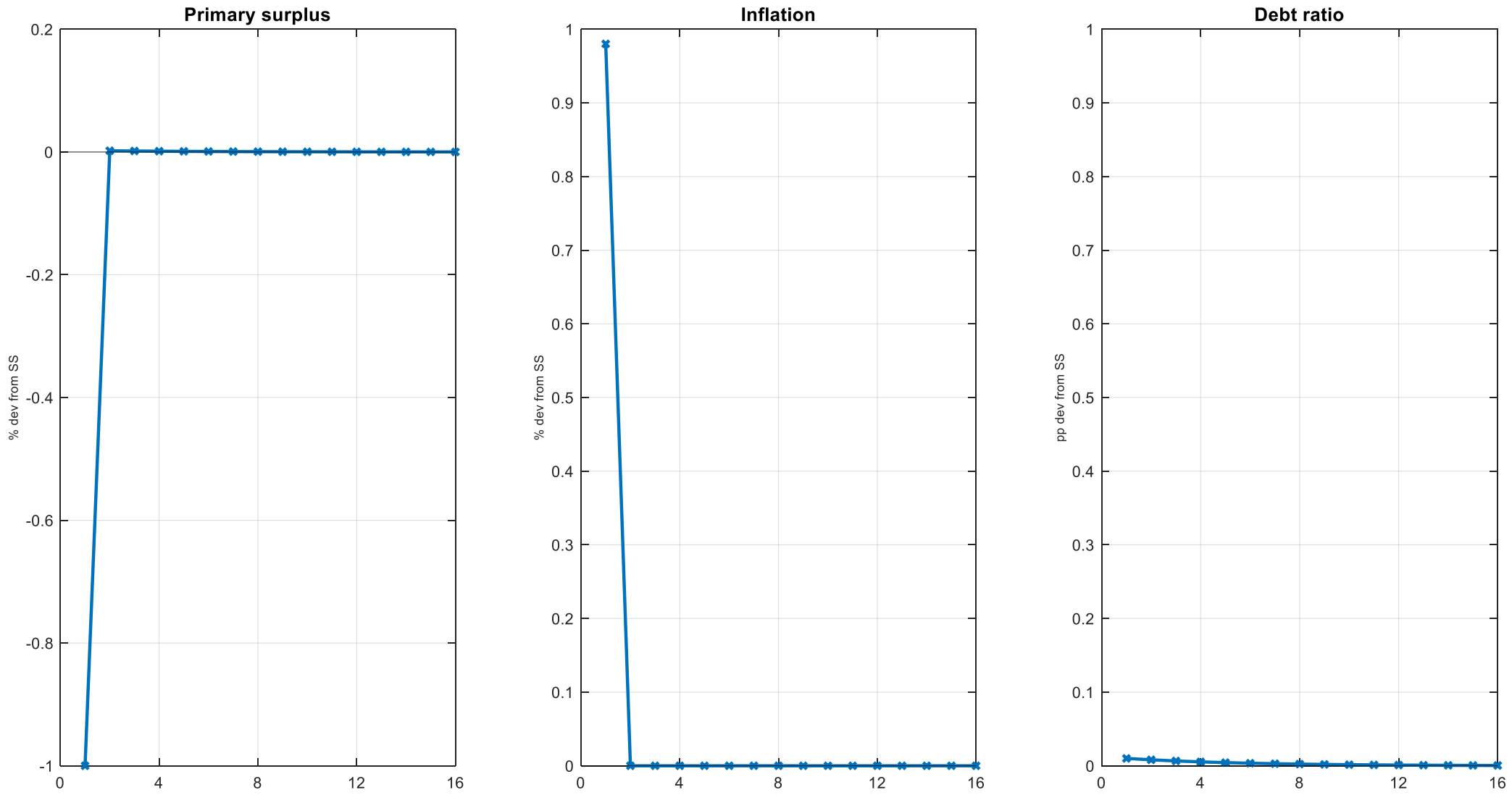
- Combining equations:

  $E_t\pi_{t+1} = \psi\pi_t$

  $b_t = (\beta^{-1} - \delta_b)b_{t-1} - b(\beta^{-1} - \psi)\pi_t + \varepsilon_t^{\tau}$



Monetary-led regime: $\psi > 1$ and $\delta_b > \beta^{-1} - 1$ (AM/PF)



Fiscal-led regime: $\psi < 1$ and $\delta_b < \beta^{-1} - 1$ (PM/AF)

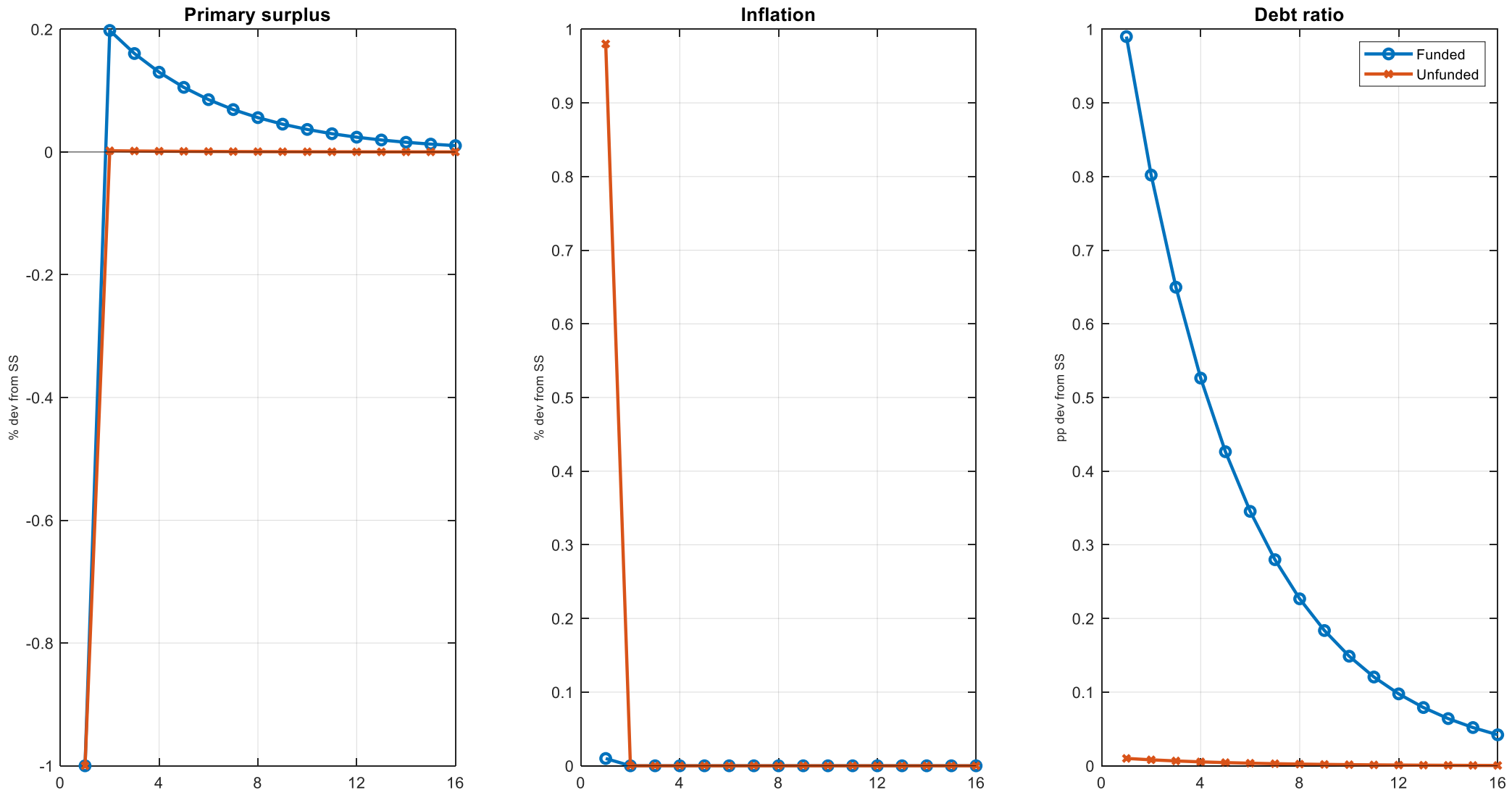
Bianchi, Faccini and Melosi (2023): Mixed regime

- A model with both funded and unfunded shocks can be developed by modifying the policy reaction functions as follows:

$$\tau_t = \delta_b(b_{t-1} - b_{t-1}^F) - \varepsilon_t^{\tau M} - \varepsilon_t^{\tau F}$$

$$R_t = \psi(\pi_t - \pi_t^F)$$

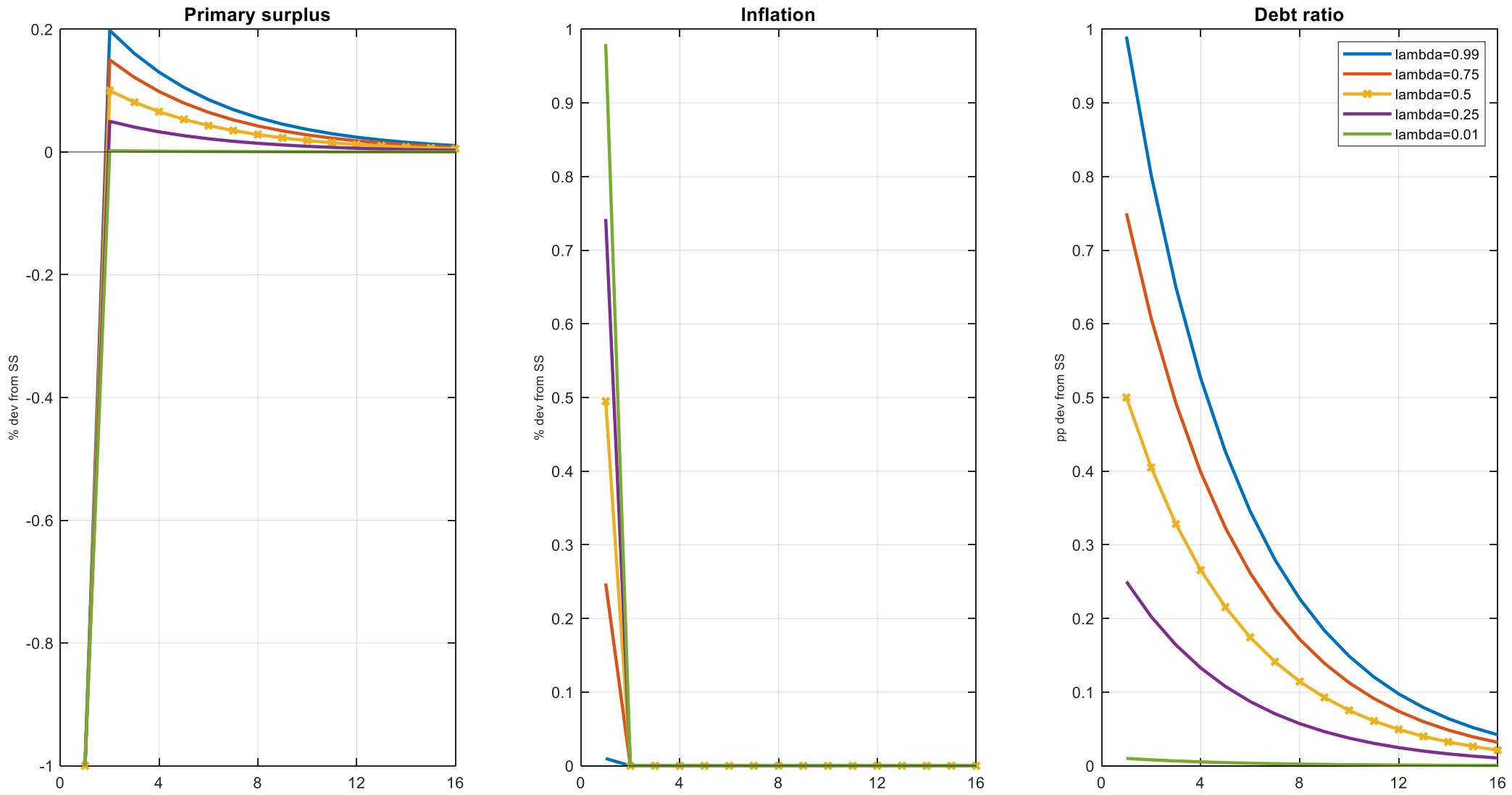
- The subscripts M and F refer to the funded and unfunded nature of the fiscal shocks, b_t^F is unfunded debt and π_t^F is fiscal inflation or a time-varying inflation target necessary to stabilize unfunded debt.
- Unfunded debt and fiscal inflation are determined in a fiscal-led shadow economy only featuring the unfunded fiscal shocks



Mixed regime with funded and unfunded shocks (BFM, 2023)

This paper: Intermediate regime of partial fiscal funding

- In the **mixed** regime of BFM (2023) uncorrelated fiscal shocks are either completely funded ($\varepsilon_t^{\tau M}$) or completely unfunded ($\varepsilon_t^{\tau F}$).
- In this paper we analyze an **intermediate** regime in which fiscal shocks can be partially funded.
- Using the BFM (2023) methodology, this can easily be implemented by defining $\varepsilon_t^{\tau M} = \lambda \varepsilon_t^{\tau}$ and $\varepsilon_t^{\tau F} = (1 - \lambda)\varepsilon_t^{\tau}$.
- The parameter λ captures the degree to which the shock is funded.



Intermediate regime with partial fiscal funding given by λ

Partial fiscal backing and other business cycle shocks

- A second difference with BFM (2023) follows from the realization that all macro-economic shocks have fiscal implications.
- In the monetary-led regime, these fiscal implications are irrelevant because of lump sum taxes and Ricardian equivalence.
- In a model with partial fiscal backing, the fiscal implications matter for the transmission of the various shocks to economic activity and inflation
- In what follows:
  - Consider a Representative-Agent-New-Keynesian (RANK) model with long-term nominal government debt and four shocks (productivity, demand, monetary policy and fiscal transfer shocks)
  - Roughly calibrate the model as in Bianchi-Melosi (2022)
  - Show how different degrees of fiscal backing ($\lambda's$) impact the transmission of those shocks.

RANK model with partial fiscal backing

$$y_t = E_t y_{t+1} - [R_t - E_t \pi_{t+1}] + \varepsilon_t^d \quad \text{(Forward-looking IS curve)}$$

$$\pi_t = \kappa(y_t - y_t^*) + \beta E_t \pi_{t+1} \quad \text{(New Keynesian Phillips curve)}$$

$$y_t^* = \varepsilon_t^a \quad \text{(Potential output)}$$

$$R_t = E_t R_{t,t+1}^b \quad \text{(No arbitrage condition)}$$

$$R_{t-1,t}^b = \frac{\rho}{R} P_t^b - P_{t-1}^b \quad \text{(Return on long-term bond)}$$

$$b_t = \beta^{-1} b_{t-1} + b\beta^{-1}\left(R_{t-1,t}^b - y_t + y_{t-1} - \pi_t\right) - \tau_t \quad \text{(Govt budget constraint)}$$

RANK Model with partial fiscal backing

Monetary policy rule:

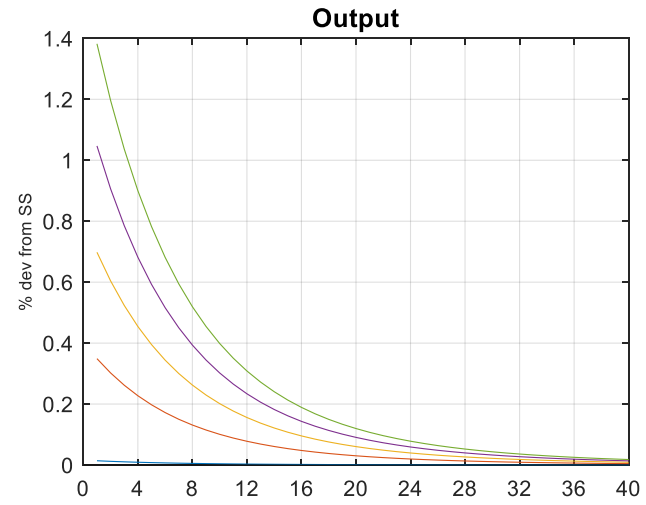
$$R_t = \rho_R R_{t-1} + (1-\rho_R)\left[\psi_\pi(\pi_t - \pi_t^F) + \psi_\pi^F \pi_t^F + \psi_y\left((y_t - y_t^*) - (y_t^F - y_t^{F*})\right) + \psi_y^F(y_t^F - y_t^{F*})\right] + \varepsilon_t^{mp}$$

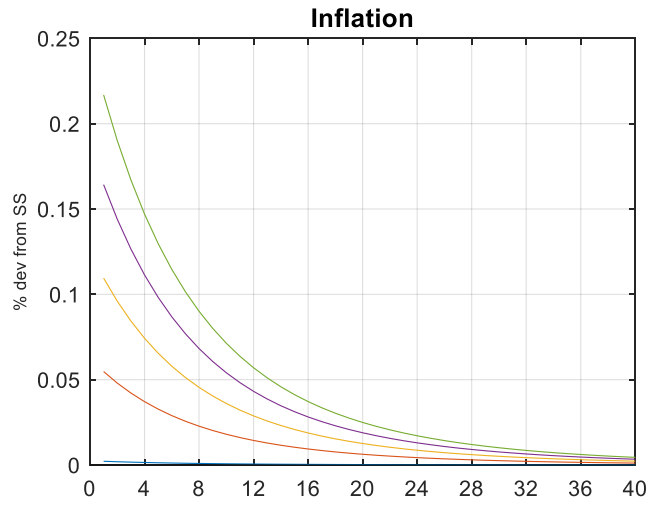
Fiscal policy rule:

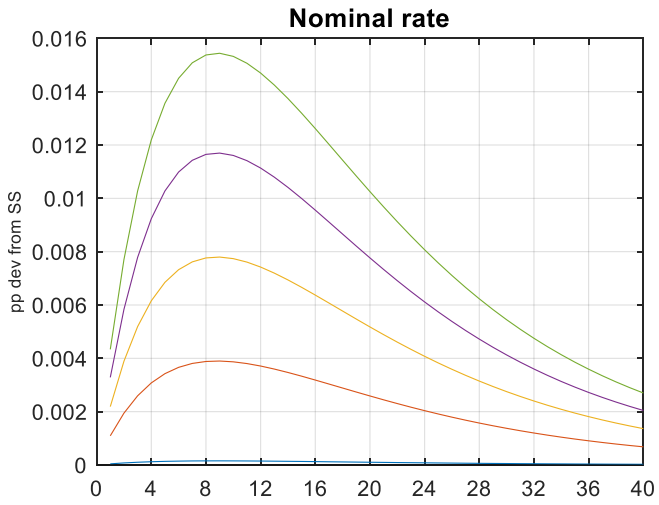
$$\tau_t = \rho_\tau \tau_{t-1} + (1-\rho_\tau)\left[\delta_b(b_{t-1} - b_{t-1}^F) + \delta_b^F b_{t-1}^F + \delta_y(y_t - y_t^*)\right] + \delta_{dy}(y_t - y_{t-1}) + \varepsilon_t^\tau$$

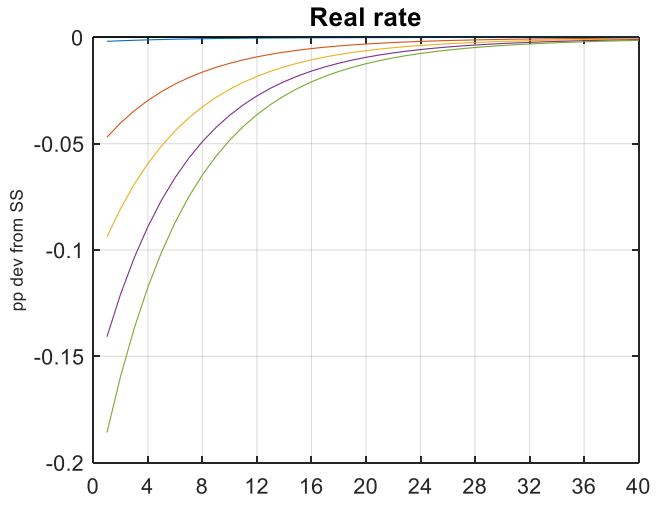
Unfunded debt, b_t^F, and fiscal inflation, π_t^F, are again determined in a fiscal-led shadow economy.

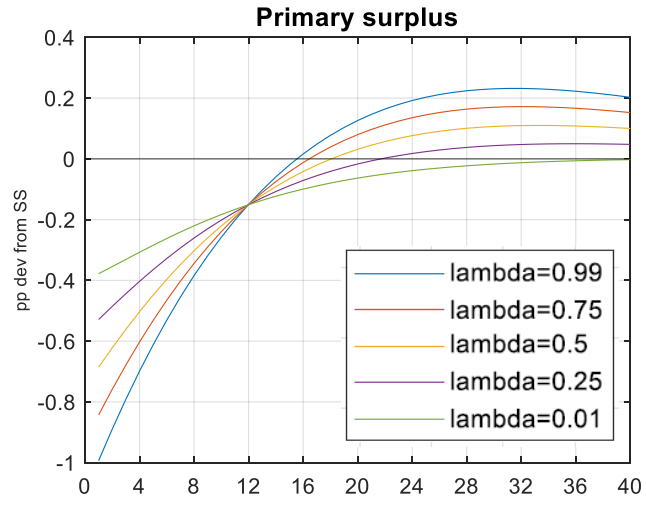
Expansionary transfer shock (RANK model)

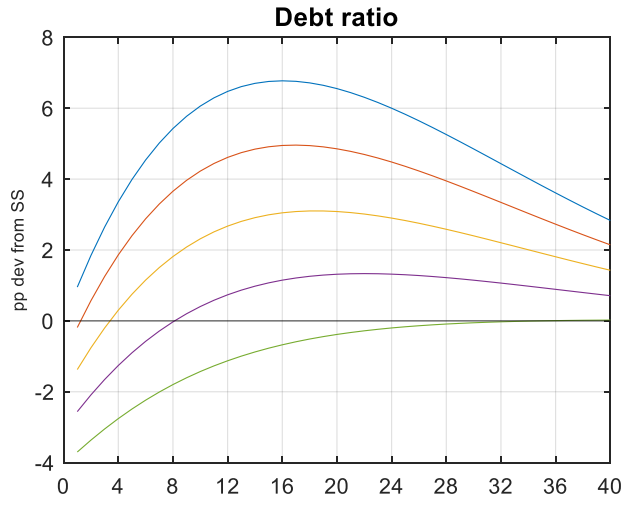




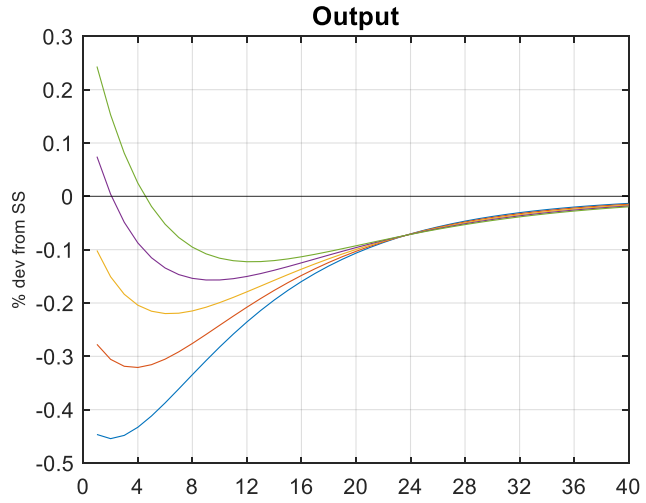


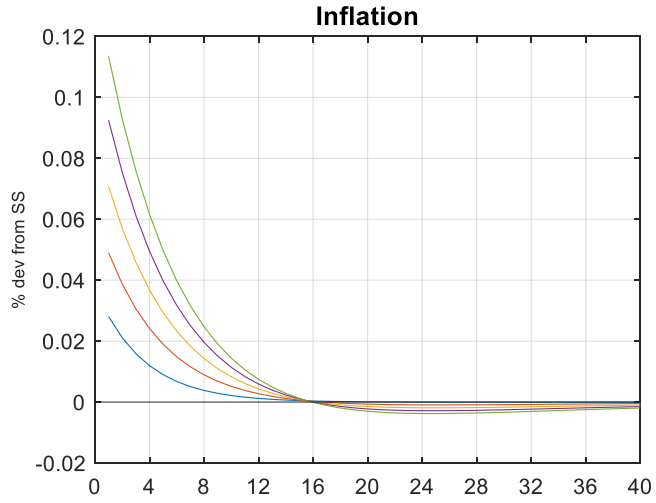


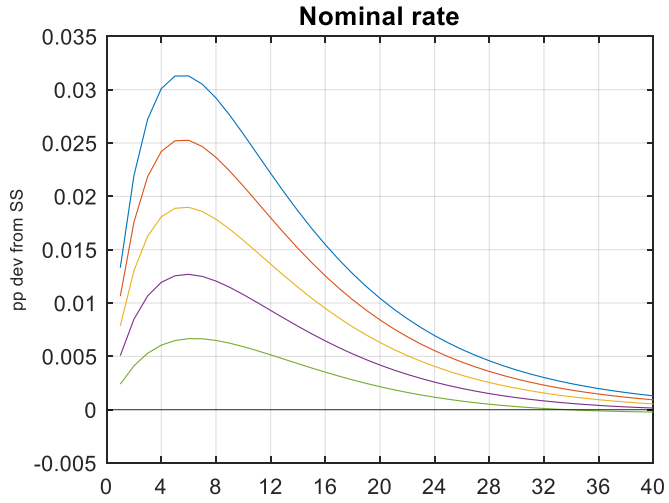


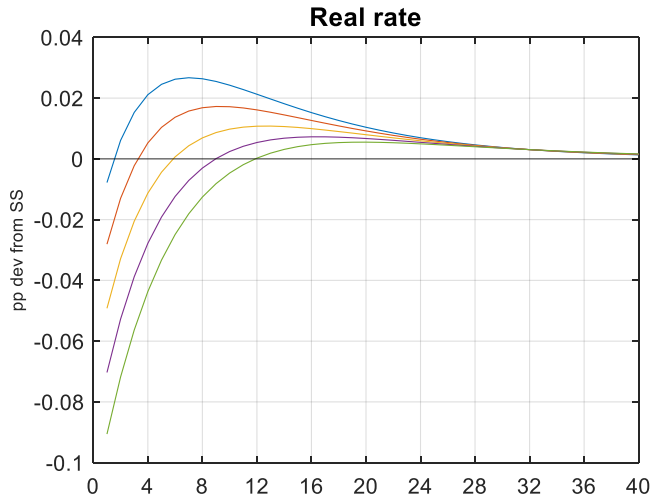


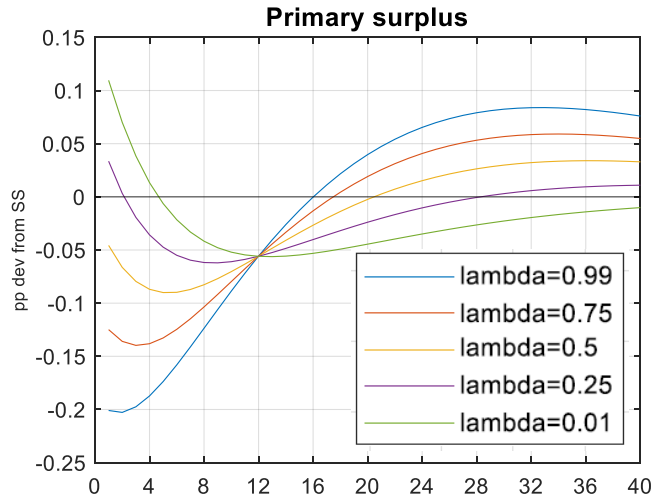
Negative productivity shock (RANK model)

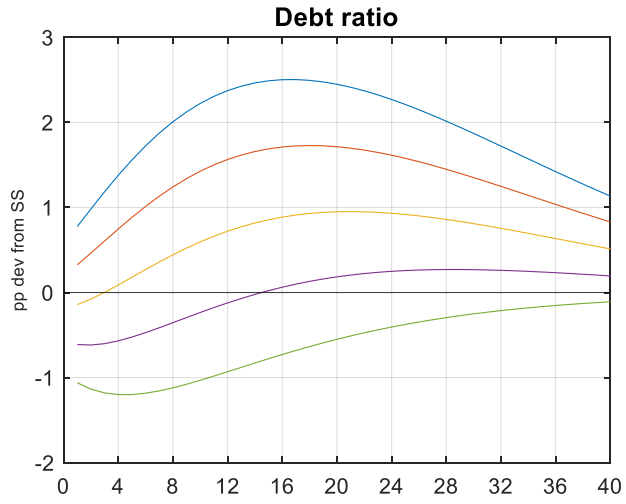




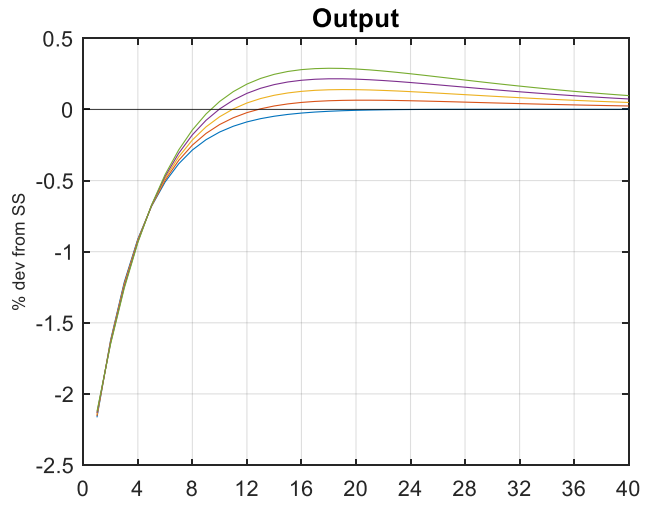


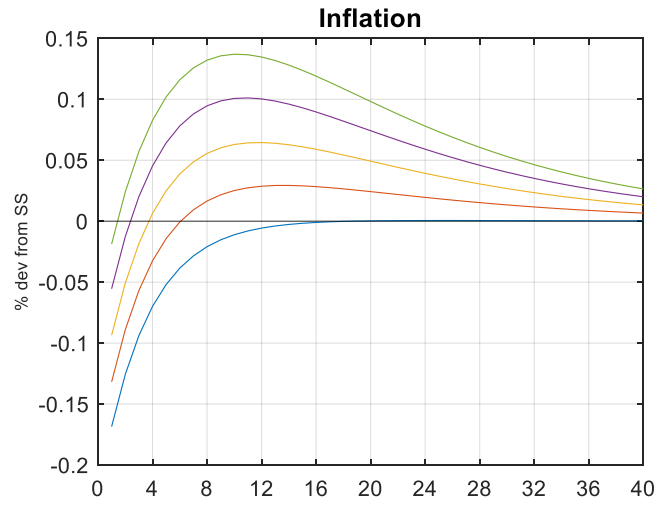


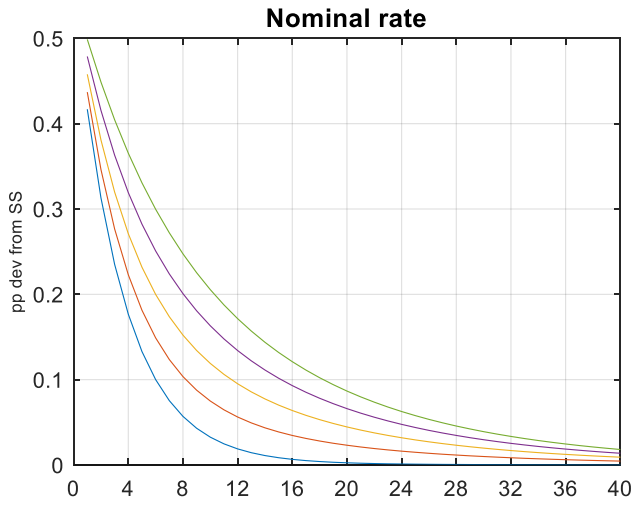


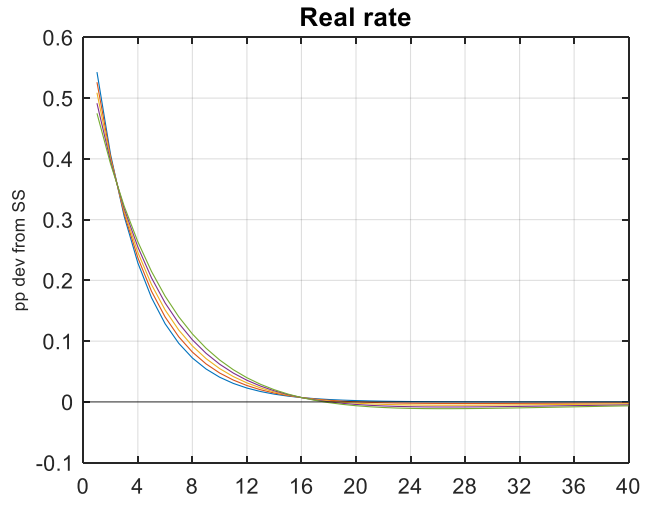


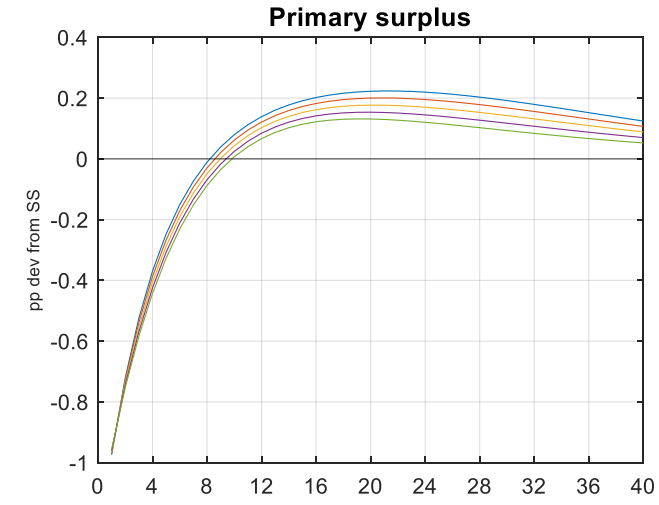
Tightening monetary policy shock (NK model)

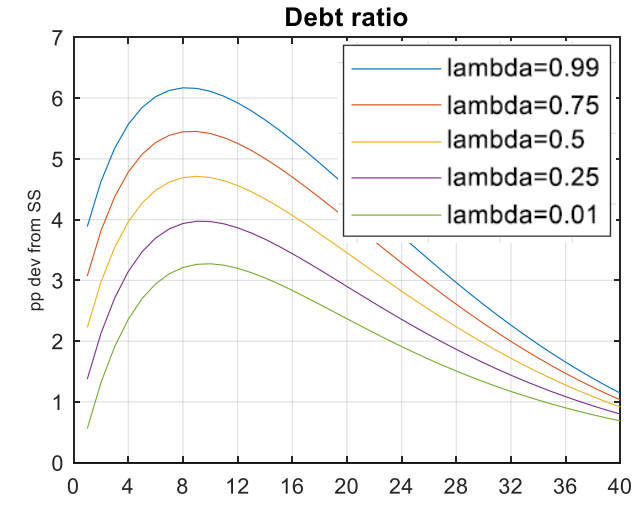




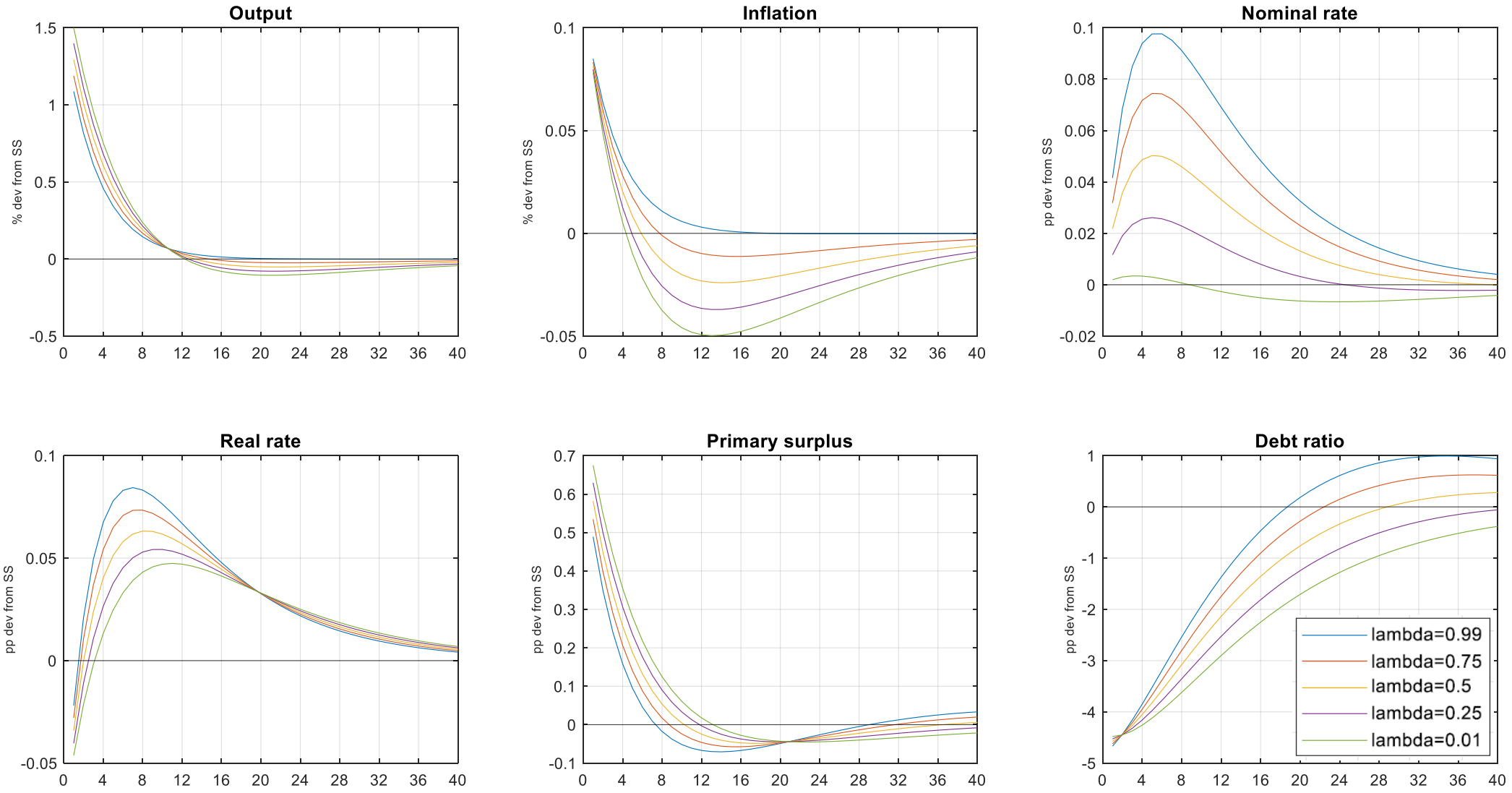








Expansionary demand shock (RANK model)



Outline

- Motivation and objectives
- Methodology
- Estimation results
- Post-pandemic inflation
- Conclusions and follow-up

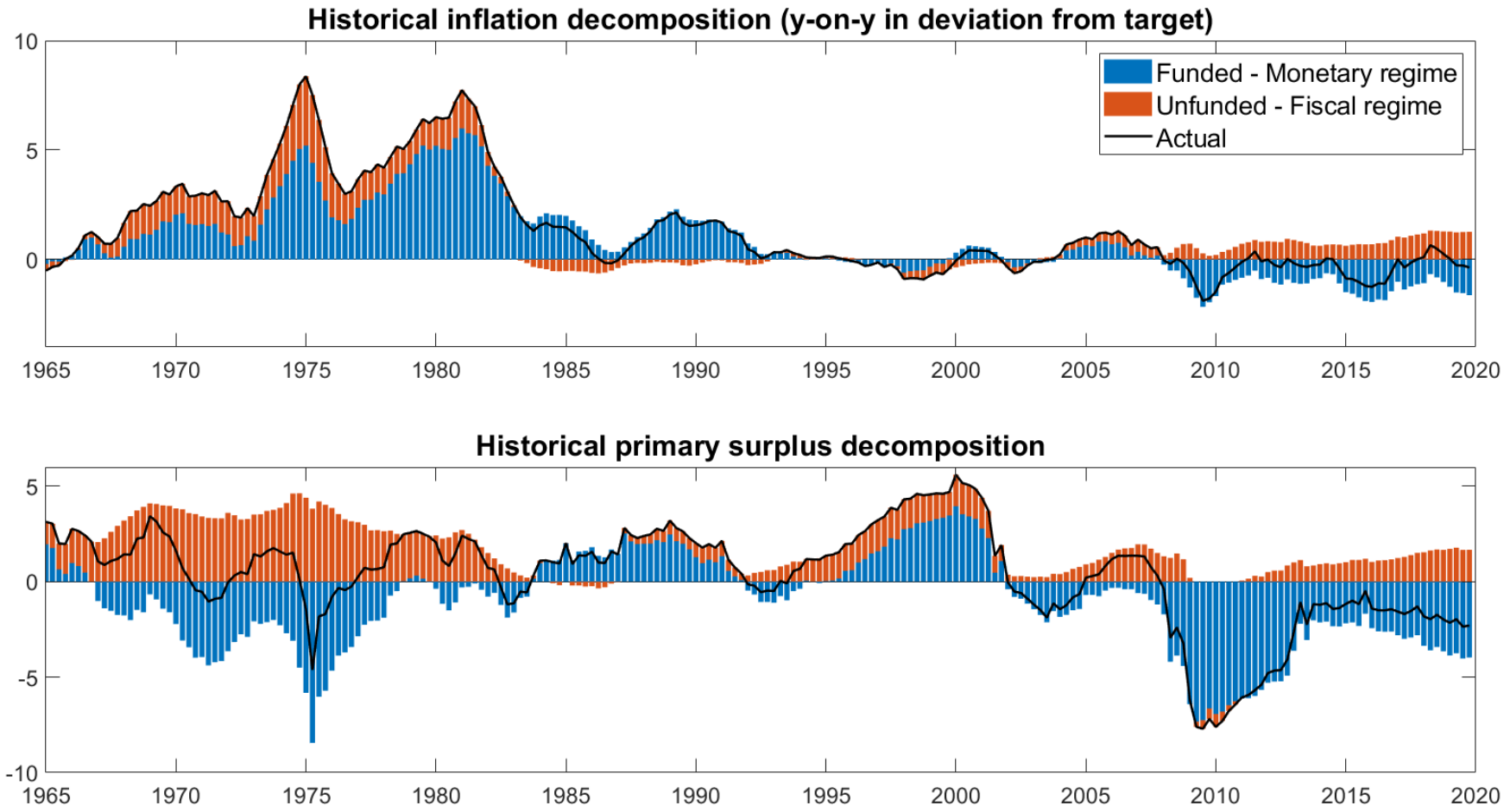
Smets-Wouters (2007) with partial backing

- Smets-Wouters (2007): usual seven observables and shocks
- Add fiscal block with equations for taxes, transfers, government spending and the intertemporal government budget constraint:
  - Observables: market value of government debt, primary surplus, growth rate in transfers, and in government spending.
  - Four additional fiscal shocks: lump sum tax, lump sum transfer, government spending and a residual debt shock. The latter can also be interpreted as measurement error.
- Extend the dataset with a 1-year short-term interest rate and a forward guidance shock to take into account the ELB periods after the Global Financial Crisis.
- Add fiscal-led shadow economy to keep track of unfunded debt and fiscal inflation: All shocks affect the shadow economy with a parameter $(1 - \lambda)$.

Selected estimation results (1965Q1-2019Q4)

Regime	Monetary-led	Intermediate	Fiscal-led
λ	1.00	**0.83**	0.00
Log likelihood	-2765	**-2757**	-2842
Calvo price stickiness	0.72	0.79	0.87
Calvo wage stickiness	0.53	0.63	0.73
Habit	0.64	0.62	0.81
Investment costs	3.96	3.83	7.23
Maturity parameter	0.86	0.90	0.84
Transfers: Debt feedback	0.05	0.07	-
Transfers: Persistence	0.99	0.99	0.99

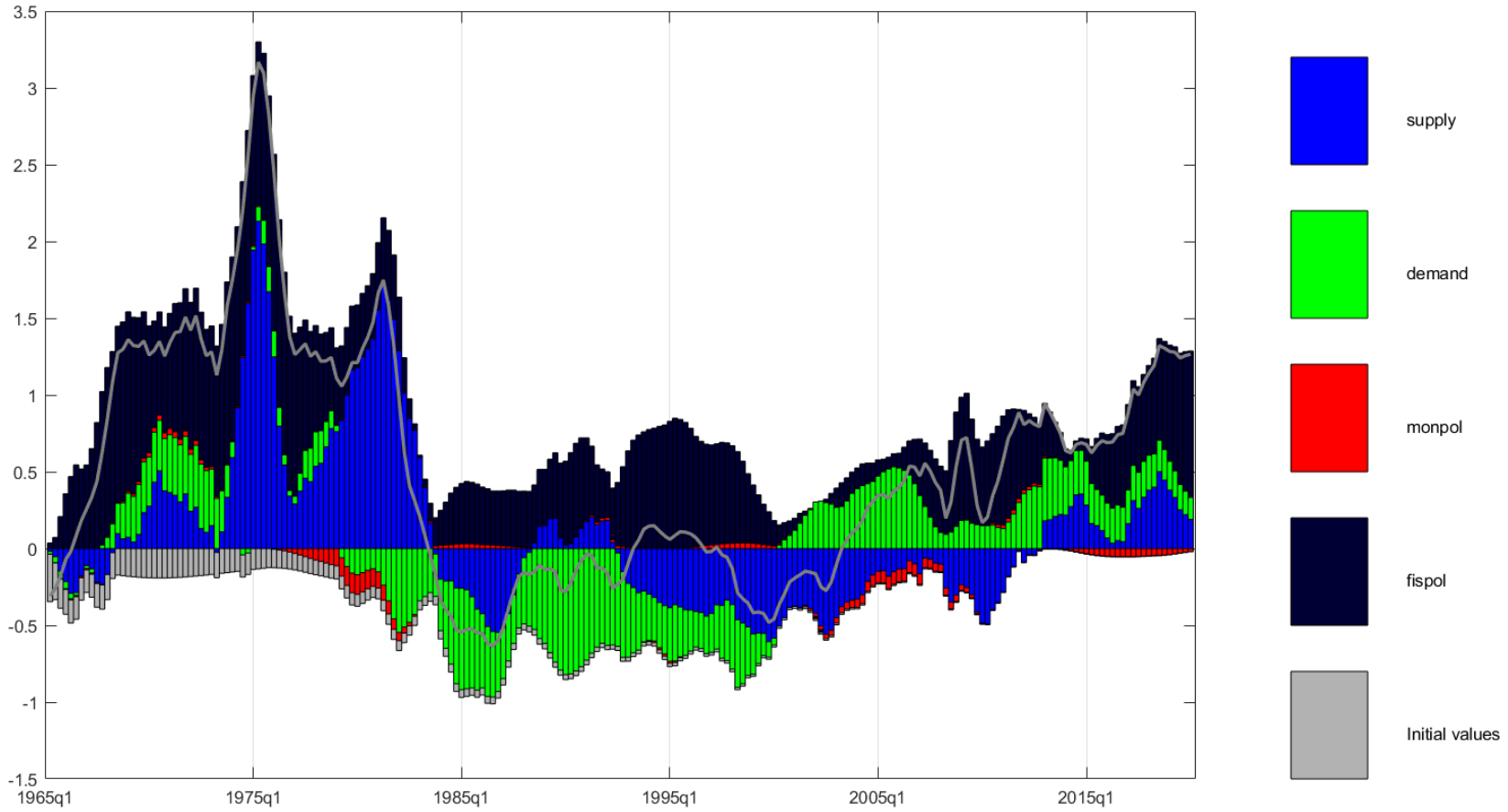
Monetary and fiscal drivers of inflation and primary balance



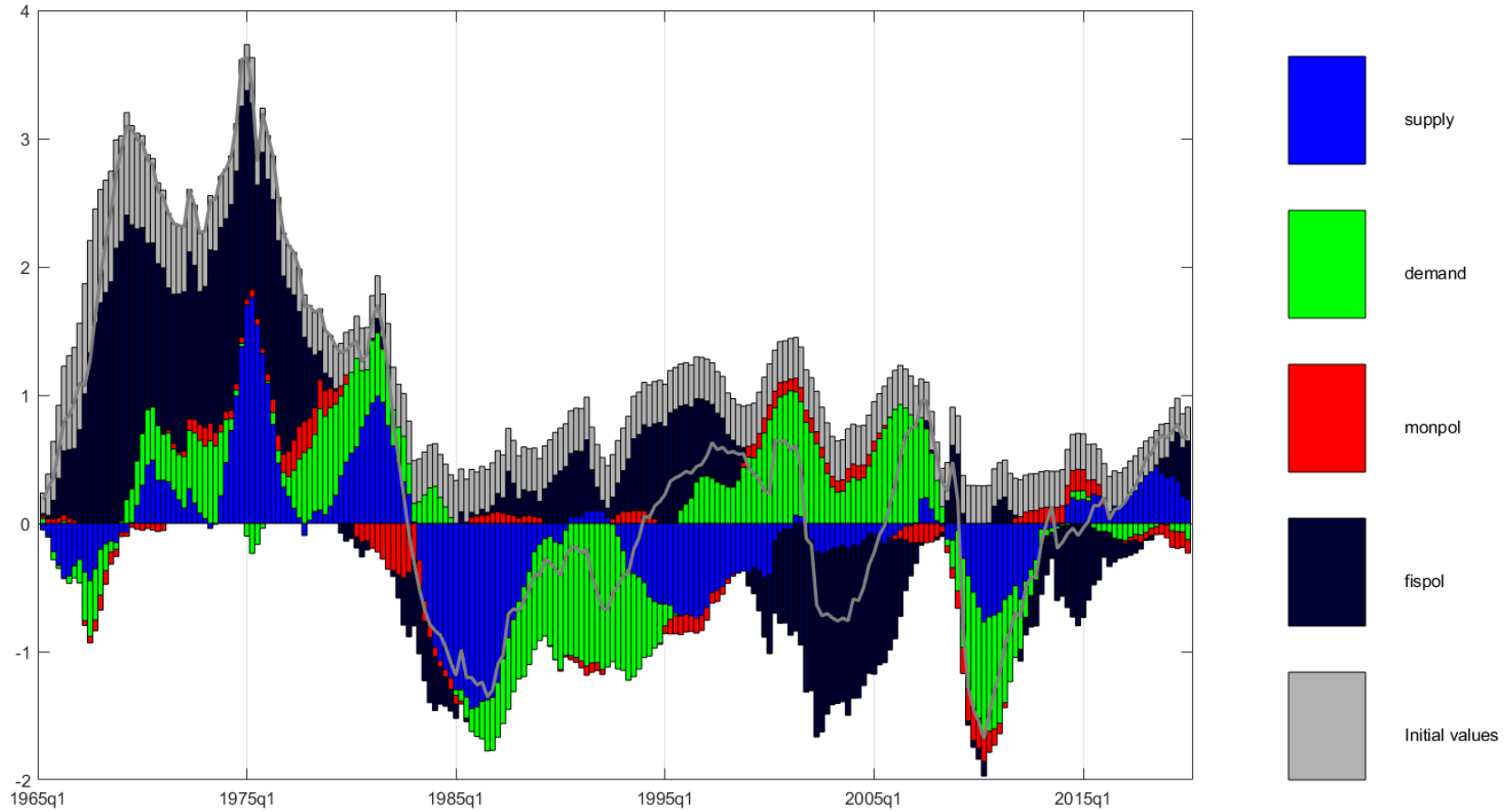
Variance decomposition (10-year horizon)

	Supply shocks	Demand shocks	Monetary shocks	Fiscal shocks
Real GDP	0.60	0.33	0.03	0.04
Unfunded	0.30	0.17	0.01	0.53
Inflation	0.79	0.15	0.01	0.05
Unfunded	0.57	0.13	0.00	0.30
Primary balance	0.43	0.37	0.04	0.17
Unfunded	0.37	0.19	0.01	0.43
Nominal rate	0.14	0.66	0.19	0.00
Real rate	0.17	0.43	0.36	0.04
Government debt	0.43	0.39	0.05	0.13

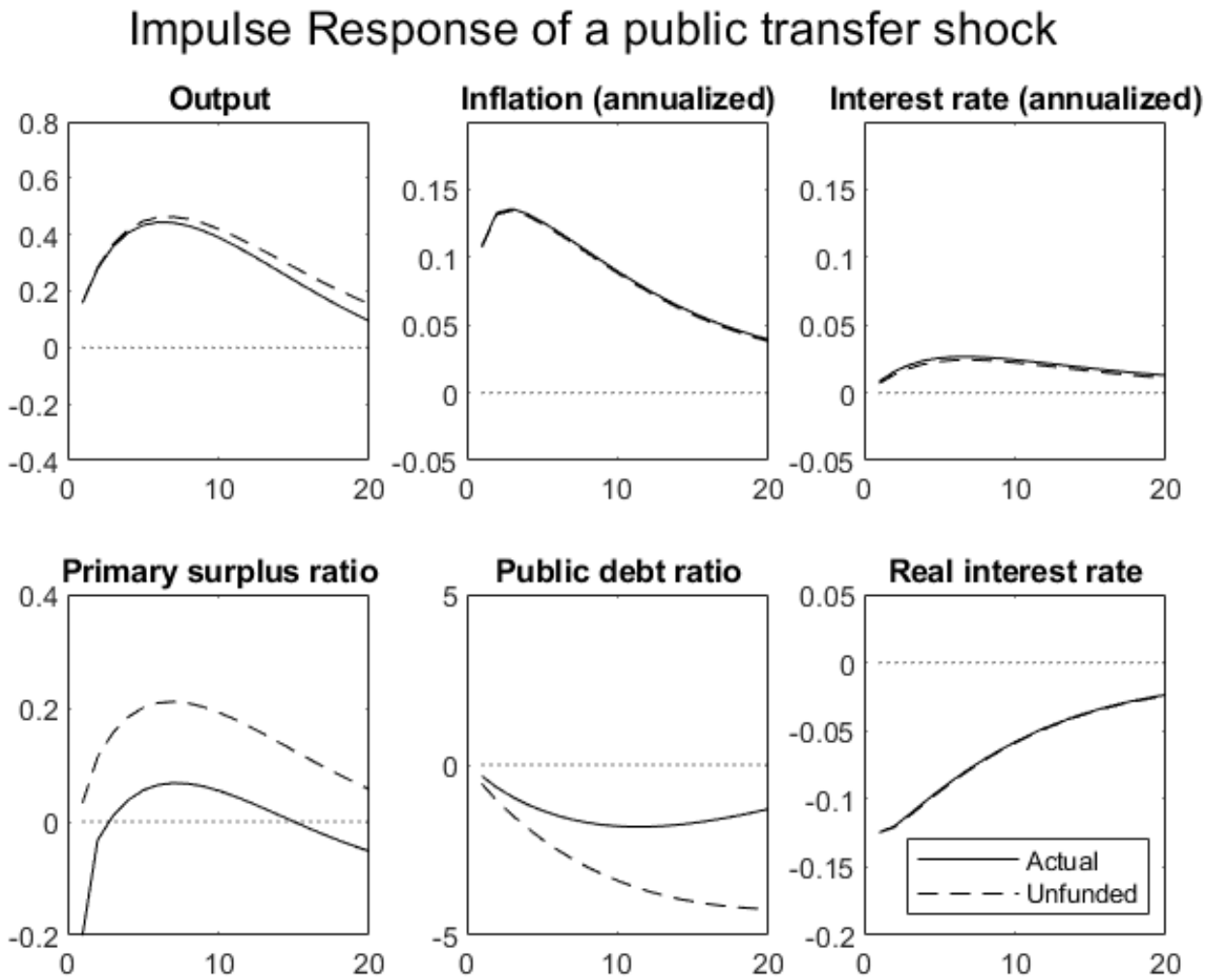
Historical decomposition: fiscal-led inflation



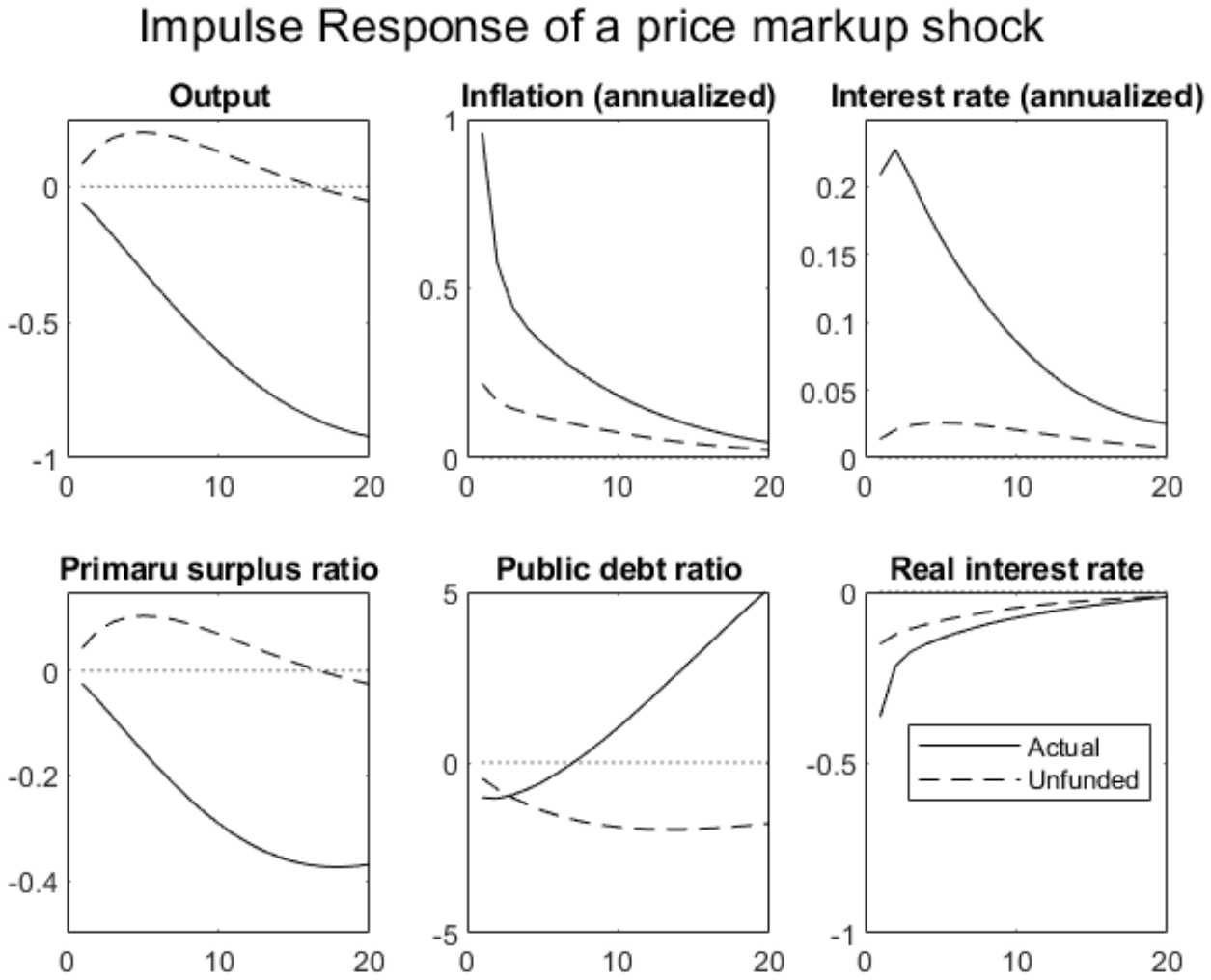
Historical decomposition: unfunded primary balance



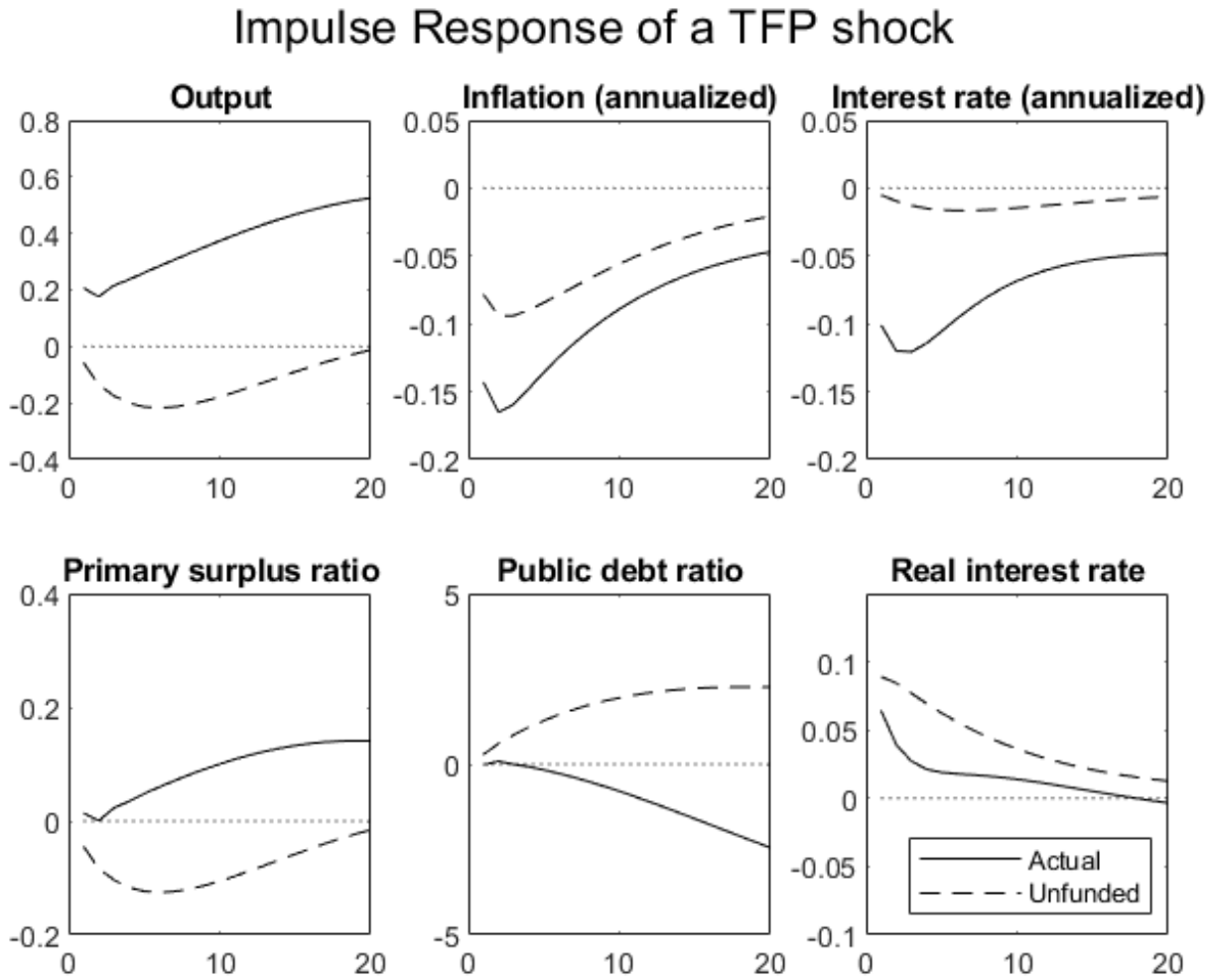
Public transfer shock in estimated SW model



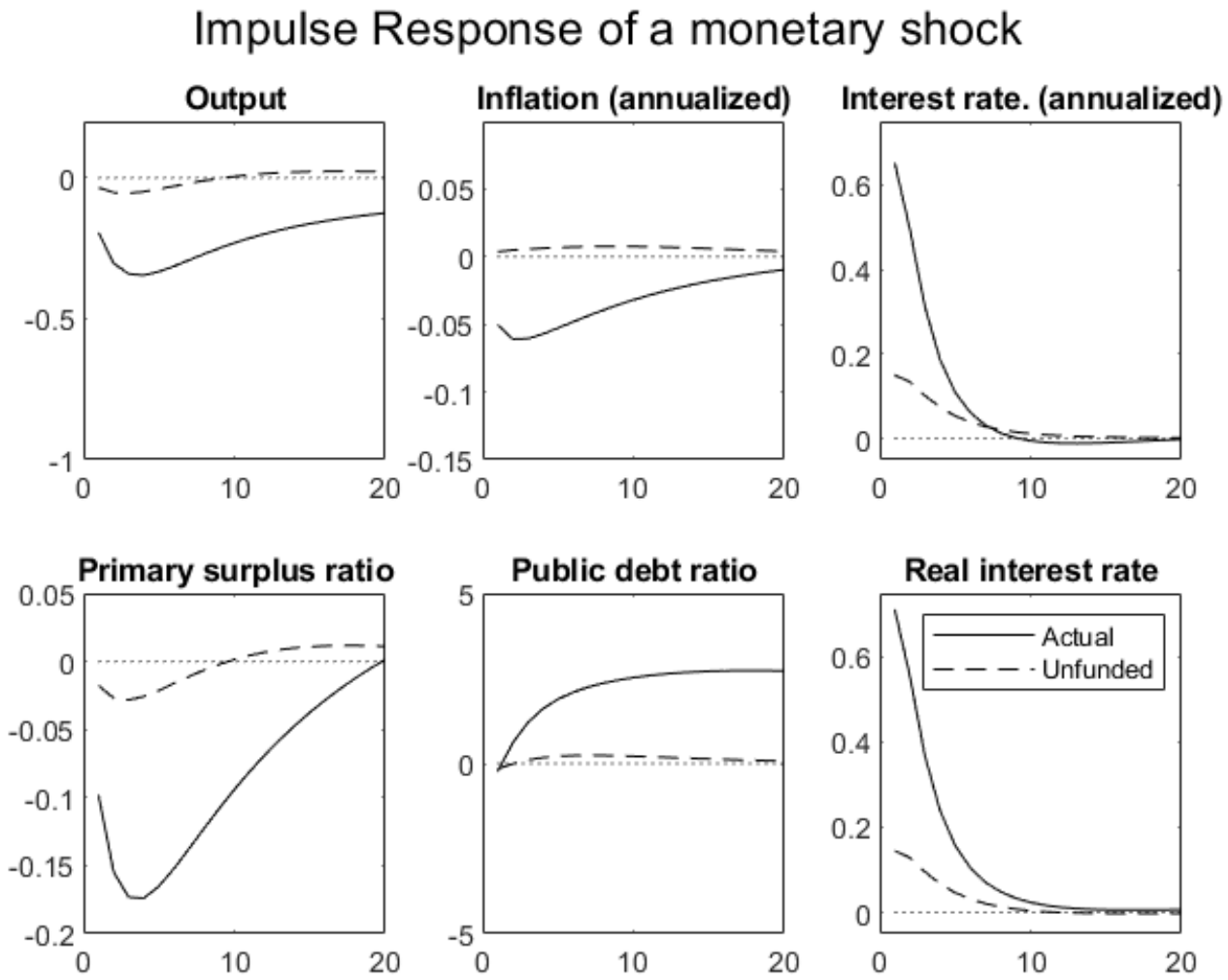
Mark-up shock in estimated SW model



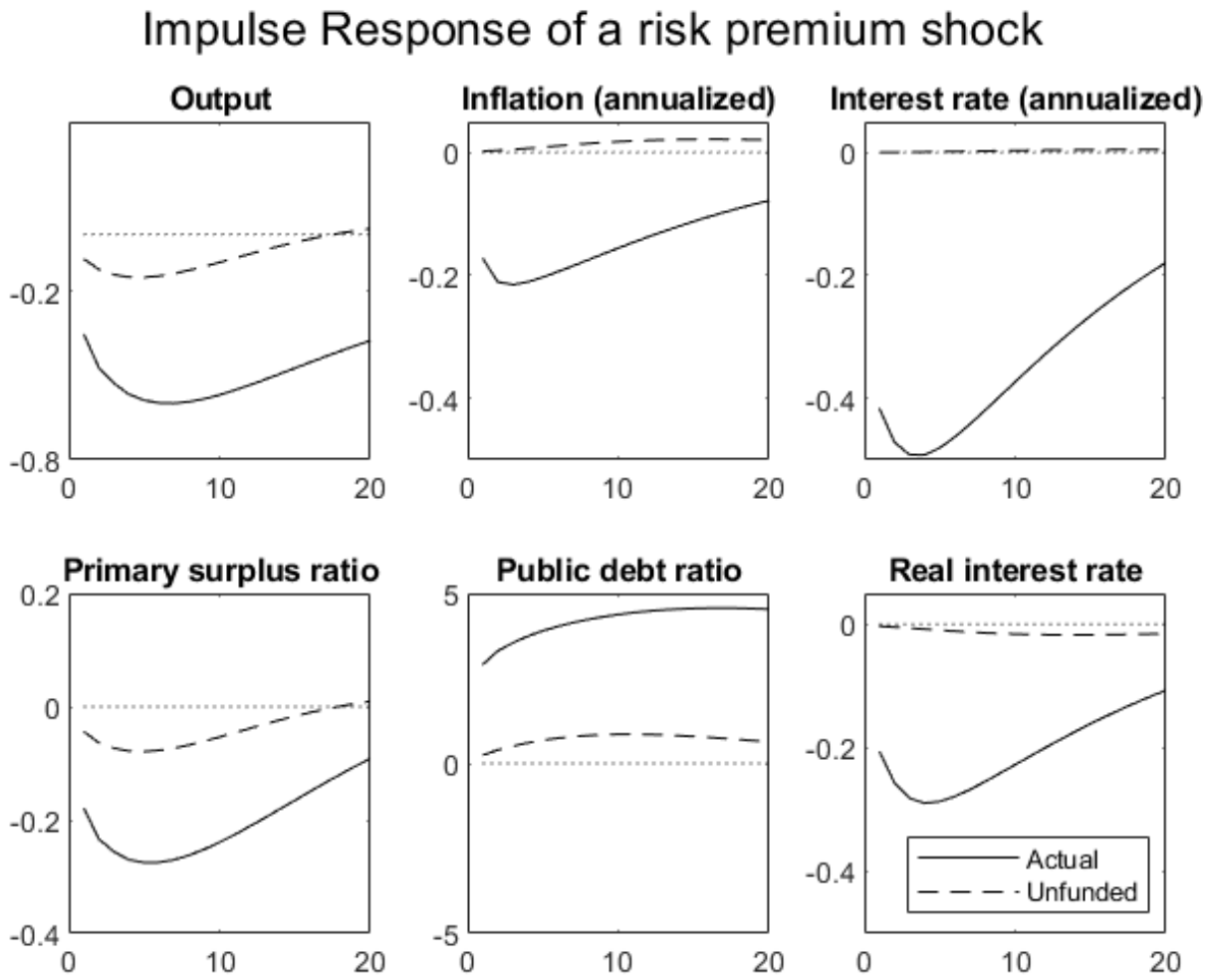
Productivity shock in estimated SW model



Monetary policy shock in estimated SW model



Risk premium shock in estimated SW model

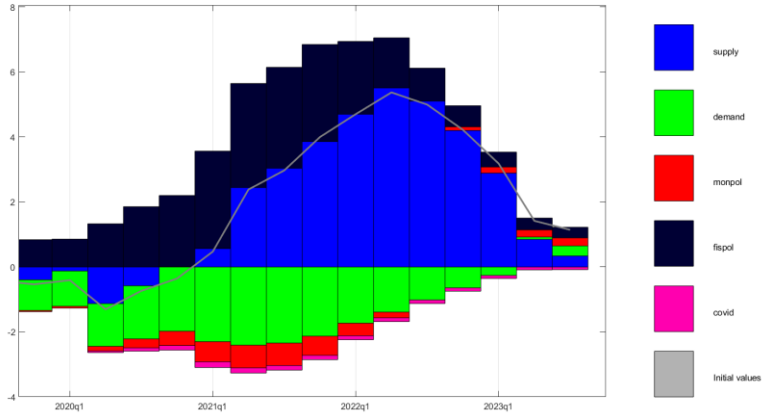


Outline

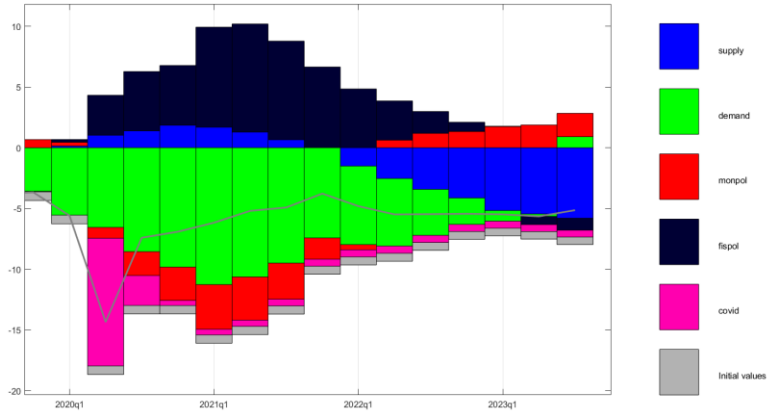
- Motivation and objectives
- Methodology
- Estimation results
- Post-pandemic inflation
- Conclusions and follow-up

Accounting for the post-pandemic inflation

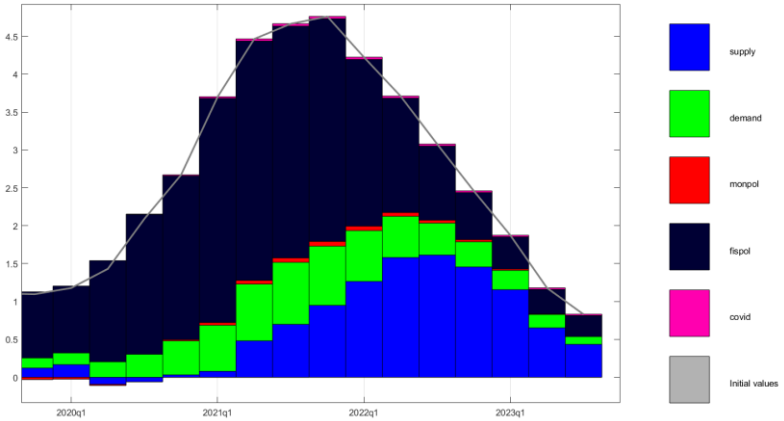
Inflation



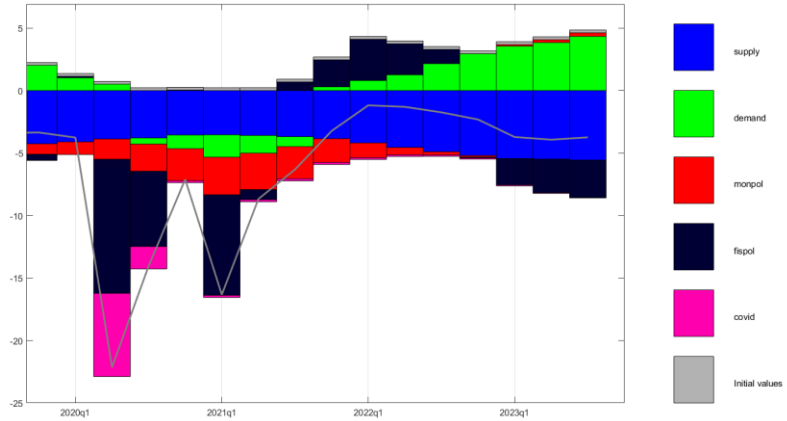
Real GDP



Fiscal inflation



Primary balance



Outline

- Motivation and objectives
- Methodology
- Estimation results
- Post-pandemic inflation
- Conclusions and follow-up

Main findings

- What is the average degree of fiscal backing?
  - 0.83
- Are the most important drivers of inflation monetary or fiscal-led?
  - Monetary-led.
- How does lack of fiscal backing affect the propagation of various business cycle shocks?
  - Enhances the inflationary effects, stimulates output and creates fiscal space following expansionary fiscal and negative supply shocks
  - Limited effect on propagation of demand shocks
- The post-pandemic inflation peak in 2022 is mostly driven by negative supply shocks, but fiscal policy (and fiscal inflation) did offset the impact of negative demand developments in 2021.

Follow-up

- Has the degree of fiscal backing changed over time?
- Is the degree of fiscal backing different in response to different shocks?
- How robust are the results with respect to TANK models
- Is the degree of fiscal backing asymmetric?
- What is the optimal degree of fiscal backing?

Is the degree of fiscal backing the same for all shocks and all periods?

- Consider alternative specifications:

1. model with λ_i different for types of shock
~ shock specific fiscal backing ?

2. outcome for subsample: 1965-1979 / 1985-2019
3. Regime-Switching between models with different λ
~ time variation in fiscal backing ?

4. allow for independent funded and unfunded shocks:
with $\sigma_U/\sigma_F = (1-\lambda)/\lambda$ for all shocks (ea, em, etc)
~ fiscal backing is time and shock specific ?

Is the degree of fiscal backing shock specific?

- Model with λ_i different for fiscal and non-fiscal shocks (uniform prior)
  - λ_{Fiscal} = 0.88 [0.84-0.97] $\lambda_{Non\text{-}Fiscal}$ = 0.82 [0.72-0.88]
  - No difference in Marg.Lik

- Model with shock specific λ_i with prior N(0.83,0.1)
  - λ_a = 0.80 λ_p = 0.88 λ_w = 0.80
  - λ_b = 0.91 λ_e = 0.66 λ_{qs} = 0.94 λ_m = 0.85
  - λ_g = 0.87 λ_{tra} = 0.83 λ_{tax} = 0.88

  => No systematic differences in fiscal backing of various shocks

Has the degree of fiscal backing changed over time?

- Baseline model is estimated over two subperiods: 1965q1-1979q2 and 1984q1-2019q4
- $\lambda_{subper1}$ = 0.75 [0.49-0.84] $\lambda_{subper2}$ = 0.71 [0.58-0.78]

  => λ are equivalent across subperiods and slightly lower than 0.83

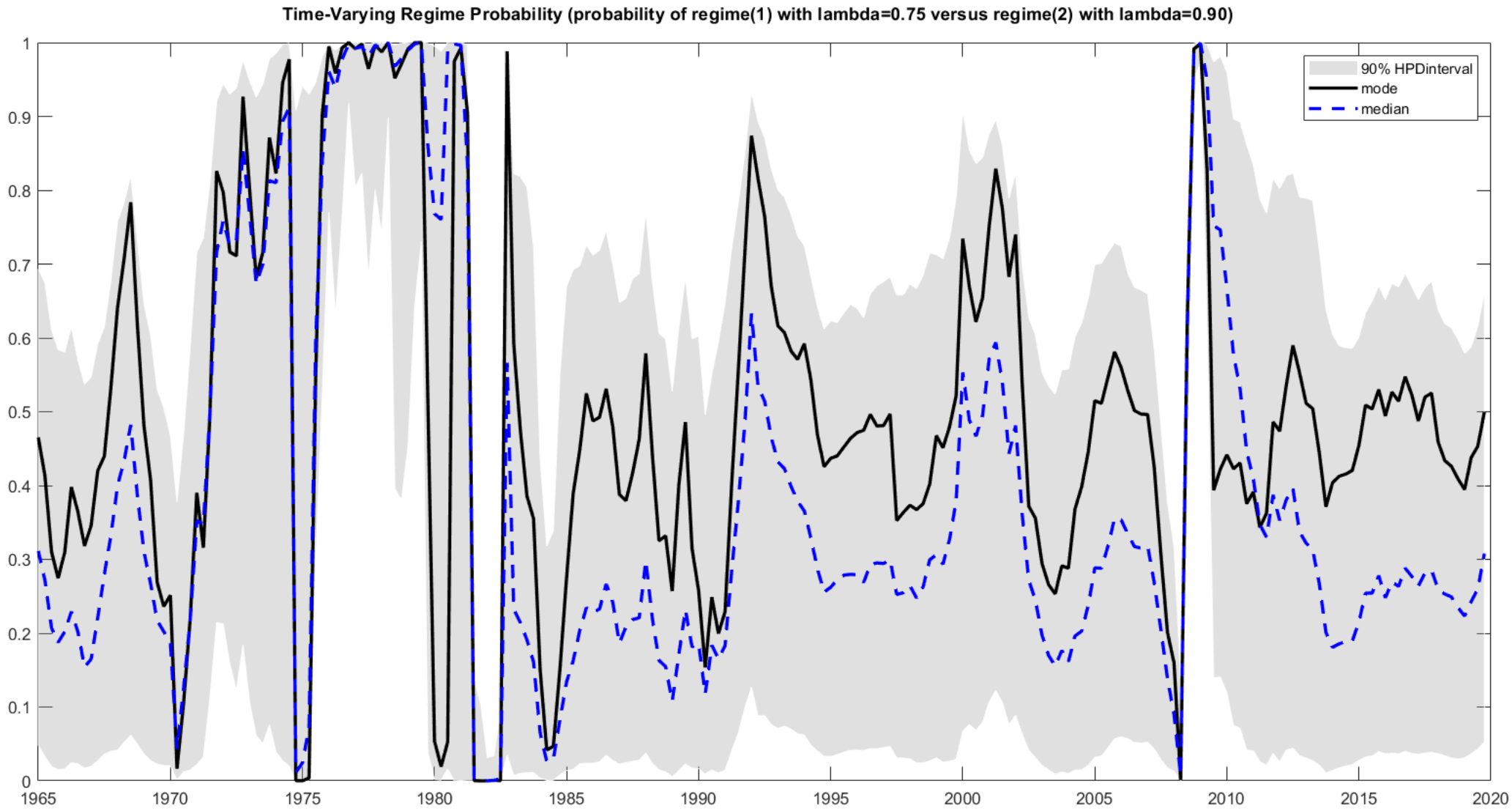
- Some interesting changes in other parameters as well (~SW2007): increase in nominal price stickiness, increase in policy response to inflation (and higher in both subperiods for response in fiscal-led shadow regime)

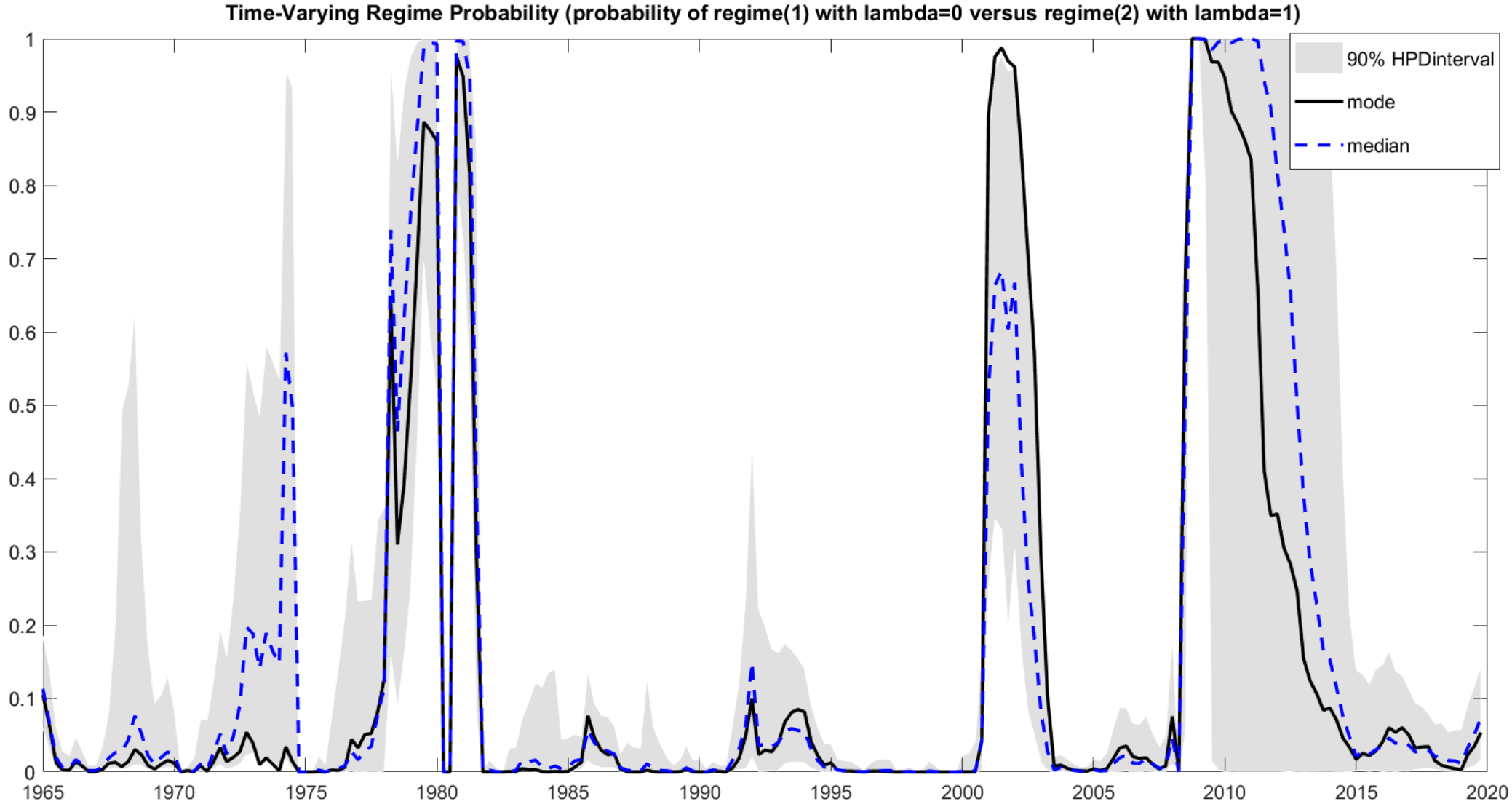
Has the degree of fiscal backing changed over time?

- Consider two regimes with λ fixed at 0.75 and 0.9 in a stochastic Regime-Switching model and estimate regime probability with RISE
- Marginal Log Likelihood is very similar to the baseline with $\lambda = 0.83$
- Regime Transition probabilities: [0.85 0.15 ; 0.11 0.89]

- Compared to the two extreme regimes with λ fixed at 0 and 1
- Marginal Log Likelihood only slightly worse
- Regime Transition probabilities: [0.89 0.11 ; 0.05 0.95]

=> weak evidence of time variation with less fiscal backing in 70s, after the GFC, and more general after recessions


Time-Varying Regime Probability (probability of regime(1) with lambda=0.75 versus regime(2) with lambda=0.90)
90% HPDinterval
mode
median
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020


Time-Varying Regime Probability (probability of regime(1) with lambda=0 versus regime(2) with lambda=1)
90% HPDinterval
mode
median
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

Flexible model with independent shocks that are either completely funded or unfunded

- Relative standard deviation of shocks with fiscal backing relative to shocks without backing: $\lambda = 0.75$ (same λ imposed for all shocks)
- Smoothed estimates of innovations in F/U shock are highly correlated for most shocks (0.6 for ε_b, 0.78 for ε_{tra}, 0.72 for ε_p, 0.99 for ε_g)
- Marginal Log lik = -2746 > -2757
- Impact on estimated parameters: less price stickiness, lower inflation reaction in monetary-led regime (higher in fiscal-led regime)

=> Evidence of changes in the transmission channel of shocks depending on the degree of fiscal backing (but not a simple function of time or shock-type)

How robust are the results with respect to TANK models?

- Estimate same mechanism in models with

    1. Model with a fraction of households that is liquidity-constrained (and targeted transfers): positive income effect from transfers on private consumption, aggregate demand and inflation
    2. Model with complementarity between private consumption and government consumption: crowding in from public consumption on private consumption, amplifying aggregate demand and inflation effects

    => Estimated λ does not materially change: the impact from partial fiscal backing on aggregate demand and inflation seems stronger, applies for all shocks and is more persistent

Outline

- Motivation and objectives
- Methodology
- Estimation results
- Post-pandemic inflation
- Conclusions and follow-up

- Questions - Suggestions?