Star struck; Monetary Policy and the Neutral Real Rate

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Motivation

- In past decades (until upswing of inflation in 2021-2022), sharp decline in r-star ▸ Low Rates
  - Curtailed central banks' ability to manoeuvre
  - Prompted many of them to perform mission reviews
  - Particularly strong ↓ during the Great Financial Crisis (GFC) and the subsequent expansionary monetary policy (MP) phase
    - Idea that MP can endogenously push down the neutral rate

- In contrast, recent shocks during post-pandemic period have necessitated MP to pursue higher policy rates, in order to bridge gap with r-star
  - Positive demand shocks and negative supply shocks seem to have pushed up the neutral rate

Contribution

- We analyze whether macroeconomic shocks are able to affect commonly used measures of short-run (SR) r-star
  - We use **auxiliary information** (in this case external shocks) **to validate the estimates of latent variables** (Coibion et al. 2018; Kiley, 2020)
- We expect estimates of the SR r-star
  - To react to shocks that affect near-term productive capacity of economy such as productivity or government spending
  - Not to react to transitory demand shocks, such as monetary policy shocks (Kaplan, 2018; McKay et al. 2021)
- Moreover, if impact of macroeconomic shocks to SR r-star is gradual and long-lived, then hard to distinguish between
  - Movements in short-run r-star, which should be merely cyclical and transitory in nature
  - And long-run (LR) counterpart, which is driven by secular forces

Related Literature

- Endogenous interactions r-star and monetary policy
  - Rungcharoenkitkul (2020); Bhattarai, Lee and Park (2021); Borio (2021); McKay and Wieland (2021), Mian et al. (2021)
  - Empirical impact of MP on r-star: Aranovich and Meldrum (2021), Borio et al. (2017), Bianchi et al. (2021)
- Self-sustaining consequences of low interest rates
  - Booms and Low Productivity Growth: Asriyan et al. (2020, 2021)
  - Zombie Lending: Banerjee and Hofmann (2018); Shivardi et al (2020)
  - Unresponsiveness inflation at low rates (Rational inattention): Cavallo et al. (2017); Coibion et al. (2018)
- Information content of monetary policy shocks
  - Monetary policy interactions with (opinionated) markets: Caballero and Simsek (2021); Rungcharoenkitkul and Winkler (2021)
- Measurement issues for macroeconomic equilibrium concepts
  - Using auxiliary info (here, external shocks) to validate estimates of latent variables (Ramey, 2018)
    - Coibion et al. (2018): Estimates of potential output

R-star Measures

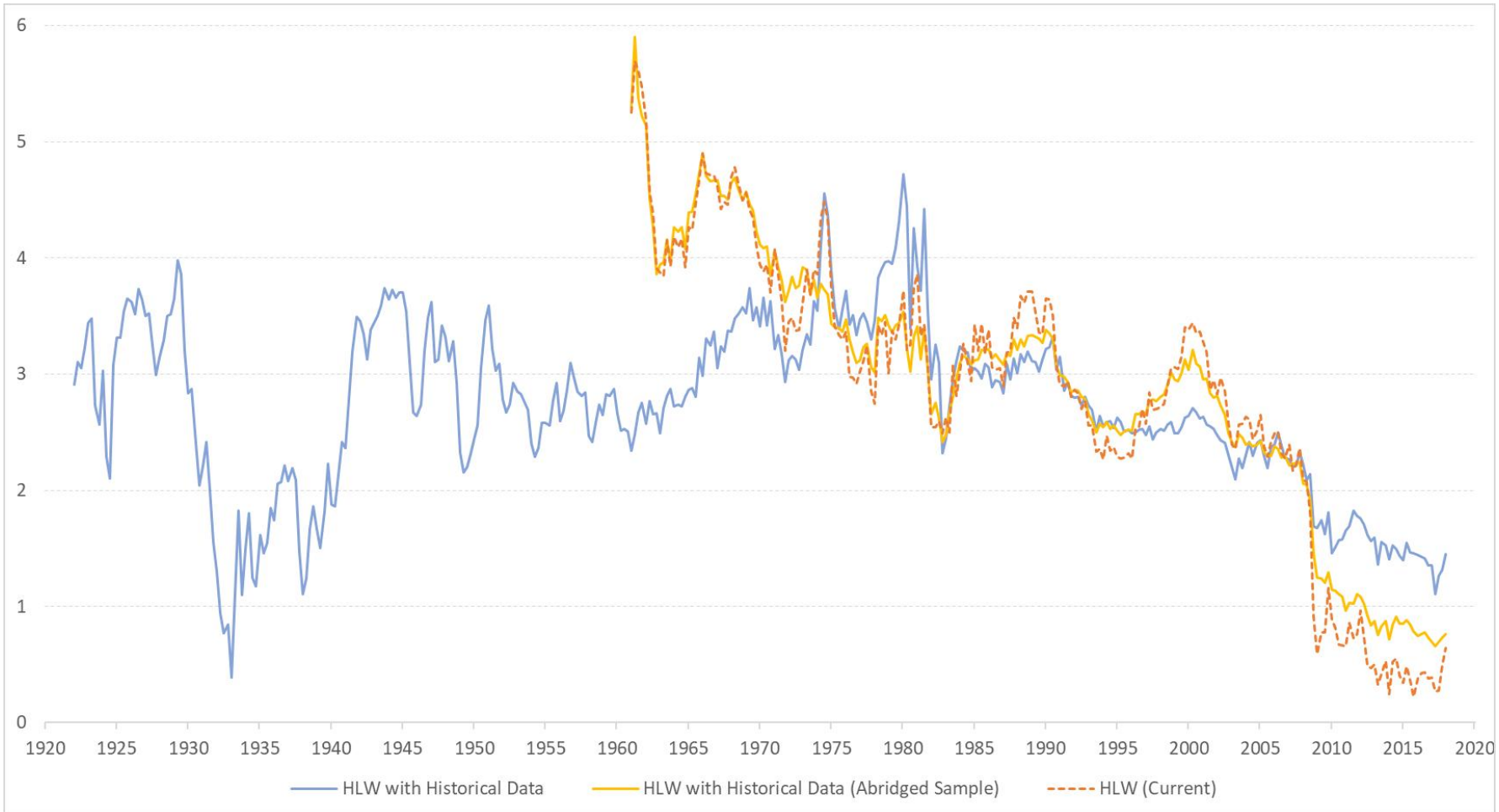
- Long-run component (natural rate or long-run r*)
  - Riskless real return that matches supply of savings to demand for investment in LR, absent of shocks
    - Governed by secular drivers, e.g. productivity growth, demographics, inequality (Platzer and Peruffo, 2022)
    - Slow moving, not affected by temporary shocks (Linde et al., 2022) ▸ Secular Drivers
- Short-run component (neutral rate or short-run r*)
  - Interest rate that removes inflationary or deflationary pressures, present in economy without nominal rigidities (Obstfeld, 2023)
    - Can be affected by transitory economic shocks (Laidler, 2011)
    - For example, an ↑ in autonomous spending or an adverse supply shock can temporarily move the SR neutral rate away from its LR trend (Woodford, 2003; Brainard, 2018)
    - However, prevailing Neo-Wicksellian view that r-star is largely exogenous to monetary policy (McKay and Wieland, 2021)
- Typically constructed with financial or macroeconomic data

▸ Overview Measures ▸ Figure Measures

Time Series for Neutral Rate

- Holston-Laubach-Williams (HLW 2017, 2023)
  - Algorithm can generate long time series
  - While shortcomings, most prevalent in academic/policy debate
- Several modifications in recent years
  - Adjusted measures more cyclical and increase after GFC
    - Lewis and Vazquez-Grande, 2019; Hakkio and Smith, 2017
- Adjusting starting point HLW measure naturally yields these changes
  - HLW measure extended with ▸ historical data
    - Balke and Gordon, 1986; Romer, 1996; Shiller; Alfred
  - Less pronounced trend-wise drop over last decades
  - Values post-GFC higher than other measures
- Sensitivity HLW measure to starting point (Buncic, 2020)
  - Natural mean revision over longer time period (Eichengreen, 2015)
    - Extended HLW measure is stationary ▸ Stationarity Test

Extended HLW (2017, 2023) with Historical Data



Empirical Model

- Baumeister and Hamilton (2018) ▸ BVAR Model
  - New asymmetric t-distribution for incorporating information about signs in a non-dogmatic way
  - Using info about both structural coefficients and impacts of shocks
- 6 variable Bayesian Vector Autoregression (VAR)
  - 3 core variables: Output gap, Personal Consumption Expenditures (PCE) deflator, fed funds rate
    - Allow us to identify supply, demand and MP shocks
  - 3 additional variables (treated exogenously in identification)
    - Real rates
    - Commodity price
    - Earnings
- Quarterly data from 1962-2015
  - Estimation over 3 subsamples
    - 1962-1979; 1980-1997;1998-2015 ▸ Subsamples

Impulse Response Functions - Supply and Demand shocks

- Positive supply shocks typically push values for r-star down
  - Positive supply shock (↑ in productivity / ↓ in wage mark-up / ↑ in labor supply) → temporary ↑ in neutral rate of output → temporary ↓ in r-star (Woodford, 2003; Guerrieri et al. 2022)
  - Response of r-star to supply shocks is relatively subdued
    - Expectation for these shocks to impact r-star, as they affect the productive capacity of the economy (Smets and Wouters, 2007)
    - However, HLW measure only picks this up for second subperiod
- Positive demand shocks lead to higher levels of r-star
  - Positive demand shock (↑ in confidence/exogenous fiscal stimulus) → higher investment/consumption → ↑ r-star (Linde, 2022)
  - Effects of demand shocks on r-star are quite persistent
    - Impact on r-star is significant and comparatively larger than with the supply shocks, with exception of third subperiod
  - Confidence about signs of the effects well beyond 2y for the first and third subsample

Impulse Response Functions - Monetary Policy Shock

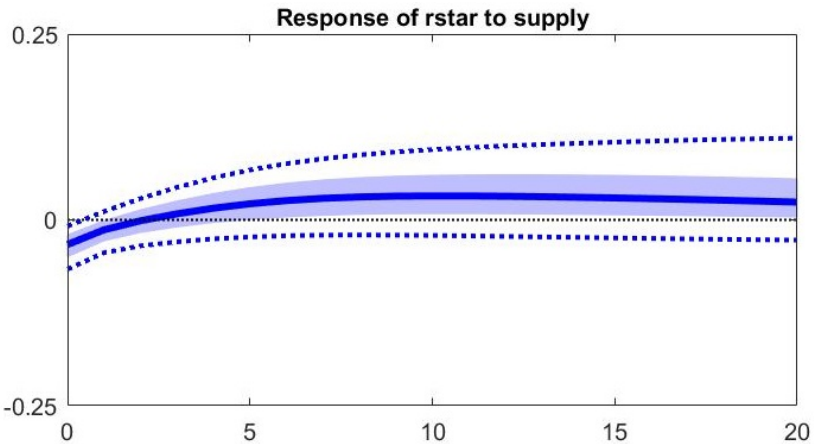
- A one-unit increase in monetary policy shock significantly pushes up the neutral rate
  - When the economy is near the effective lower bound (ELB), about half of federal funds rate (FFR) ↑ passes through into r-star; effect is long-lasting (7Q)
  - To the extend that restrictive monetary surprises can persistently ↓ near term growth prospects, these shocks can lead to an ↑ in r-star
  - Goes against prevailing Neo-Wicksellian view that r-star is largely exogenous to monetary policy (Woodford, 2003)
    - Similarly, policymakers believe that ST neutral rate is only influenced by non-monetary drivers of near-term GDP growth (Brainard, 2018; Kaplan, 2018)
  - Several authors (McKay et al. 2021, Mian et al., 2021, Rungcharoenkitkul and Winkler, 2021) have recently discussed this endogeneity between r-star and MP
    - Transmission channels through impact on future consumption, build up of debt, or informational feedback via learning between central bank and markets

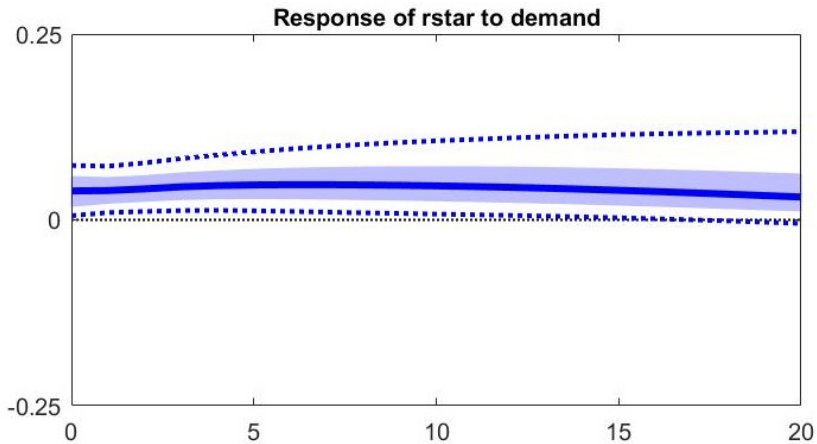
Focus here Period 3: 1998Q1 - 2015Q4

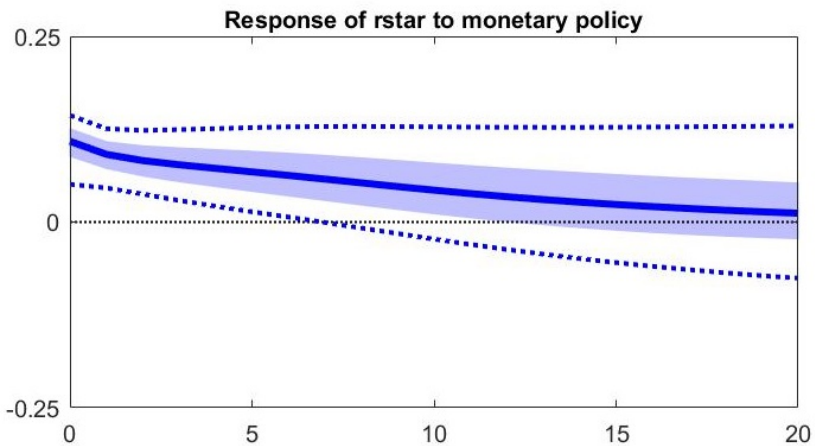
- Since 1998, the interest rate gap for advanced economies has remained negative
  - Low-real-rates and low-inflation environment
  - Debt levels substantially increased (Beaudry and Meh, 2021)
  - Financial cycles more prevalent through increased financial liberalization (Borio, 2021)
    - 2 well-known examples: internet mania and crash at end of 1990s, and liquidity boom and bust of 2000s (Perez, 2009)
- Crisis period, post-GFC, saw severe downturn in financial markets spill to real economy with substantial output losses, increased unemployment and deflationary pressures
  - Fed engaged in unconventional monetary policy measures
  - Policy rates low, and near ELB, prompting questions whether low rates were here to stay (Bernanke et al, 2019)
  - After GFC, economic recovery has been markedly slow (Fernald et al., 2017)

▸ Period 1 ▸ Period 1-IRF ▸ Period 1-Hist Decomp
▸ Period 2 ▸ Period 2-IRF ▸ Period 2-Hist Decomp

Period 3 - Impulse Response Functions for R-star

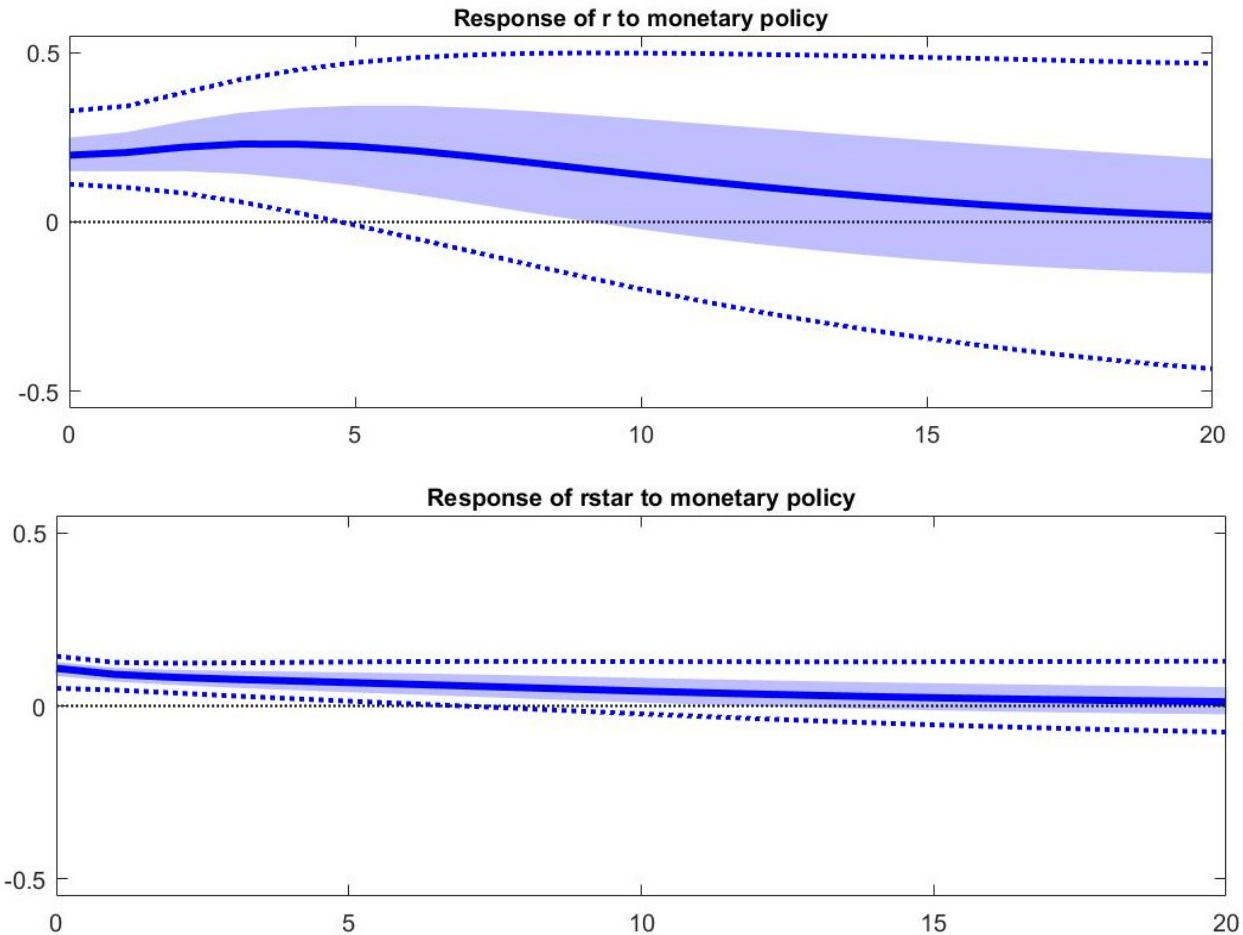






▸ Period3-IRF-Main

Period 3 MP Shock



▸ Period3 Hist Decomp

Findings

1. While demand shocks produce expected response, the SR r-star estimate seems to underreact to supply shocks and overreact to monetary policy shocks
   - Questions the validity of this commonly used estimate, as it underreacts to shocks that affect the near-term productive capacity of the economy, and overreacts to transitory demand shocks such as MP shocks
2. Response of the neutral rate to macroeconomic shocks is relatively persistent
   - Impact up to 2y and beyond, particularly for demand and MP shocks
   - Shocks to the SR neutral rate hard to distinguish from movements in the LR trend, especially if they move in same direction
   - Difficulty in disentangling persistent SR and LR movements of r-star also can explain diverging views on what kept r-star deflated after the GFC
3. Given the importance of the neutral rate in the realm of central banking, this endogeneity between monetary policy rate and SR r-star can complicate policy decisions
   - Expansionary monetary policy can deflate SR r-star, further reducing headroom for policy

Discussion

- Our results raise 2 questions
  - How can the Federal Reserve use r-star within their policy framework given its imprecise estimates, its sensitivity to shocks, and its endogeneity with monetary policy itself?
  - Given the latter interaction of policy rates and r-star when the economy is at the ELB, how should we think about the effectiveness of unconventional monetary policy?
    - We examine the transmission channels between monetary policy and r-star and link our results with literature

▸ Interactions

Role of R-star in Policy Making

- When assessing the stance of monetary policy, policymakers turn to the neutral rate as reference guide (Fischer, 2016)
  - For example, Taylor rule (1993) prescribes a policy rate based on where output and inflation stand compared to their equilibrium rate
- However, 2 caveats regarding r-star in policy making
  1. Estimates of neutral real unstable, imprecise and often revised with new data (Beyer and Wieland, 2019; Hamilton et al., 2016)
     - Policymakers could perceive r-star to be higher/lower than actual value and make costly mistakes (Ajello et al., 2021)
  2. Changing economic environments alter perception of neutral rate, and might require different policy response
     - Response to macroeconomic shocks is long-lived, and can be confounded with movements in LR neutral rate
     - Policymakers acknowledge dangers of such persistent deviations
     - For example, Powell (2022, p.2) highlights that "*In current circumstances, with inflation running far above 2 percent and the labor market extremely tight, estimates of longer-run neutral are not a place to stop or pause.*"

Role of R-star in Policy Making

- How should policymakers best deal with these concerns?
  - Risk-management strategy (Powell, 2018)
    - Multiple Reserve Banks produce estimates of r-star, thus providing a whole range of measures
  - Careful approach whereby they wait to see whether information distilled from equilibrium rates also translates into observable variables
    - Monitoring broad set of variables and looking beyond inflation for signs of pressures
  - In recent years, inflation no longer best indicator of tightness in labor market or pressures regarding resource utilization, due to flattening Phillips curve and anchoring of expectations (Jorgensen and Lansing, 2019)
    - Most destabilizing excesses have emerged from financial markets
    - Interaction financial cycles and inflation, brings financial stability concerns closer into monetary policy realm (Borio, 2021)

Conclusion

- We test validity of estimates of SR neutral rate based on their response (magnitude, sign and persistence) to macroeconomic shocks
  - While demand shocks are as expected, r-star estimate seems to underreact to supply shocks and overreact to monetary policy shocks
    - When economy in low-rate low-inflation environment, expansionary monetary policy has forceful downwards impact on r-star
  - Positive demand shocks typically push up neutral real rate, while negative supply shocks have similar effect
    - Helpful in understanding some of recent, post-pandemic developments, whereby policymakers have warranted strong tightening by arguing that neutral real rate has increased substantially
  - Our mechanism is compatible with secular phenomena, as we analyze SR, more volatile component of neutral rate
    - Shocks to SR r-star have relatively persistent effects, and can thus push its values away from LR neutral rate for a considerable period of time

Conclusion

- We offer a LR view on r-star, showing substantial mean-reversion over time
  - Extending HLW measure to 1920s yields a more cyclical series, and higher values post GFC
  - There has been a strong focus on the very recent developments in r-star, with a particular focus on the last decades
    - Although important, these must be seen within a longer term perspective
    - High rates in 1980s rather exceptional and have their specific macroeconomic reasons
- Our analysis adds to current discussion around efficacy of neutral rate and its use in policy setting, and offers 2 avenues forward
  - It can raise more awareness with policymakers about the endogeneity between monetary policy and neutral rate, especially when policy rate is near the ELB
  - It may inspire researchers to take into account this interaction more explicitly when modeling neutral rate
    - Importance of persistent temporary shocks could improve our estimates

Conclusion

- Central banks should be cautious when using neutral real rate in making policy decisions
  - Shocks could dictate the trajectory of their seemingly ideal policy rate
  - Commonly used measures of r-star should be interpreted as SR concepts, which can still be influenced by cyclical forces; and not as LT returns absent of shocks
- Our work also brings together monetary policy and financial stability concerns by looking at the self-sustained consequences of low rates
  - We witnessed an extraordinary amount of monetary policy accommodation over the last 2 decades
    - Assumption that neutral real rate had dropped substantially due to reasons exogenous to central bank decision making
  - However, this aggressive policy strategy might be less effective when the economy is in a debt trap, and could even exacerbate the issues in LR by endogenously pushing down r-star

Conclusion

Thank you!

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Motivation

- Low interest rate environment - **low-for-long** (Bernanke et al., 2019)
  - Strategy review Fed/ECB
- Self-fulfilling element? (Bullard, 2018)
  - *Has MP partly been responsible for deflating real rates?*
    - Policy rates close to/at ZLB
- Low inflation environment
  - Asymmetry in MP impact (Barnichon et al., 2017)
  - Pushing on a string (Tenreyro and Thwaites, 2016)
    - Are CBs able to push inflation expectations up and real rates down at the ELB? (Coibion et al., 2020)

▸ Motivation

Drivers of Structural Decline

- Demographic trends: Impact on intertemporal preferences and intertemporal prices
  - Carvalho, Ferrero and Nechio (2015); Gagnon, Johannsen and Lopez-Salido (2016); Cooley and Henriksen (2018); Lunsford and West (2019); Eggertsson, Mehrotra and Robbins (2019); Papetti (2020)
- Inequality
  - Auclert and Rognlie (2016); Straub (2017); Rannenberg (2019); Mian, Straub and Sufi (2021)
- Supply side: Intangible capital and market power
  - Farhi and Gourio (2018); Nattal and Stoffels (2019)
- Safe Assets
  - Bernanke (2015), Del Negro et al. (2017); Caballero, Farhi, and Gourinchas (2017); Glick (2019); Ferreira and Shousha (2020)
- Other:
  - Fiscal Policy: Rachel and Summers (2019)
  - Technological Change: Eichengreen (2015)

▸ Measures of the neutral rate

R-star Measures

▸ R-star Measures

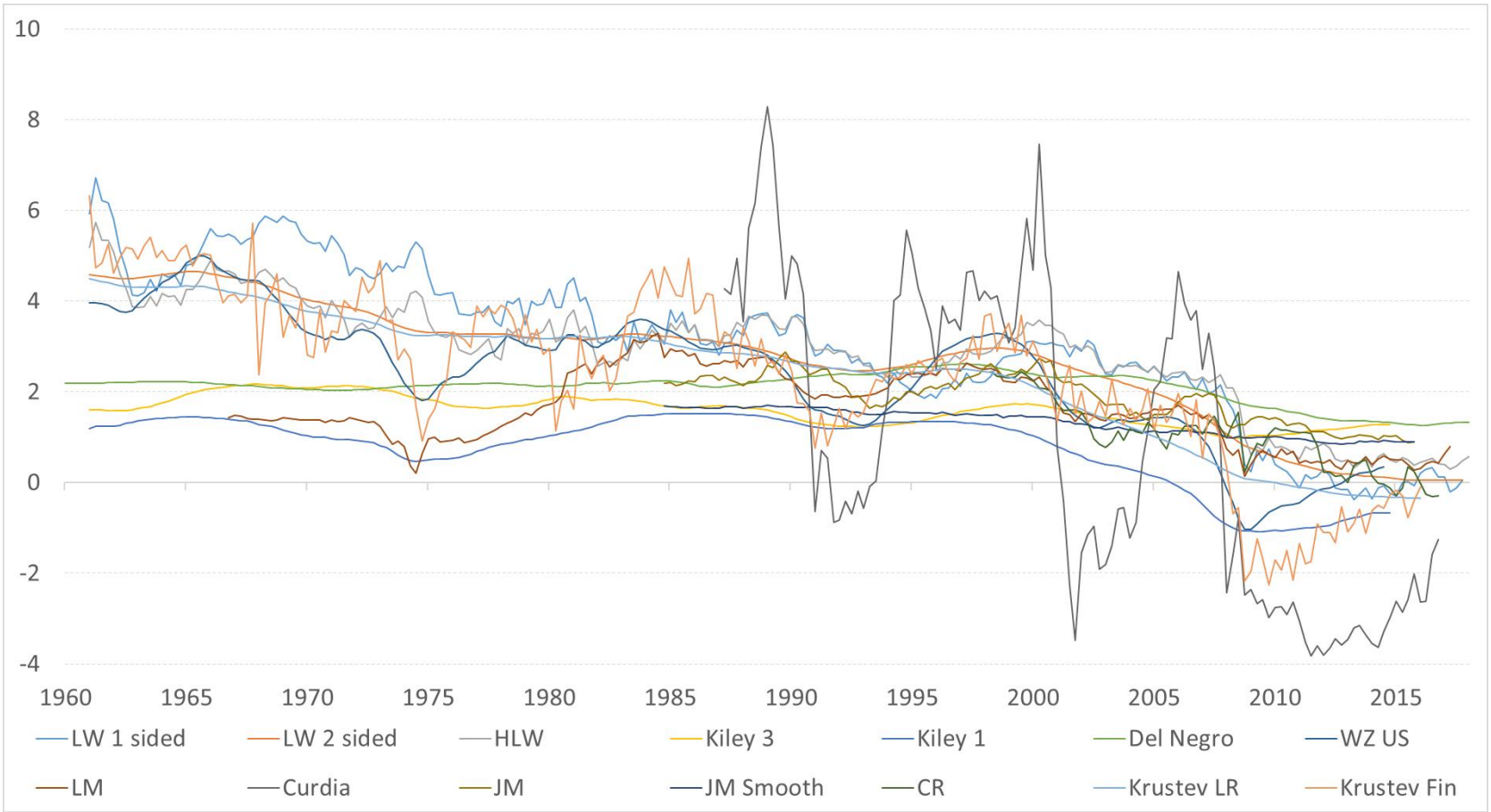
Index	Authors	Model
LW 1 sided	Laubach and Williams (2003-2016)	NK
LW 2 sided	Laubach and Williams (2016)	NK
HLW	Holston, Laubach, Williams (2017)	NK
Kiley 3	Kiley (2015)	Bayesian
Kiley 1	Kiley (2015)	Bayesian
Del Negro	Del Negro et al (2016)	Factor
WZ US	Wynne and Zhang (2016)	2 country
LM	Lubik and Matthes (2015)	TVP forecast

R-star Measures

Index	Authors	Model
Curdia	Curdia et al (2015)	NK
JM	Johannsen and Mertens (2016)	Endogenous ST IR
JM Smooth	Johannsen and Mertens (2016)	Endogenous ST IR
CR	Christensen and Rudebusch	Fin Measures
Krustev LR	Krustev (2018)	NK
Krustev Fin	Krustev (2018)	NK and fin frictions
Fior	Fiorentini et al (2018)	Local level Model

▸ R-star Measures

Disparity R-star Measures in Literature



▸ R-star Measures

Application HLW to Historical Data

▸ Time Series R-star

Macro Series	Sources
Consumer Prices ST Rates	Fred, Alfred (multiple series)
LT IR	Shiller, Alfred (multiple series)
RGDP	Balke and Gordon (1986), Romer (1996), Alfred

Stationarity Test

- Comparison between the historical HLW measure and the original HLW (2017)

▸ Time Series R-star

n=216 (trend and intercept)	Historical HLW	Original HLW	5%Level
Augmented Dickey-Fuller	-4.074	-2.701	-3.431
	(0.008)	(0.238)	
Phillips-Perron	-4.074	-2.749	-3.431
	(0.0080)	(0.218)	
Kwiatkowski et al.	0.248	0.178	0.146

Empirical Model

- Let $Y_t = (y_{1,t}, y_{2,t}, \ldots, y_{n,t})$ be a $n \times 1$ vector of endogenous data

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \ldots + A_p Y_{t-p} + CX_t + \varepsilon_t \quad (1)$$

- $A_1, A_2, \ldots, A_p$: p matrices of dimension $n \times n$ containing parameters for endogenous variables
  - C : $n \times m$ matrix with coefficients for exogenous regressors, captured by an $m \times 1$ vector X_t (featuring constant terms, time trends, and other exogenous data series)
  - $\varepsilon_t = (\varepsilon_{1,t}\, \varepsilon_{2,t}\, \ldots\, \varepsilon_{n,t})$: vector of residuals following a multivariate normal distribution: $\varepsilon_t \sim N(0, \Psi)$

▸ Empirical Model

Empirical Model

- Impact of shocks on neutral rate estimated in structural BVAR model
  - We follow Baumeister and Hamilton (2018), and rely on an asymmetric t-distribution for incorporating info about signs in non-dogmatic way
  - Reduced form VAR is given by

$$y_t = \Phi x_{t-1} + \varepsilon_t \quad (1)$$

$$\Phi = A^{-1} B \quad (2)$$

- Reduced-form residuals and structural shocks relate to each other as follows

$$\varepsilon_t = A^{-1} u_t \quad (3)$$

$$E\left(\varepsilon_t \varepsilon_t^{'}\right) = \Omega = A^{-1} D \left(A^{-1}\right)^{'} \quad (4)$$

- We assume that structural shocks u_t are mutually uncorrelated white noise with $E\left(u_t u_t^{'}\right)$ given by diagonal matrix D
  - Number of lags m is set to 4

▸ Empirical Model

Empirical Model

- We include 6 variables in our framework
  - On the one hand, we rely on three core variables: output gap, inflation rate, and federal funds rate: y_t, π_t, r_t
- Our model can be described by **3 state equations**
  - These include a Phillips Curve, an aggregate demand equation, and a monetary policy rule

$$y_t = k^s + \alpha^s \pi_t + \left[b^s\right]' x_{t-1} + u_t^s \tag{5}$$

$$y_t = k^d + \beta^d \pi_t + \gamma^d r_t + \left[b^d\right]' x_{t-1} + u_t^d \tag{6}$$

$$r_t = k^m + \zeta^y y_t + \zeta^\pi \pi_t + \left[b^m\right]' x_{t-1} + u_t^m \tag{7}$$

▸ Empirical Model

Empirical Model

- Matrix A summarizing contemporaneous structural relations then

$$A = \begin{bmatrix} 1 & -\alpha^s & 0 \\ 1 & -\beta^d & -\gamma^d \\ -\zeta^y & -\zeta^\pi & 1 \end{bmatrix} \tag{8}$$

- To identify supply, demand and monetary policy shocks $\left(u_t^s, u_t^d, u_t^r\right)$, we need additional info about elements of A
  - Prior beliefs about underlying economic structure, imposed on the elements of A, are incorporated in a less dogmatic way
    - Contrast with traditionally hard restrictions
  - Weighting different elements in the identified set with their prior plausibility, i.e. by assigning plausibility to their different magnitudes, allows us to incorporate uncertainty about the model itself
    - Inference guided by prior information about signs but also about magnitudes

▸ Empirical Model

Empirical Model

- We add **three additional variables** to this basic framework: the real neutral rate, commodity prices and earnings
  - By adding our r-star measure, we can test impact of macroeconomic shocks on the neutral rate
    - Our approach, which incorporates Bayesian priors to assign plausibility to different magnitudes, is helpful given the uncertainty around the neutral real rate
  - Additionally, commodity prices are included to help mitigate the price puzzle, while earnings provide insights on second round effects arising from inflation.
- Our estimation is based on quarterly data
  - Full sample runs from the start of 1962 until end of 2015
    - Estimation over 3 subsamples

▸ Empirical Model

Subsamples

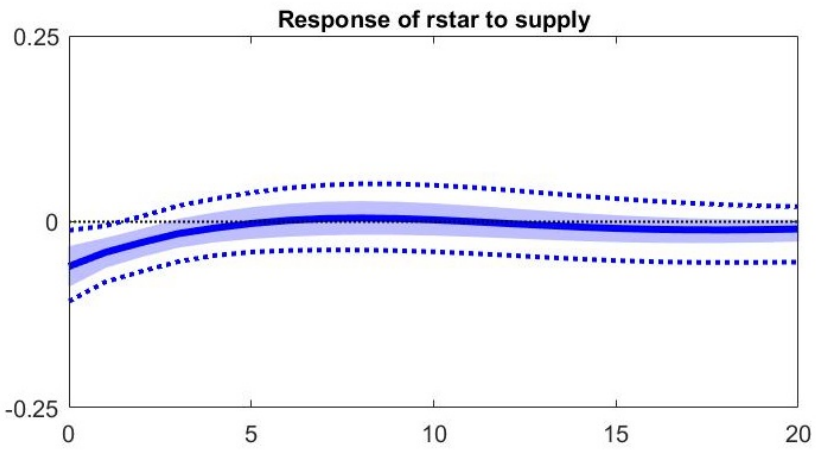
- **1962Q1-1979Q4**
  - Pre-Volcker
  - Oil Shocks during 70s
- **1980Q1-1997Q4**
  - Volcker disinflation (Mumtaz and Theodoridis, 2020)
  - Recession (double dip) in early 80s
- **1998Q1-2015Q4**
  - Inflation trap (Krugman, Delong)
    - Since 1998, the interest rate gap for AEs remains negative
    - Actual LT real interest rate minus 20y moving average
  - Boom and bust cycle (dot-com, GFC)

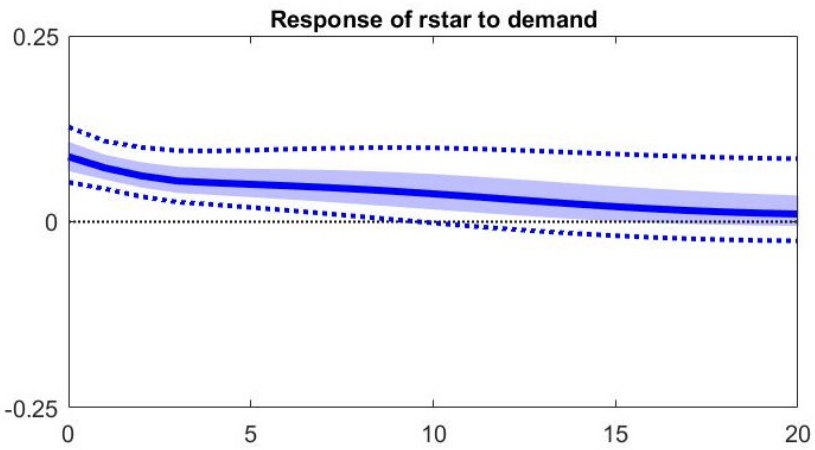
▸ Empirical Model

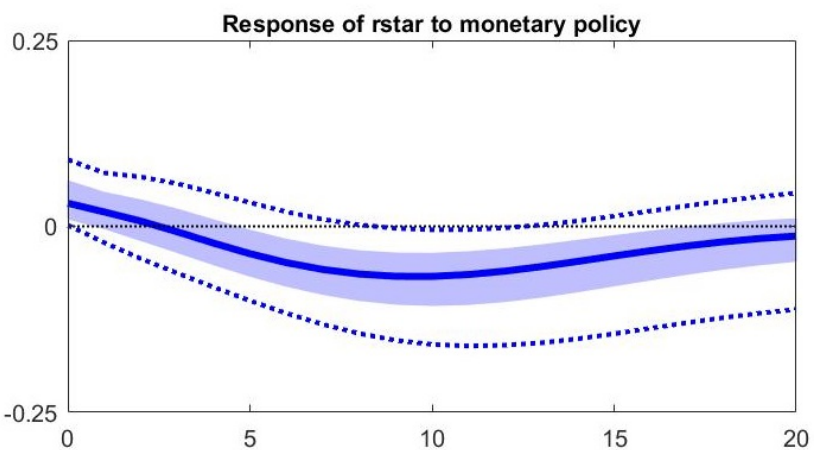
Period 1: 1962Q1 - 1979Q4

- During this period, US economy was hit by a series of sizable and persistent macroeconomic shocks
  - Collapse of Bretton Woods system, which led to end of dollar's convertibility to gold in 1971, and 2 oil shocks in 1973–74 and 1978–79 (Lubik et al., 2016)
- Nobody at Fed "in a position to make anti-inflation policy placed a sufficiently high priority on stopping inflation" (DeLong, 1997, p.249)
  - Monetary policy stance was overly expansionary in response to the macroeconomic shocks
    - Loss of credibility and double digit inflation values
    - By end of subsample, CPI stood close to 15%, highest value in more than 30y

Period 1 IRFs for R-star

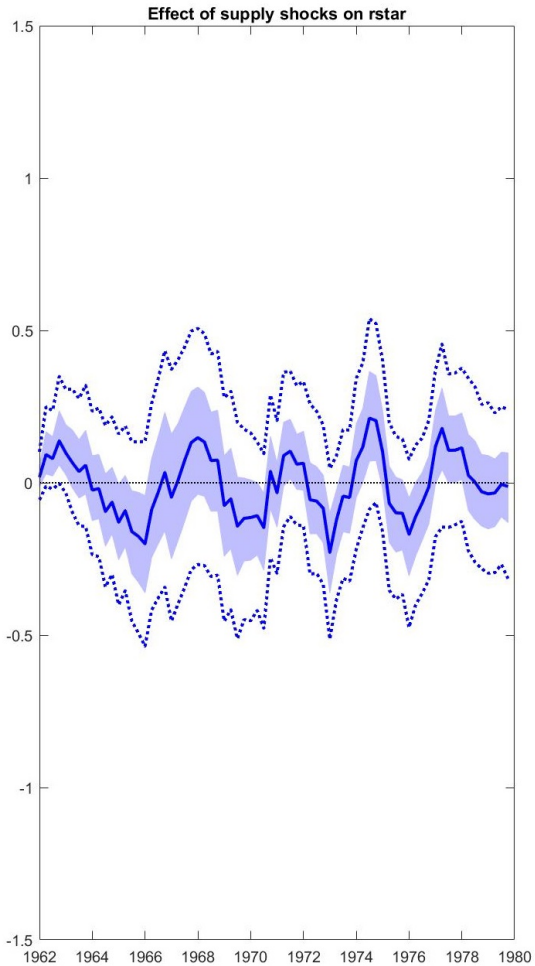


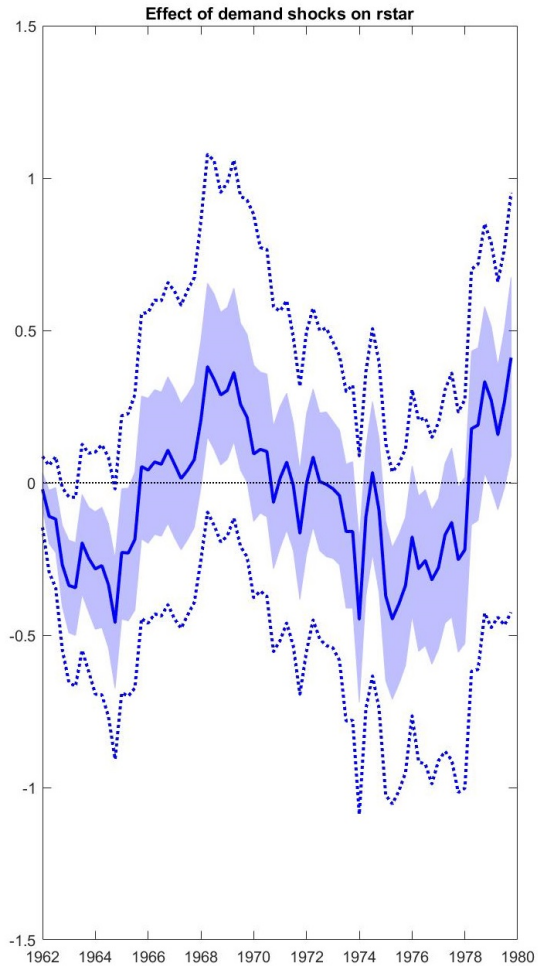


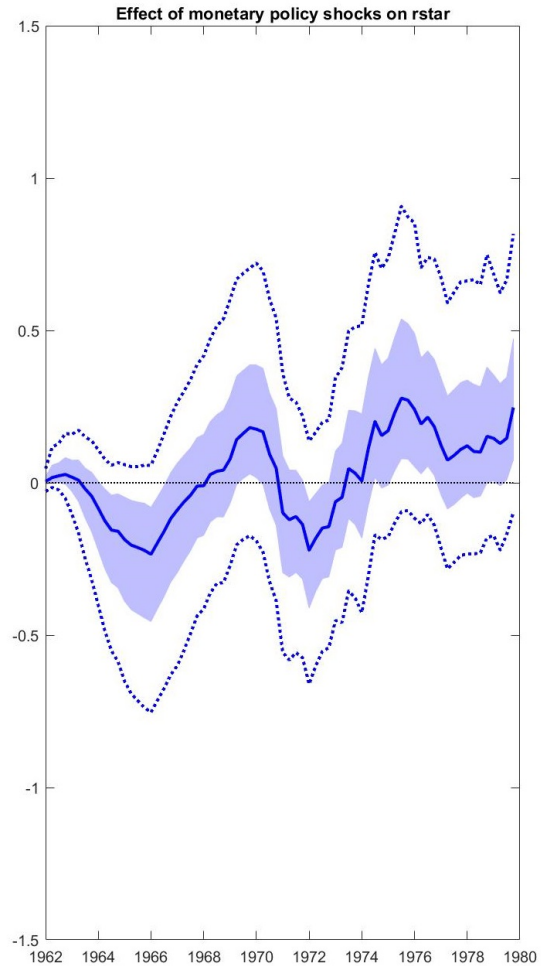


▸ Period1-IRF-Main ▸ Back

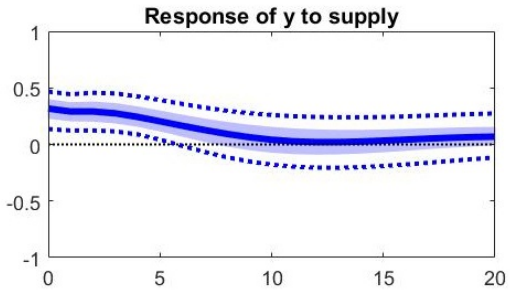
Period 1 Historical Decomposition R-star

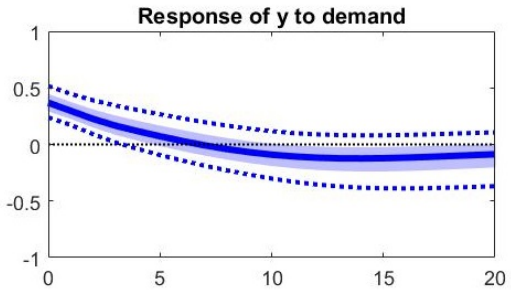


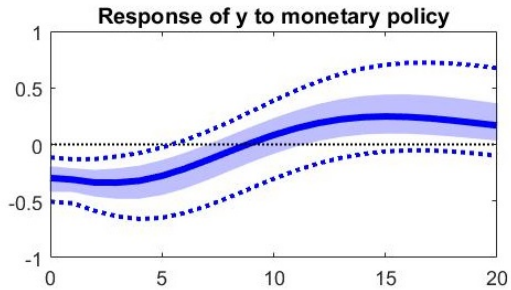


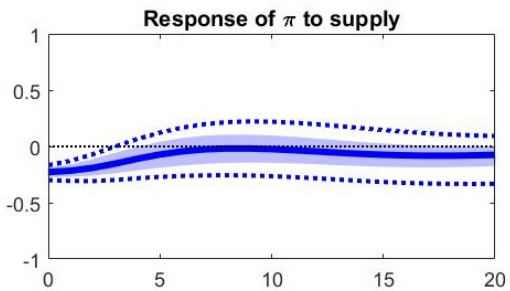


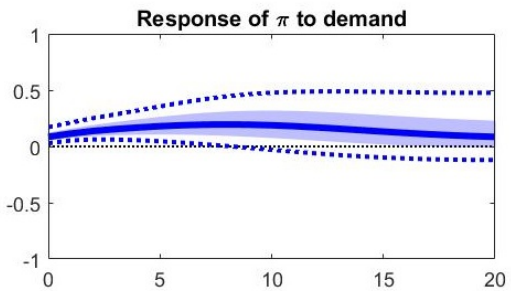
Period 1 IRFs

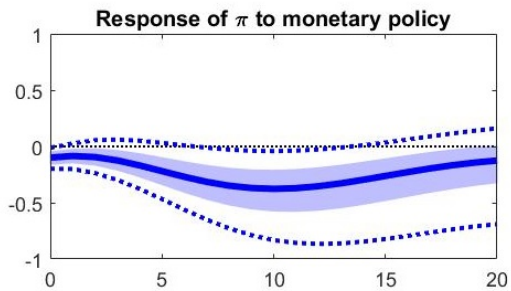


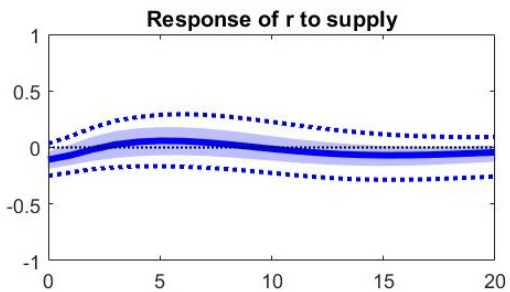


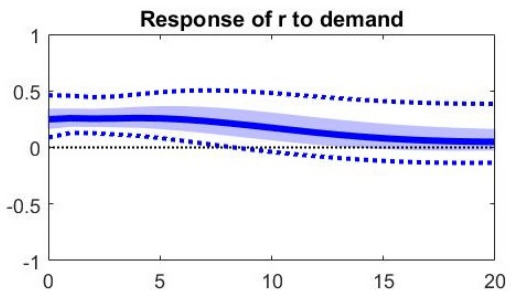


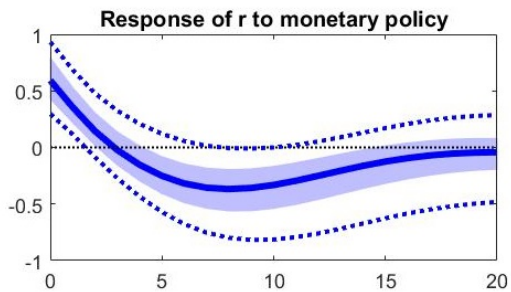










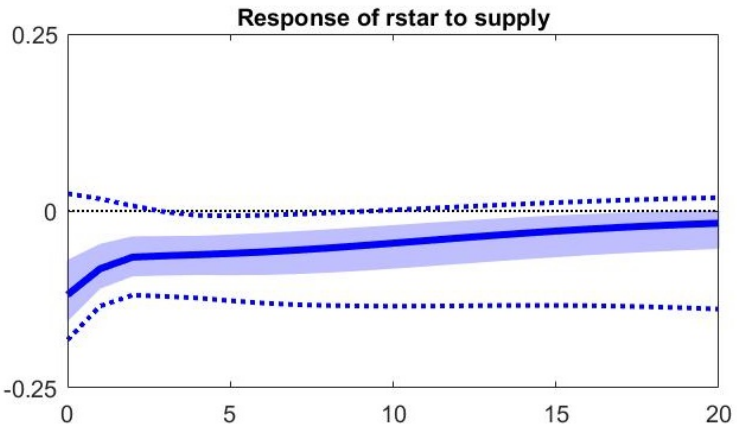


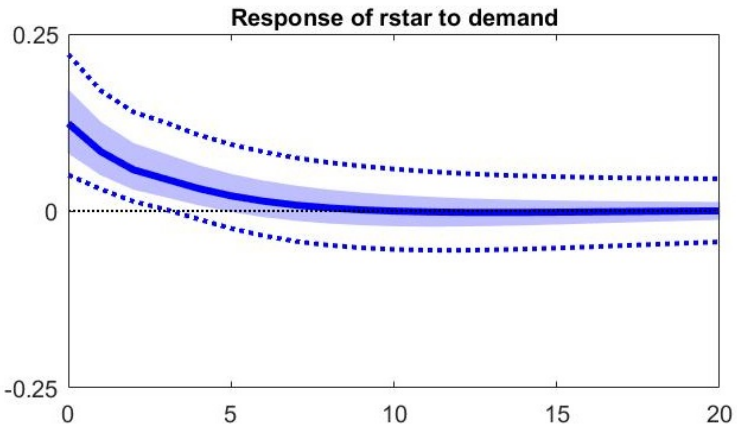
▸ Period 1 ▸ Back

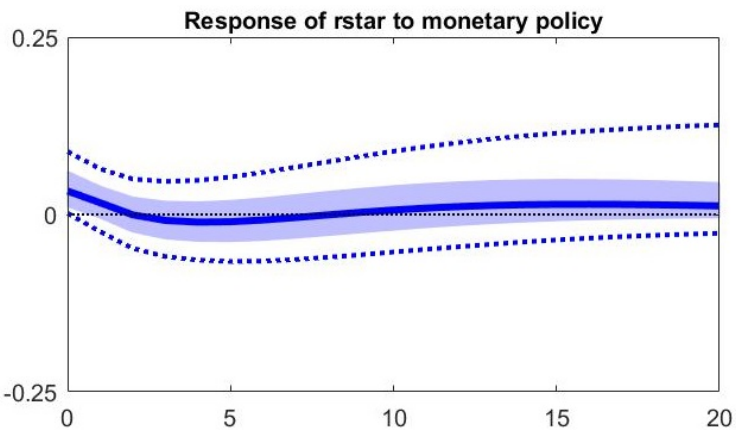
Period 2: 1980Q1 - 1997Q4

- Volcker disinflation: Fed established its credibility and managed to anchor inflation expectations (Kliesen and Wheelock, 2021)
  - Initially, painful process causing double dip recession in early 80s
  - But subsequent period (great moderation): substantially lower variability of both output and inflation (Kim and Nelson, 1999)
- Next to policy change, also important structural changes (McConnel and Perez-Quiros, 2000)
  - Both technological and institutional changes as well as business practice improvements (e.g. inventory management) helped improve ability to absorb shocks (Bernanke, 2004)
  - Increased globalization, particularly with entry of Soviet bloc, China and emerging market economies, put further downward pressure on inflation (Borio, 2021)
- Shocks hitting economy also more benign, comparatively smaller and less frequent
  - Stable oil prices also helped stabilize the economy (Nakov and Pescatori, 2010)

Period 2 IRFs for R-star

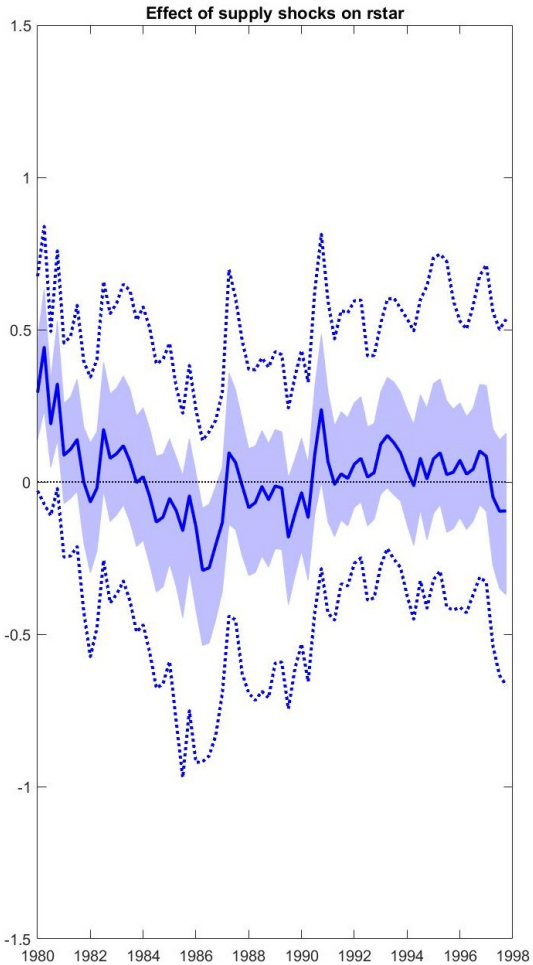


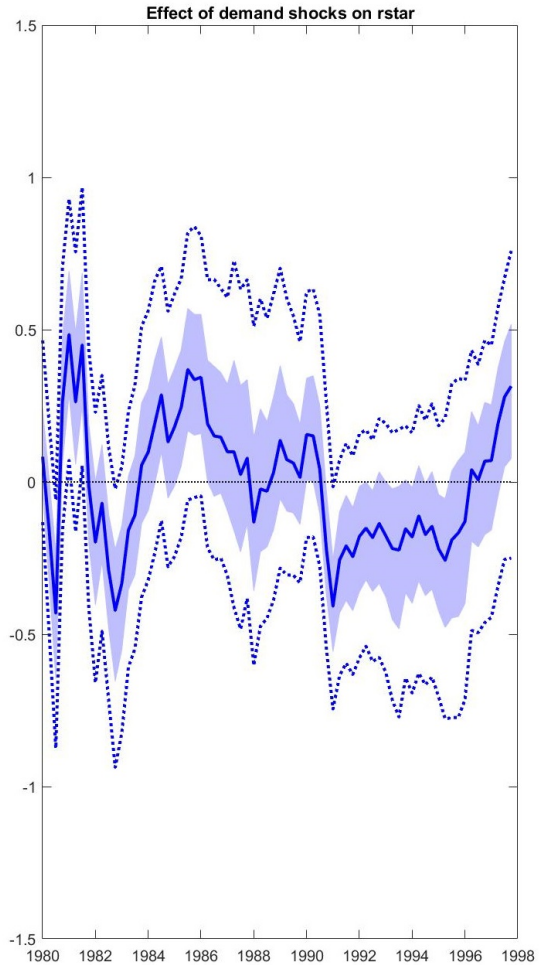


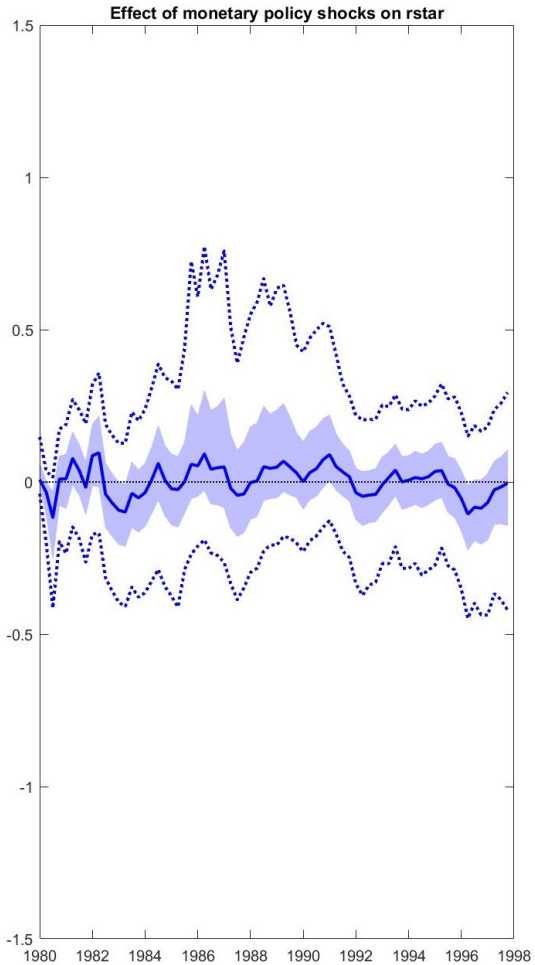


▸ Period2-IRF-Main ▸ Back

Period 2 Historical Decomposition R-star







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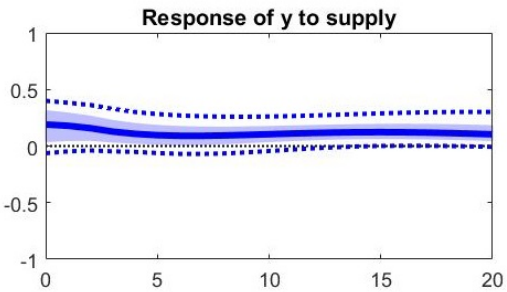
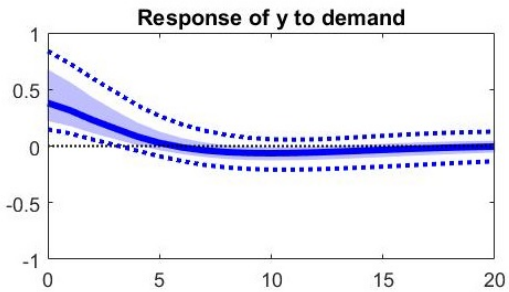
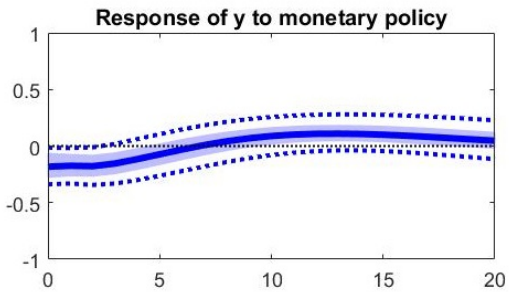
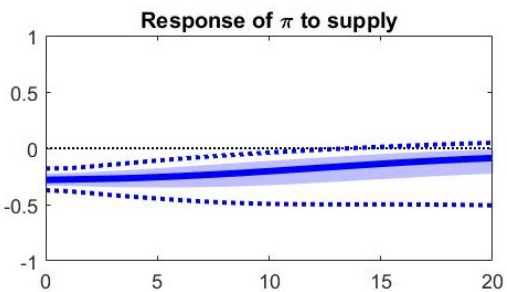
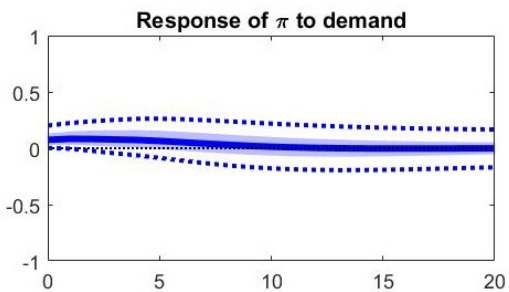
Period 2 IRFs

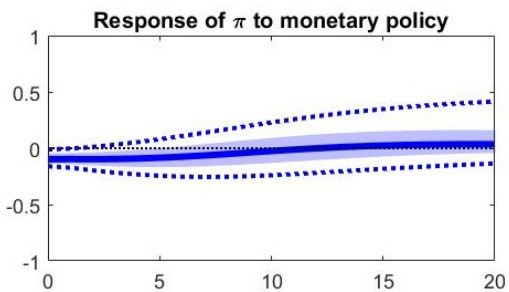


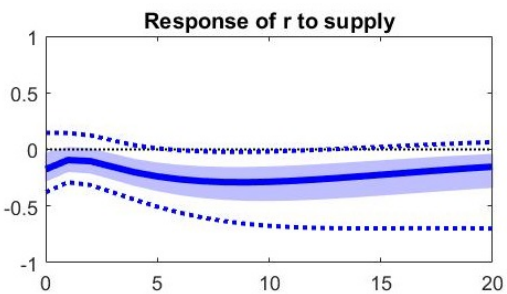


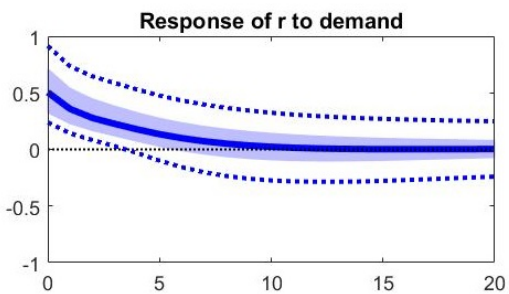


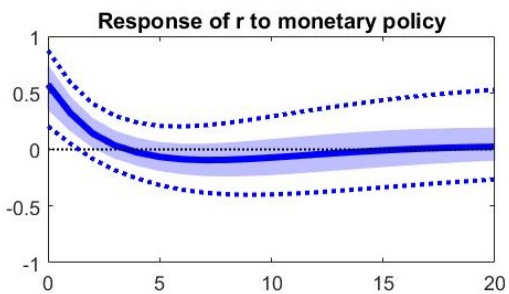












▸ Period 2 ▸ Back

Period 3 Historical Decomposition - Supply

- Contribution **supply shocks** is subdued in first half of sample
  - Small/positive contributions in 2001/in 2003; but not significant
    - Baumeister and Peersman (2013): relevance of oil supply shocks gradually ↑ in early 2000s; but contribution for r* limited
  - After that, small negative contributions until 2004 (not significant)
  - Impact of supply shocks positive from mid-2004 until mid-2006, effect small/not significant
    - Fernald (2015): from 2004 onward, productivity from high-growth to low-growth state
  - For first part, r* seems to underreact to shocks that affects near-term productive capacity of economy
- In contrast, bigger impact supply shocks in second part of sample
  - Strong positive contribution from mid 2007 until mid 2009
    - Oil price shock → strong demand/stagnant supply (Hamilton, 2009)
  - Negative contributions in mid 2010 when unit labor costs ↓
  - Small negative contributions from mid 2012 until end of sample
    - Baumeister and Killian (2017): sharp/prolonged drop in global price of crude oil after June 2014

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Period 3 Historical Decomposition - Demand

- **Demand shocks** contribute positively at start of subsample, from 1998 until mid 2001
  - However, positive impact dies out rapidly after peak around mid 2001
    - Baker and Wugler (2007): investor sentiment high before dot com bubble burst in 2000
  - During this period, neutral rate seems to overreact to transitory demand shocks
- From mid-2008 onward, contributions turn significantly negative, and remain so until end of 2011
  - Measures of uncertainty increased during 2008-2009, and stayed high during lengthy parts of recovery
    - Leduc and Liu (2016): surges in uncertainty worsened deep recession and impacted slow recovery
  - Given more profound impact of these demand shocks on productive capacity, strong contribution to r-star more in line with expectations
- For latter part of subsample, contribution of demand shocks not significant

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Period 3 Historical Decomposition - MP

- While contribution of **monetary policy shocks** is positive in 1998, impact mostly not significant for first part of subsample
  - Bordo and Haubrich (2010): recession of 2001 was preceded by modest tightening
- From 2006 until mid 2007, significant positive impact of MP shocks
  - Before the GFC, the Fed engaged in a tightening cycle starting in June 2004, after a period of 3y during which rates were markedly low (BH, 2010)
- Sign of contributions reverses strongly during GFC, when the Fed lowers policy rate and engages in QE programs
  - Largest negative contributions in 2008 and 2010
  - Similar negative impact towards end of sample, from mid-2014 onward until end of 2015
    - FFR was kept near the ELB until end of subsample
  - During this subsample, r* seems to overreact to MP shocks
    - Violates prevailing Neo-Wicksellian view that r-star is largely exogenous to MP
    - Contribution of MP shocks to neutral rate is strongest when economy at or near ELB

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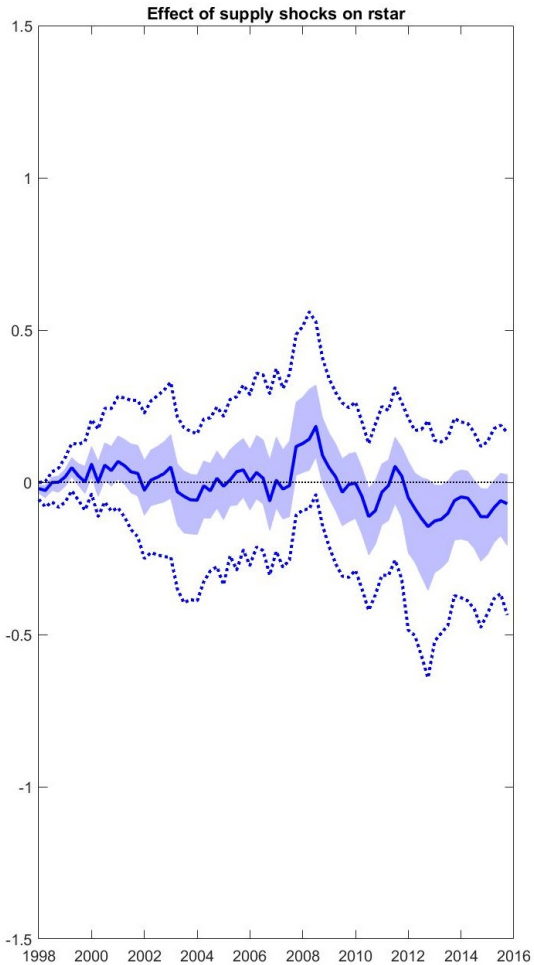
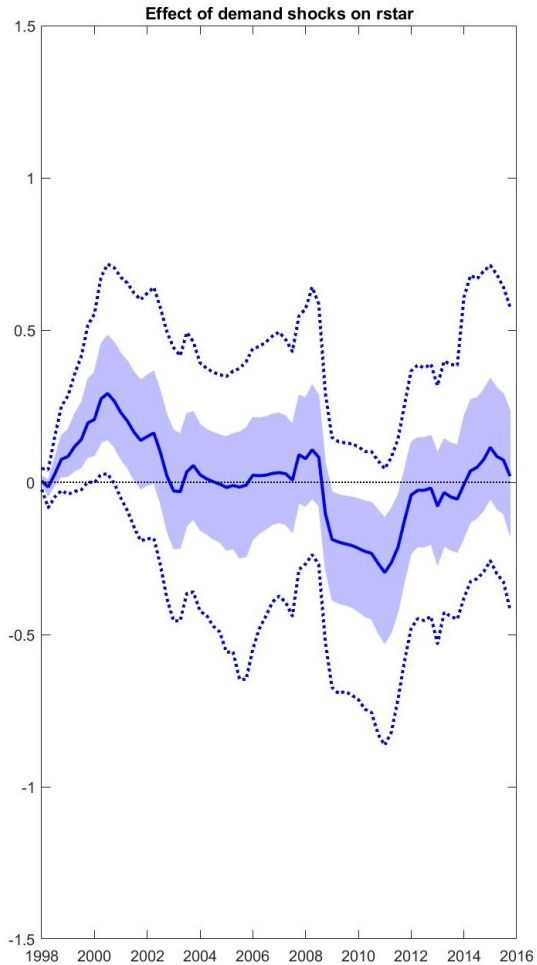
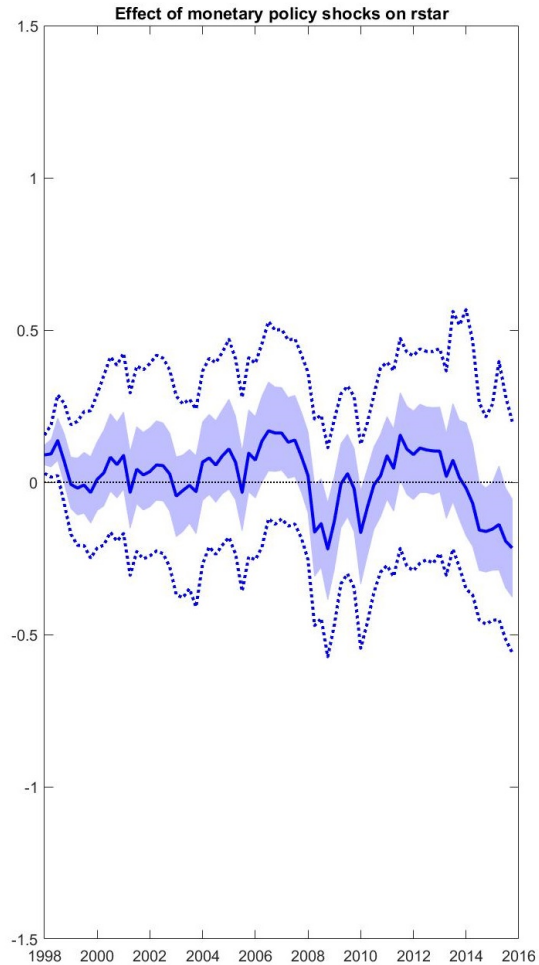
Period 3 Historical Decomposition R-star







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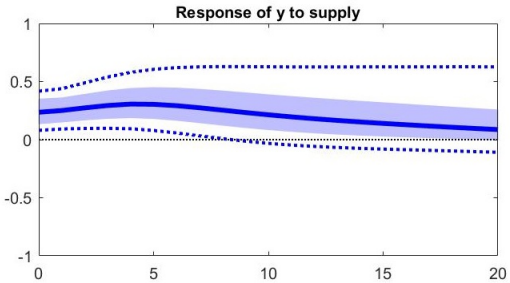
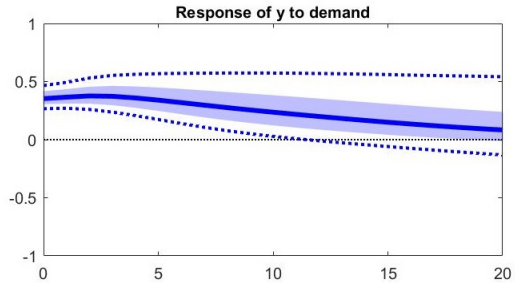
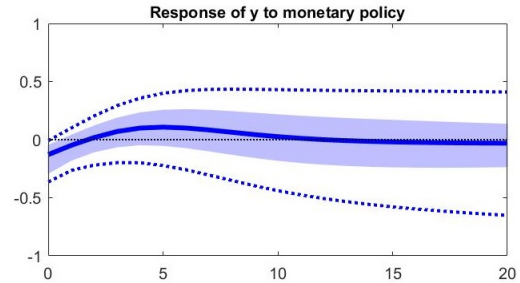
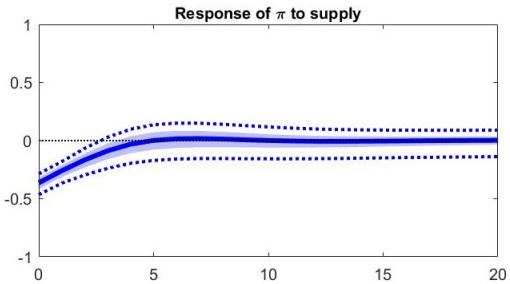
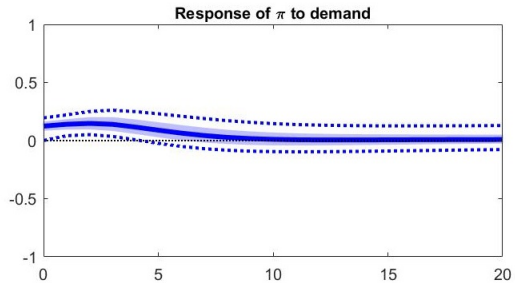
Period 3 IRFs

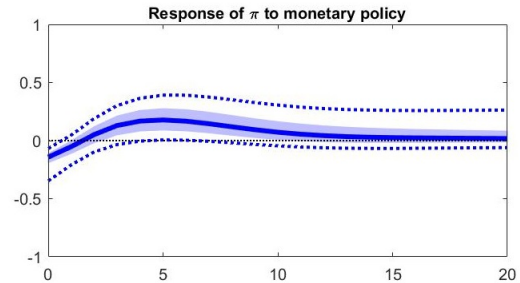


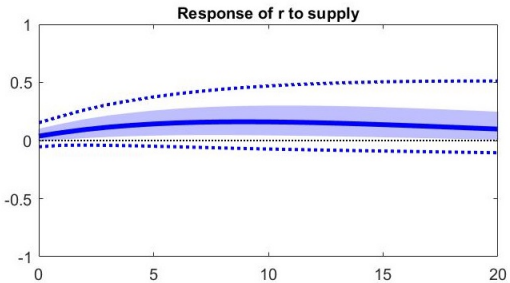


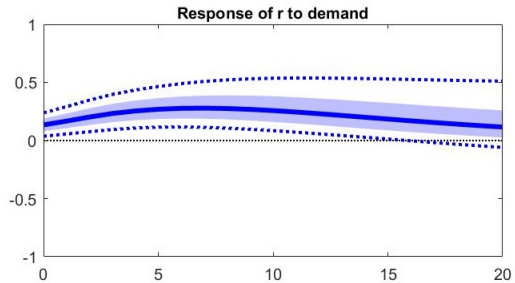


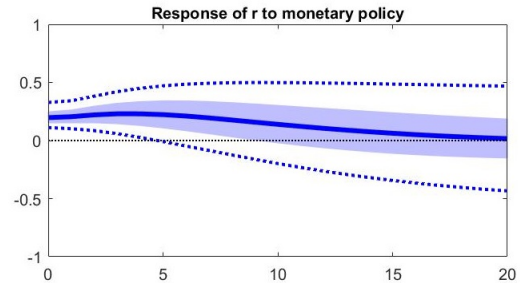












▸ Period 3

Interactions Monetary Policy and R-star

- Mechanisms and policy consequences of our finding that monetary shocks can impact the neutral rate
  - Particularly when the economy is at the ELB, this pass-through is strong, with half of changes in policy rate transmitted to r-star
  - Accomodative monetary policy has potential to further depress r-star
- Several authors have discussed potential channels for this transmission
  - Most of these involve an intertemporal trade off, involving SR stabilization at the expense of less durable consumption, financial fragility , and debt accumulation going forward
  - Other channels work through information feedback between central bank and financial markets, or entail some degree of capital misallocation

▸ Discussion

Interactions Monetary Policy and R-star

- Expansionary monetary policy prompts households to bring forward the purchase of durable goods (McKay and Wieland, 2021)
  - Increase today but fewer households buying these goods going forward
    - Interest rates must remain low to support demand in future
    - Accomodative monetary policy today deflates $r*$ going forward
    - Particularly important since GFC
- Shirakawa (2021): low rates shift consumption from future to present, but limits to this process.
  - Prolonged periods of low policy rates, to boost SR output, risk build up of financial imbalances; potentially lead to larger output losses and lower interest rates
- Rungcharoenkitkul et al. (2019) coin this as monetary hysteresis
  - Self-perpetuating interaction between credit conditions, asset prices and risk-taking
    - Akinci et al. (2021) propose a financial stability r-star, which provides a benchmark for financial stability, similar benchmark in terms of macroeconomic stability by neutral rate

▸ Discussion

Interactions Monetary Policy and R-star

- Another channel examine build up of debt
  - Mian et al. (2021): expansionary (monetary and fiscal) policy can cause debt-driven booms in SR while leading to depressed demand and lower rates of natural rates in future
    - As stimulus fades and debt repayments have to made, demand wanes
    - Central banks forced to maintain accommodative stance to avoid a downturn, pushing policy rates to effective lower bound
    - Economy ends in debt-driven liquidity trap with depressed output
    - High levels of private and public debt also make economy more vulnerable to rate hikes, with deleveraging shocks depressing aggregate demand (Eggertson and Krugman, 2012)

▸ Discussion

Interactions Monetary Policy and R-star

- Rungcharoenkitkul and Winkler (2021): interaction between central bank and the private sector can create a hall-of-mirrors effects that can explain much of the decline in real interest rates since the eighties
  - Model contains endogenous beliefs and learning feedback whereby each side tries to learn each other's private information
  - Expansionary MP shocks can trigger downward revisions in perceived r-star by both CB and private sector
  - Interest rates may display a secular trend, without any changes in true fundamentals
- Caballero and Simsek (2022) introduce a similar model
  - While central bank and private sector agree on concept of neutral rate, differences in their priors and beliefs are not updated based on observations of the economy

▸ Discussion

Interactions Monetary Policy and R-star

- Declining interest rates also affect investment patterns
  - Less productive entrepreneurs tend to invest more, raising equilibrium price of capital and crowding out more productive entrepreneurs
  - Reallocation effect can be forceful enough to lead to an aggregate output fall after a decline in rates (Asriyan et al., 2021)
  - Relatively unproductive firms have a better survival chances in such a low rate environment, due to increased zombie lending (Acharya et al. 2021)
  - Low long term rates also associated with concentrated markets, higher profits, and lower aggregate productivity growth; and can thus damage LT growth (Liu et al., 2021)
- Low interest rate environments typically also weaken pass through of monetary policy
  - Monetary stimulus has less impact on external financing constraints of banks when rates are low (Heider and Leonello, 2021)
  - Banks also find it harder to pass on reductions in policy rates to depositors (Brunnermeier and Koby, 2018)

▸ Discussion