Drivers of the Global Financial Cycle

John H. Rogers (Fudan) Bo Sun (Virginia) Wenbin Wu (Fudan)

June 3, 2024

International Seminar on Macroeconomics
Basel, Switzerland

What We Try to Understand

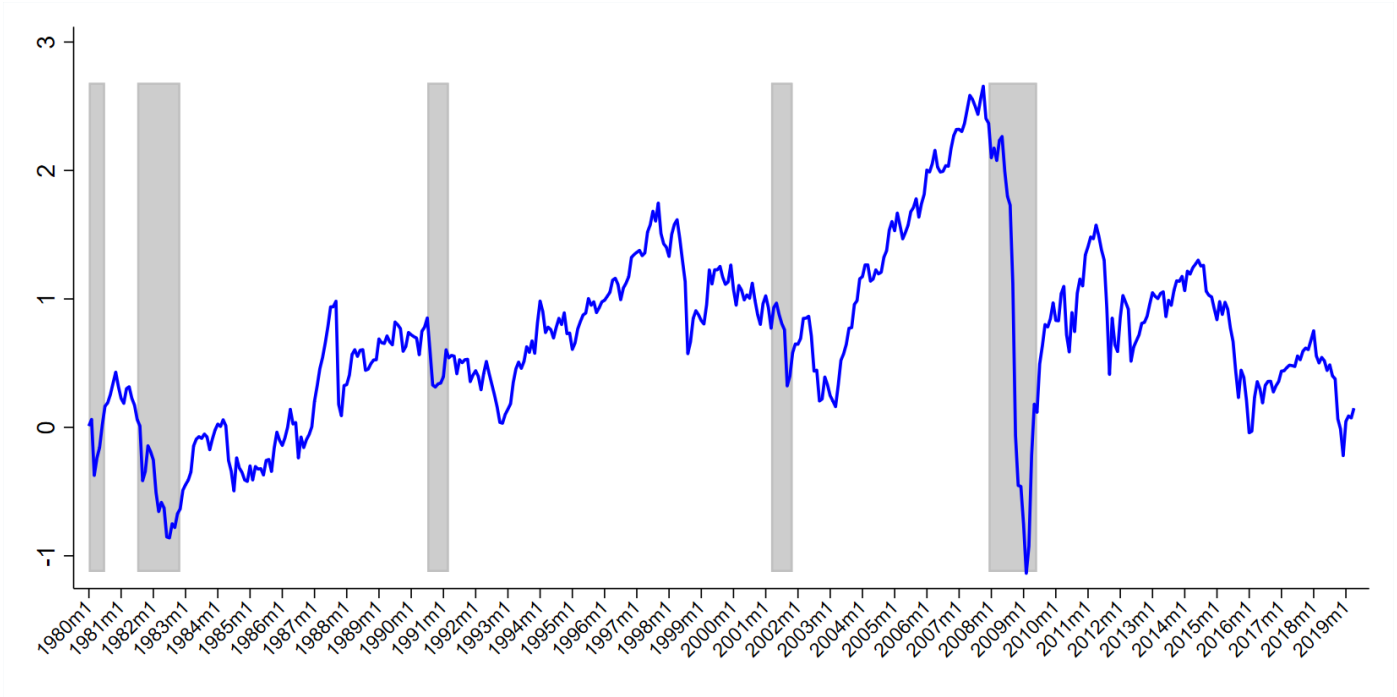


Figure: Rey's Global Financial Cycle Factor (GFC), the common component of global risky asset prices. Large, influential literature on this.

Driving forces of the Global Financial Cycle

The Usual Suspect

- U.S. monetary policy
  - purported major driving force of global asset price factor (Miranda-Agrippino & Rey 2020; Bruno & Shin 2015; Adrian & Shin 2014)

What else?

- yet to be thoroughly investigated

Additional Suspects: Domestic

- U.S. corporate bond spreads
  - drive U.S. aggregate fluctuations
    (Gilchrist and Zakrajsek 2012; Christiano et al. 2014)
  - Fed responds to aggregate fluctuations and inflation (dual mandate)
- Leverage
  - is procyclical
  - global bank leverage also found to drive asset price comovement
- U.S. Term Premium
  - reflects uncertainty about future inflation, interest rates

Additional Suspects: International

Three observations ...

Observation 1

- There are shocks originating outside the U.S.
  - European debt crisis 2010
  - Taper tantrum 2013
  - Chinese stock market crash 2015
  - Brexit 2016
- Fed is aware of these developments

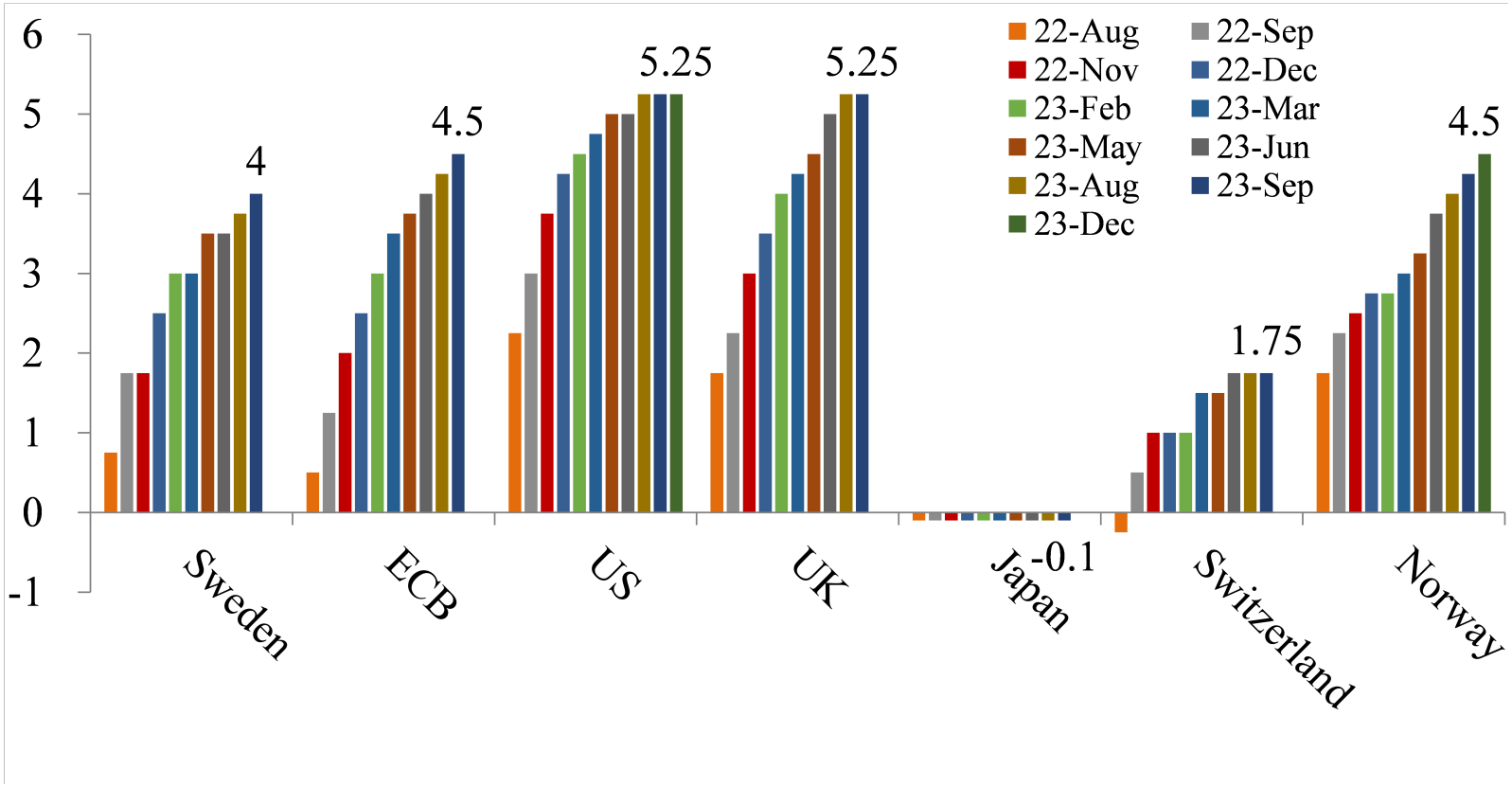
Observation 1

- There are shocks originating outside the U.S.
  - European debt crisis 2010
  - Taper tantrum 2013
  - Chinese stock market crash 2015
  - Brexit 2016
- Fed is aware of these developments
  - Ozge, Raffo, and I all gainfully employed in FRB's IF division

Observation 1

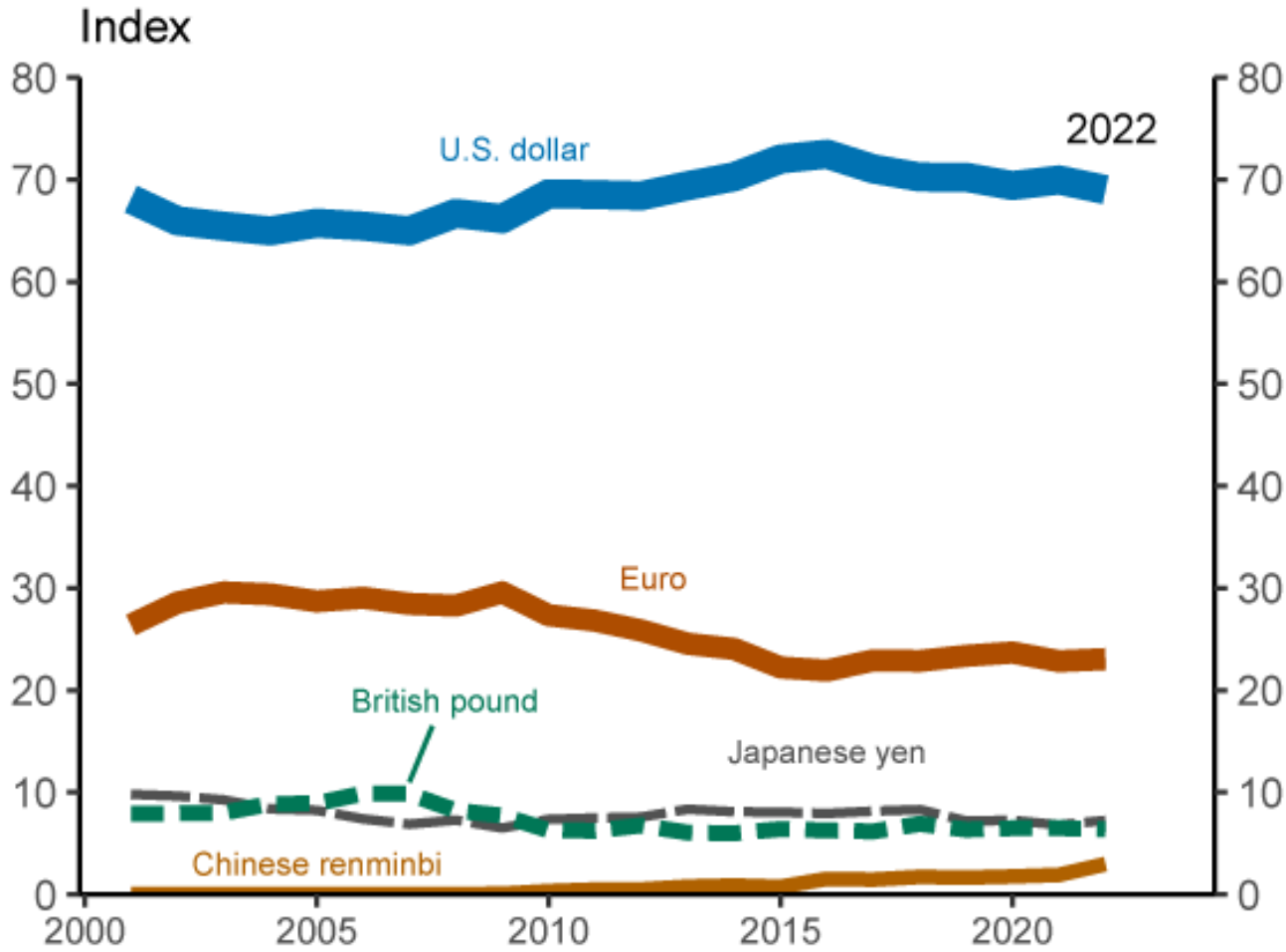
- There are shocks originating outside the U.S.
  - European debt crisis 2010
  - Taper tantrum 2013
  - Chinese stock market crash 2015
  - Brexit 2016
- Fed is aware of these developments
  - Ozge, Raffo, and I all gainfully employed in FRB's IF division
- FOMC is sometimes influenced by such developments

Observation 2: many central banks follow Fed policy



- Maybe foreign monetary policy amplifies Fed policy's effect on GFC

Observation 3: dominant usage of U.S. dollars globally



average of several currency usage indicators, from Bertaut et. al. (FEDS Note)

This paper: an attempt to sort some of this stuff out

- Estimate effects of several simultaneously-identified shocks and explore transmission channels
  - Heteroskedasticity-based Bayesian SVAR framework
- Variance decomposition exercises evaluate shocks' relative importance
- Examine channels, including mechanisms that might *amplify* effects of various shocks

Three Main Findings

- Main driver(s) are shocks to (i) U.S. corporate bond spreads (EBP), (ii) leverage of U.S. banks, and (iii) U.S. term premium

Three Main Findings

- Main driver(s) are shocks to (i) U.S. corporate bond spreads (EBP), (ii) leverage of U.S. banks, and (iii) U.S. term premium
- Relationship between U.S. bond spreads and the global financial cycle features a robust feedback loop that produces amplification effects

Three Main Findings

- Main driver(s) are shocks to (i) U.S. corporate bond spreads (EBP), (ii) leverage of U.S. banks, and (iii) U.S. term premium
- Relationship between U.S. bond spreads and the global financial cycle features a robust feedback loop that produces amplification effects
- Fed monetary policy shocks have negative effects on GFC factor
  - but role relatively small, either directly or in amplification sense
  - robust across indicators of U.S. monetary policy, horizons, VARs

Strategy

Follow econometric identification procedure of Brunnermeier et al. (BPSS, 2021) and the spirit of their application

- Spirit
  - BPSS examine feedback between U.S. credit shocks and U.S. output using an SVAR model that jointly identifies multiple causal channels.
  - Conclude "Shocks to credit spreads generate substantial contractions in output and credit, as do monetary policy shocks. The monetary policy shocks have somewhat larger effects, on average, than the spread shocks. The monetary policy shocks explain a substantial part of the variation in the credit aggregates and in one of the spread variables. These shocks are separately and stably distinguished from one another because of their variability peaking at different points in history."
  - We also rank the contribution of U.S. monetary policy shocks relative to others, now in a global context

Econometrics: SVAR identified by heteroskedasticity

- VAR representation

$$C_0 \boldsymbol{y}_t = \boldsymbol{c} + \sum_{j=1}^{p} C_j \boldsymbol{y}_{t-j} + \boldsymbol{\epsilon}_t, \tag{1}$$

- Identification by heteroskedasticity

$$\epsilon_{it} \sim N\left(0, \gamma_{i,m(t)}\right), \mathcal{T} \mapsto \mathcal{M} = \{1, ..., M\}$$

- The reduced form residual variance-covariance matrix for regime m can be written as $\Sigma_m = C_0^{-1} \Gamma_m (C_0^{-1})'$, so for any two regimes s and t we have

$$\Sigma_s^{-1} \Sigma_t = C_0' \Gamma_s^{-1} \Gamma_t (C_0^{-1}). \tag{2}$$

- An eigenvalue decomposition and rows of C_0 (which are the eigenvectors) are uniquely determined up to scale as long as the diagonal elements of $\Gamma_s^{-1} \Gamma_t$ are unique (i.e., no k, l satisfying $\gamma_{s,k}/\gamma_{t,k} = \gamma_{s,l}/\gamma_{t,l}$)

Econometrics: pros and cons

HB-SVAR procedure of BPSS (2021)

- pros
  - distinguish several channels of interaction

Econometrics: pros and cons

HB-SVAR procedure of BPSS (2021)

- pros
  - distinguish several channels of interaction
  - whenever I read Sims, I'm immediately persuaded!

Econometrics: pros and cons

HB-SVAR procedure of BPSS (2021)

- pros
  - distinguish several channels of interaction
  - whenever I read Sims, I'm immediately persuaded!
- cons
  - reliance on regime choices, including assumption that $C(L)$ are fixed over time regimes; so test
    (Montiel-Olea, Plagborg-Møller, Qian (2022, AER p&p))

Econometrics: pros and cons

HB-SVAR procedure of BPSS (2021)

- pros
  - distinguish several channels of interaction
  - whenever I read Sims, I'm immediately persuaded!
- cons
  - reliance on regime choices, including assumption that $C(L)$ are fixed over time regimes; so test
    (Montiel-Olea, Plagborg-Møller, Qian (2022, AER p&p))

Most frequently used estimation strategy: Sign or Zero Res, TVP, IV, ...

- Miranda-Agrippino and Rey (2020) use external instruments
  - pros: direct interpretation
  - cons: don't identify multiple shocks simultaneously; can't examine amplification

We check alternatives: SV-SVAR and old-friend Cholesky

Regime Choices

Table: Baseline Regime Choices

	Start	End	Description
1	Jan 1988	Dec 1989	Recovery from early 1980s recession
2	Jan 1990	Dec 2007	Great Moderation and Greenspan Federal Reserve
3	Jan 2008	Dec 2010	Great Recession
4	Jan 2011	Dec 2015	Zero Lower Bound, Recovery from Great Recession
5	Jan 2016	Apr 2019	Monetary policy normalization

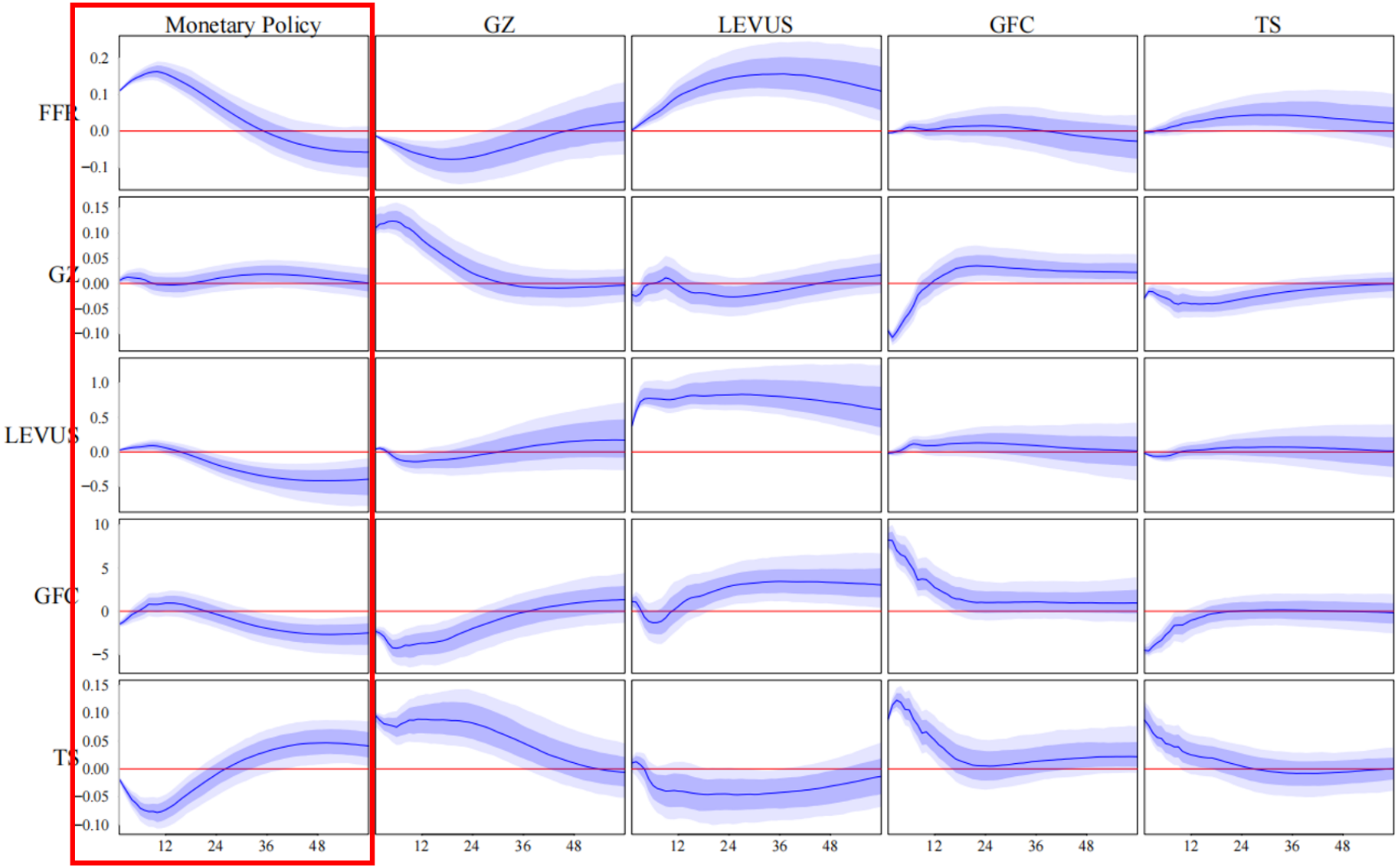
Data Series Used

Variables	Description
IP	US industrial production from FRED (code: INDPRO)
GFC	Global factor estimated by Miranda-Agrippino, Nenova and Rey (2020)
Risk aversion	Global risk aversion decomposed from GFC
Risk appetite	Risk appetite measure of Bauer, Bernanke and Milstein (2023)
FFR	Federal Funds Effective Rate from FRED (code: DFF)
WX	Wu-Xia Index as in Wu and Xia (2016)
FG	Forward Guidance as in Swanson (2021)
BRW	"Unified" shock in Bu, Rogers and Wu (2021)
NS	"Policy news" shock of Nakamura and Steinsson (2018)
ECBD	Deposit Facility Rate for Euro Area
PCE	Personal consumption expenditures price index from FRED (code: PCEPI)
PCM	CRB/BLS spot (commodity) price index from Bloomberg
EER	U.S. real effective exchange rate (narrow indices) from BIS
TS	Term spread of US Treasury (GS10 - TB3MS)
GZ	GZ spread as in Gilchrist and Zakrajšek (2012)
TED	TED Spread (MED3 - TB3MS)
GIPexUS	The world industrial production excluding the US calculated by authors
GLBIF	Global inflows all sectors from BIS
DCRTUS	US Domestic Credit, extended from Miranda-Agrippino and Rey (2020)
GDCRT	Global Domestic Credit, constructed as Gourinchas and Obstfeld (2012)
LEVUS	US banking sector leverage, extended from Miranda-Agrippino and Rey (2020)
LEVEU	EU banking sector leverage, extended from Miranda-Agrippino and Rey (2020)
MSCI	Global MSCI index downloaded from MSCI website
WUI	World Uncertainty Index from Ahir, Bloom and Furceri (2022)
FU	Financial Uncertainty from Jurado, Ludvigson and Ng (2015)

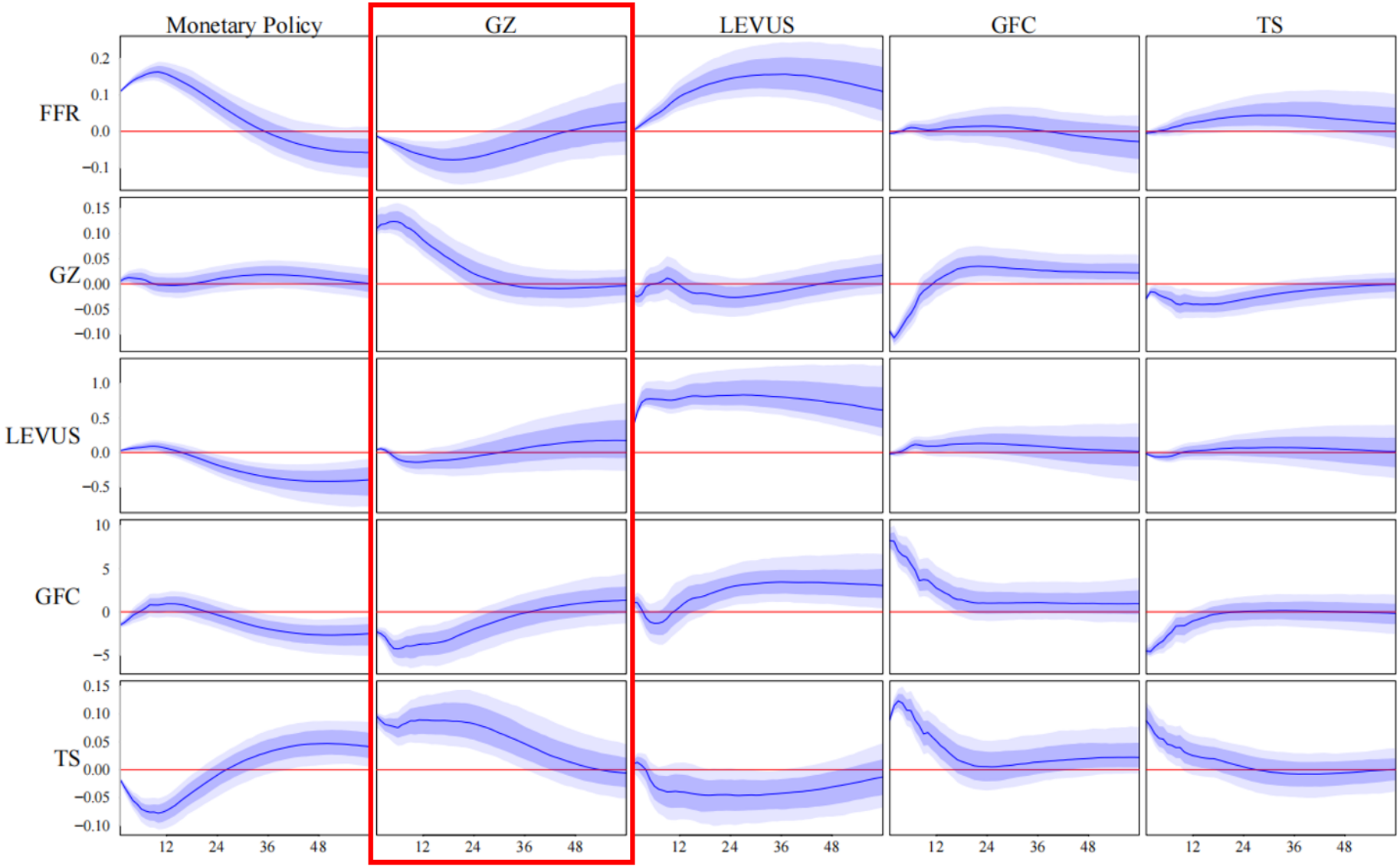
Model specifications

Variable	Source	(1)	(2)	(3)	(4)	(5)
		Baseline	Alternative Regimes	Robustness	BPSS	MAR
IP	FRED	✓	✓	✓	✓	✓
PCE	FRED	✓	✓	✓	✓	✓
TS	FRED	✓	✓	✓	✓	
PCM	Bloomberg	✓	✓	✓	✓	
GZ	GZ	✓	✓	✓	✓	✓
EBP	GZ			✓		
FFR	FRED	✓	✓	✓	✓	
1-yr T rate	FRED					✓
WX	Wu-Xia			✓@		
LEVUS	IFS*	✓	✓	✓		✓
LEVEU	IFS*	✓	✓			✓
GFC	MARb	✓	✓	✓		✓
GIPexUS	OC and BH	✓	✓	✓		✓
TED	FRED				✓	
M1	FRED				✓	
HHC	FRED				✓	
BC	FRED				✓	
EER	BIS			✓*	✓	
Glob inflows	BIS			✓*		✓
DCRTUS	IFS*			✓*		
GDCRT	OC			✓*		✓
MSCI	MSCI			✓*		
Risk aversion	OC and BEX			✓*		✓
Uncertainty	WUI, FU			✓*		

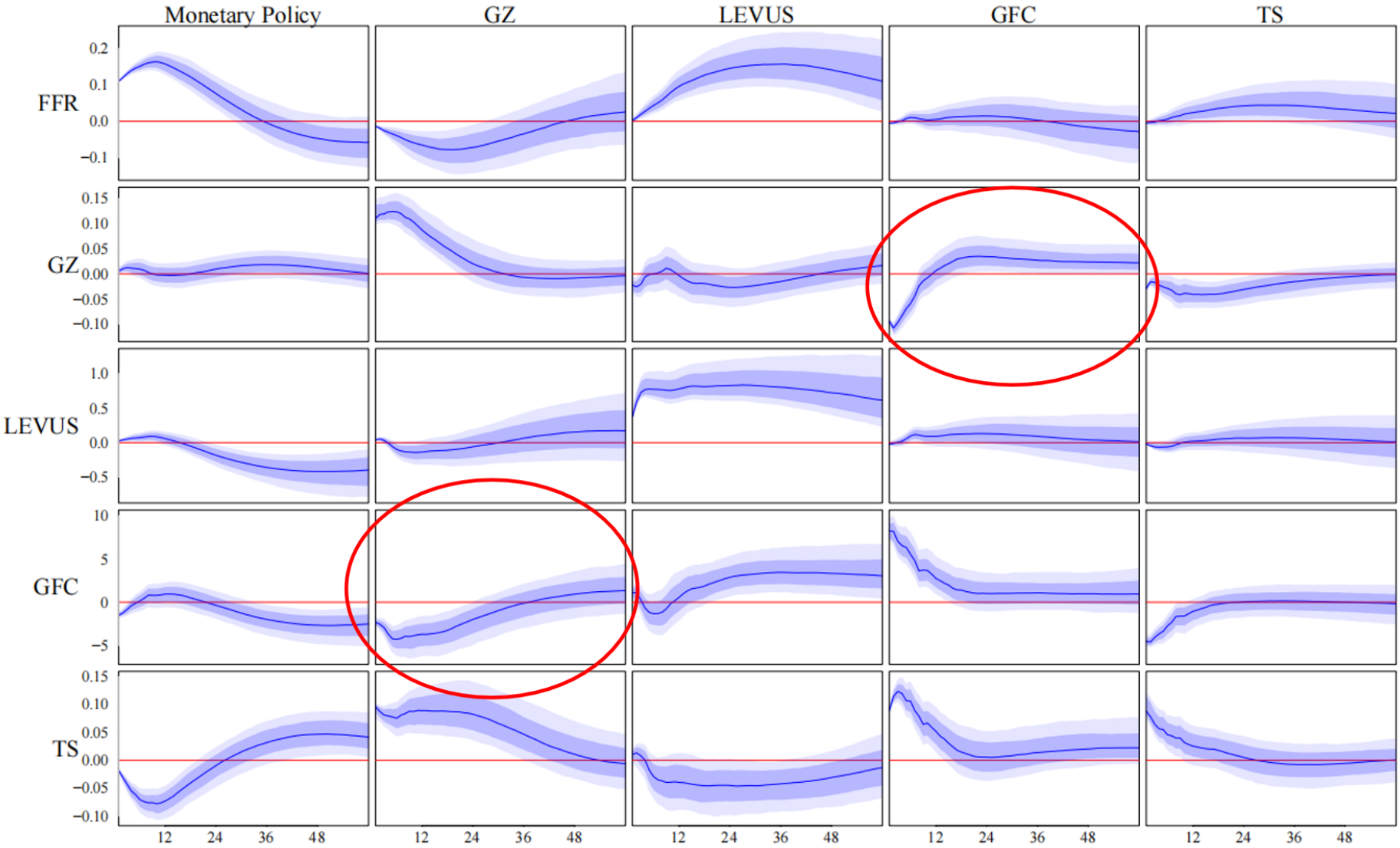
Financial Variables Responses: what M.P. shocks do



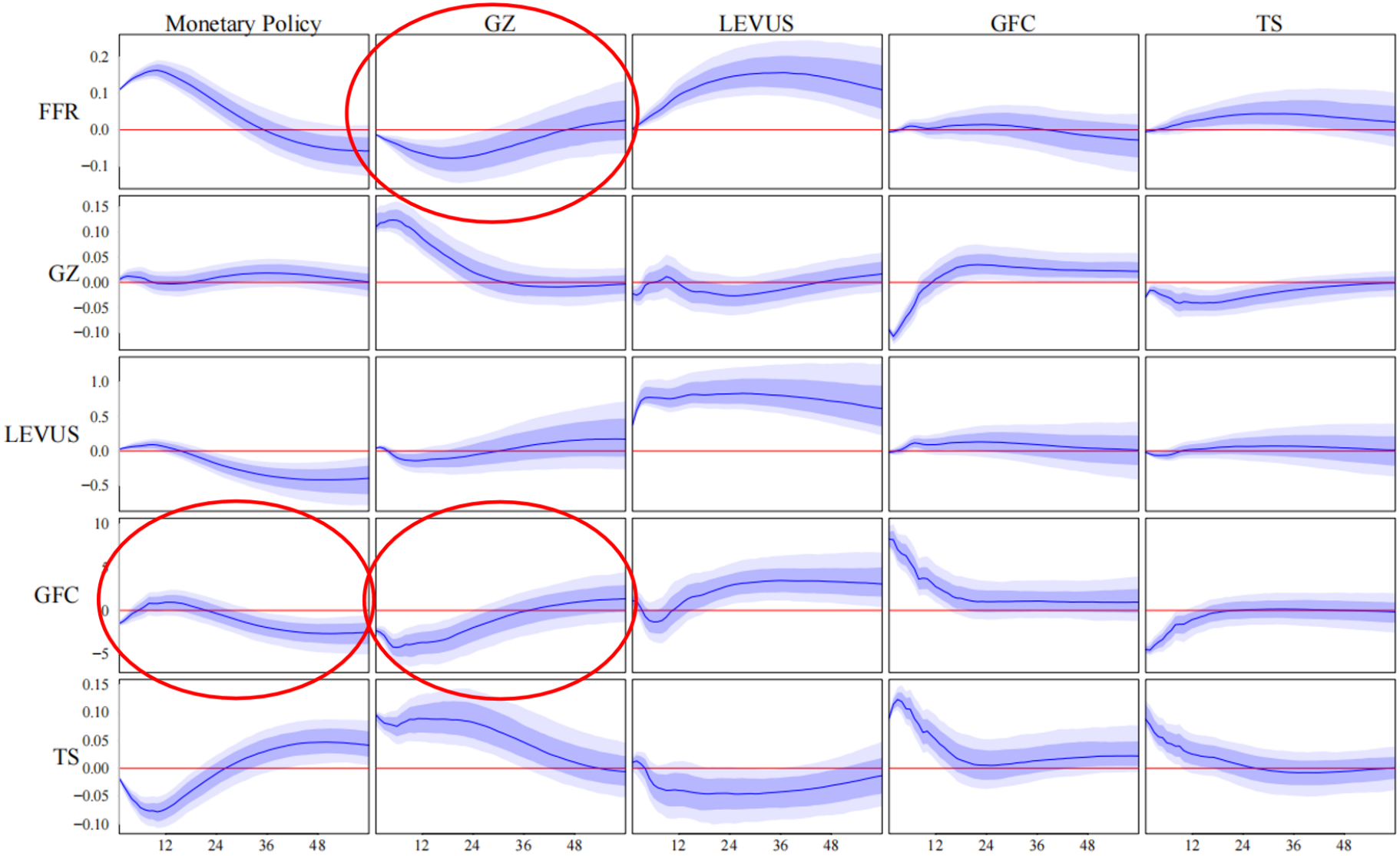
Financial Variables Responses: what GZ shocks do



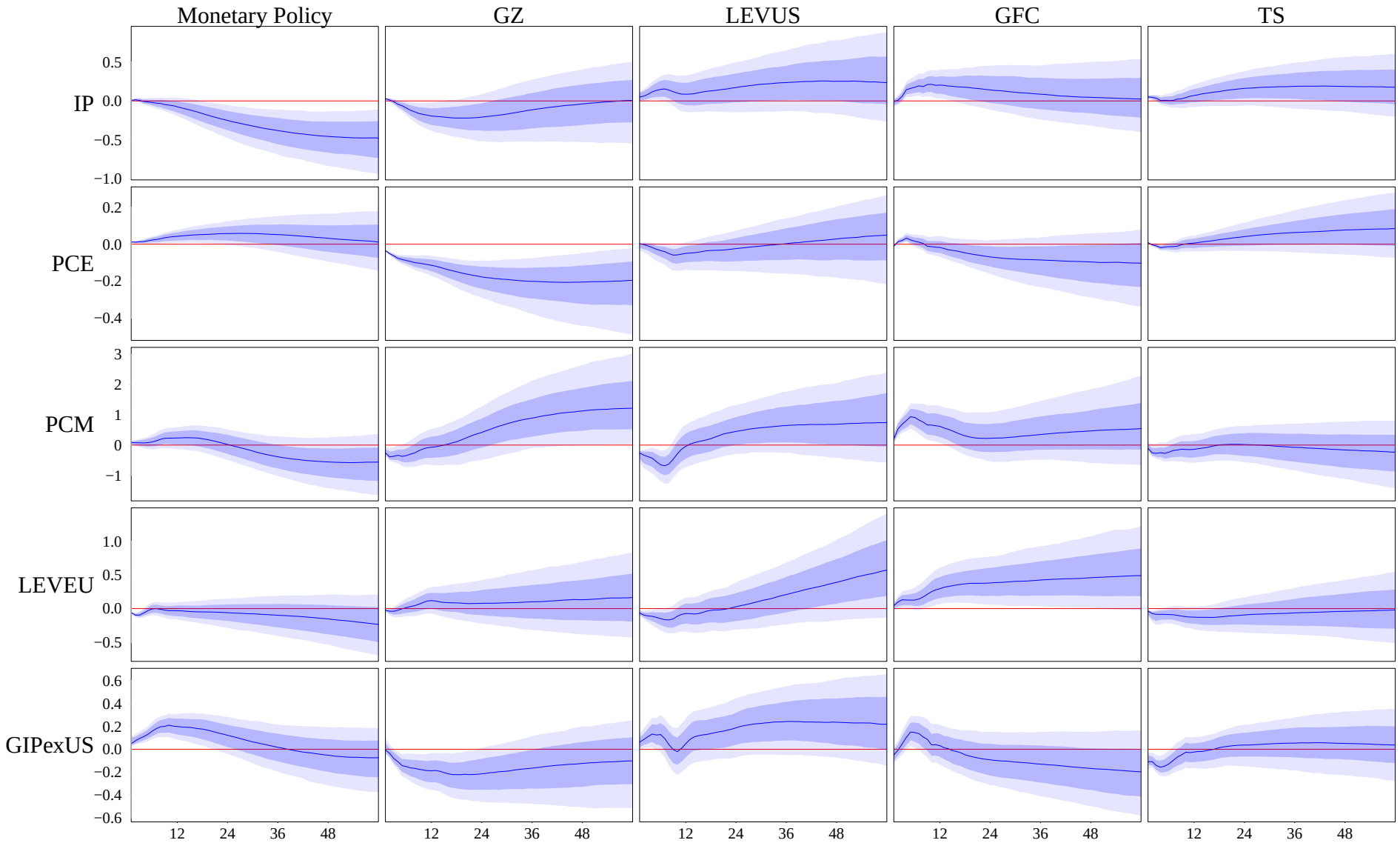
Financial Variables Responses: GZ-GFC feedbacks



GZ —> GFC not due to M.P. amplification (Fed loosens)



Real Variables Responses



Our monetary policy and GZ shocks look a lot like BPSS

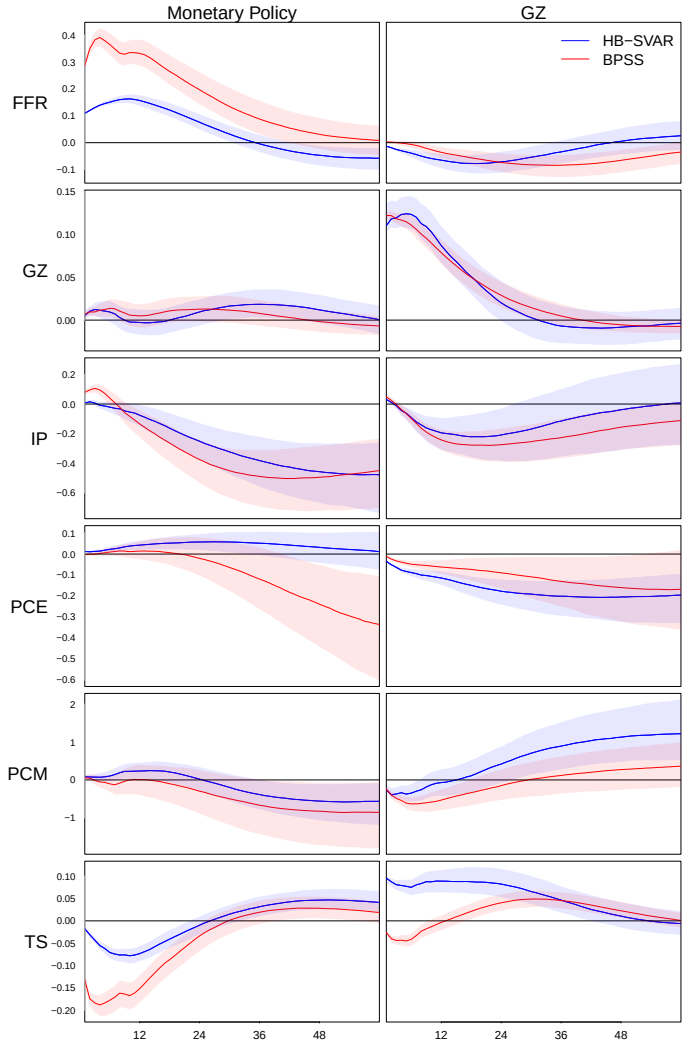


Figure: Comparison with BPSS: Responses to Monetary Policy Shocks and GZ Shocks

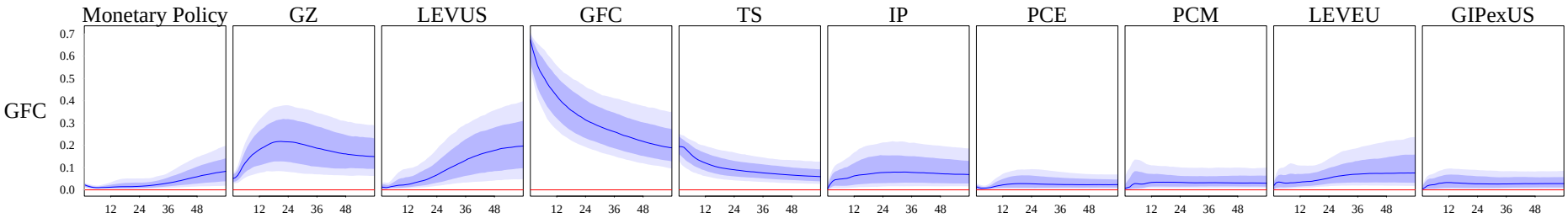
Structural Shock Volatility

Shock	Jan 1980-Dec 1982	Jan 1983-Dec 1989	Jan 1990-Dec 2007	Jan 2008-Dec 2010	Jan 2011-Dec 2015	Jan 2016-Apr 2019
IP	1.29	0.74	0.85	1.85	0.60	0.66
PCE	0.93	0.89	1.07	1.60	0.89	0.60
TS	2.85	0.84	0.46	0.93	0.53	0.39
TED	2.00	0.77	0.38	2.64	0.03	0.19
GZ	0.49	0.49	0.81	2.18	1.13	0.90
M policy	4.68	0.91	0.19	0.19	0.01	0.05
EER	1.43	1.66	0.80	0.73	0.45	0.92
GFC	0.81	1.83	0.90	1.46	0.73	0.26
RA	0.73	1.05	1.05	0.51	1.10	1.59
LEV	0.88	0.31	0.21	0.72	2.61	1.27

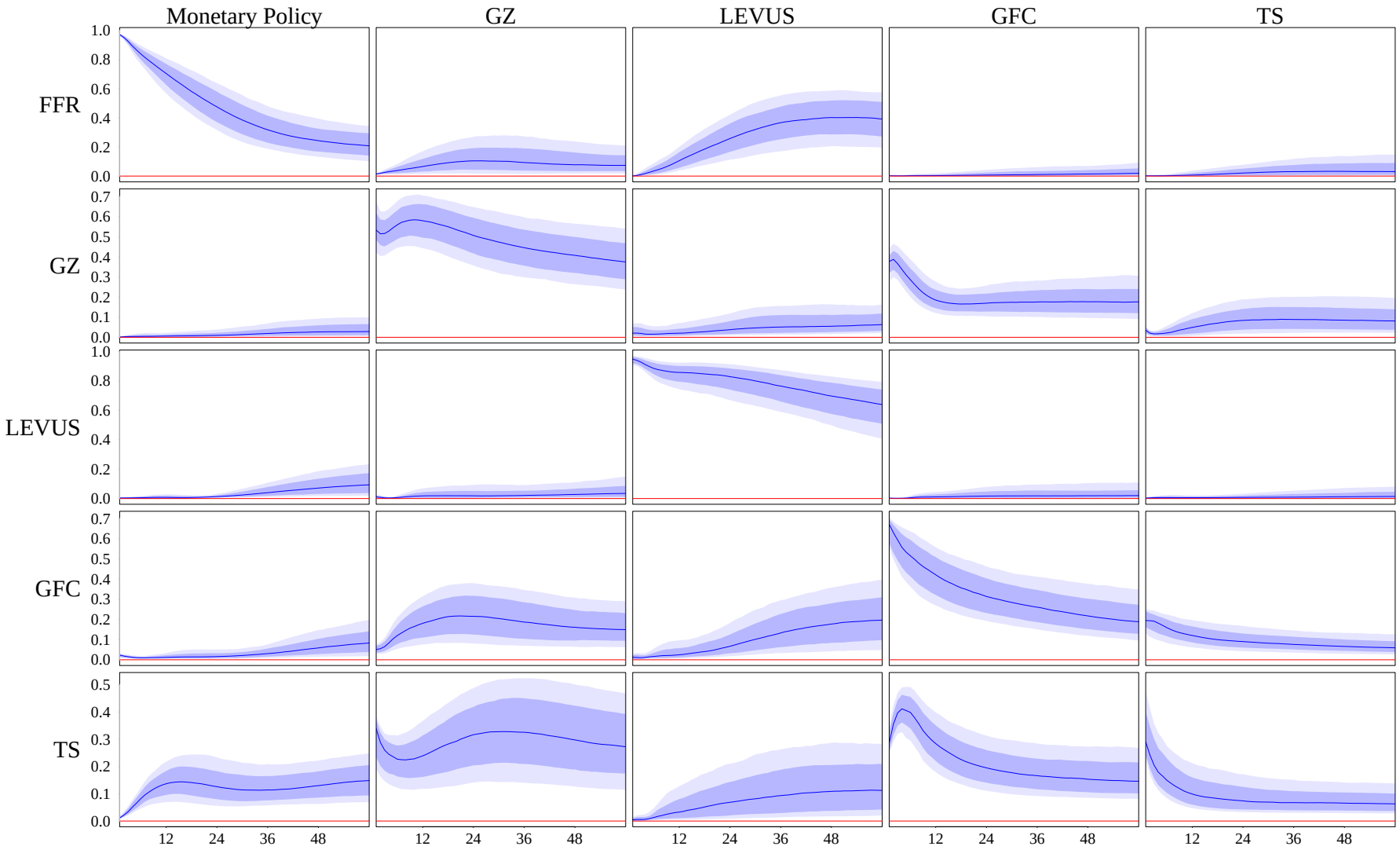
Accounting for the Global Financial Cycle

- Variance Decompositions from the baseline HB-SVAR
- An Historical Decomposition

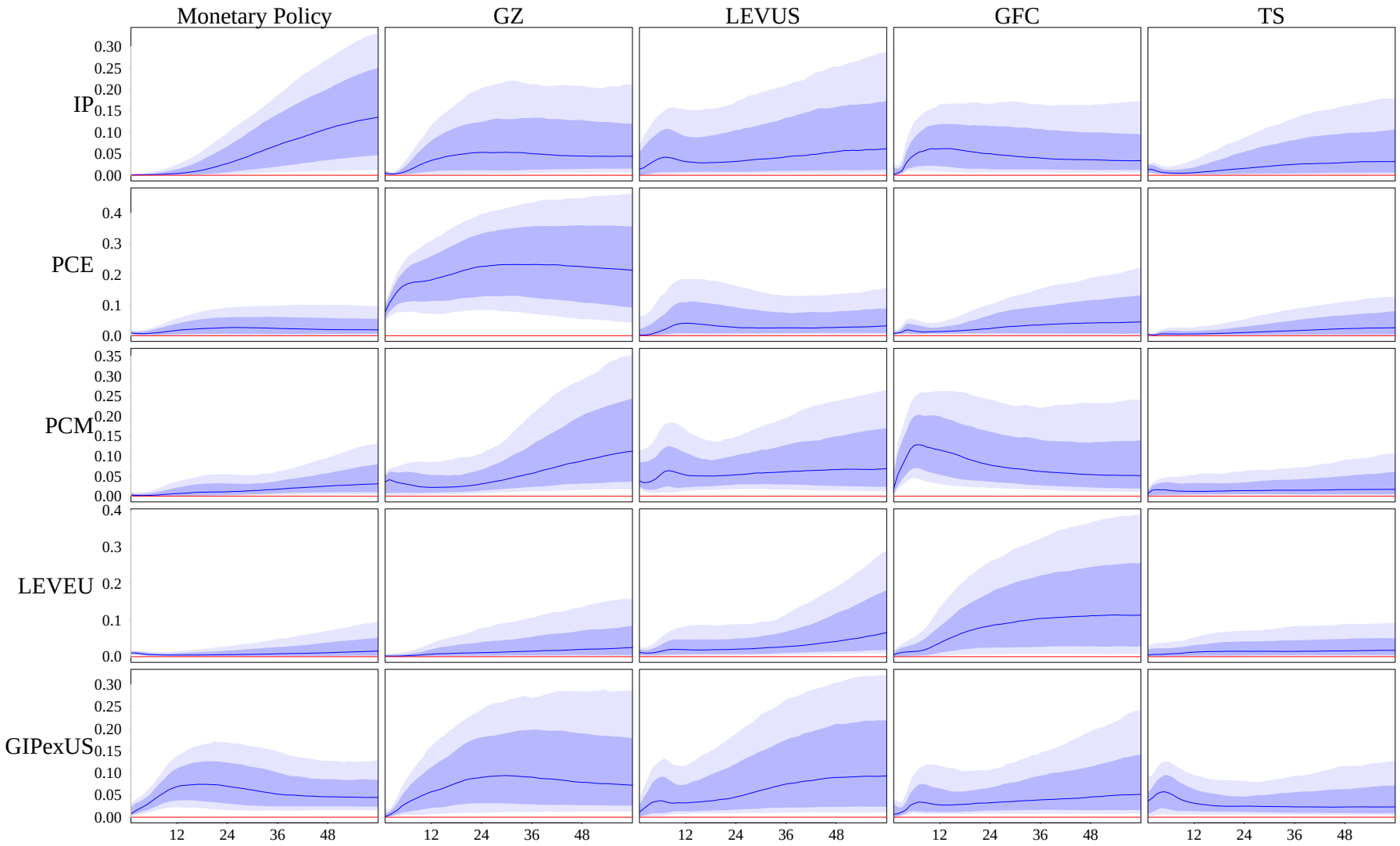
Variance Decomposition of the GFC Factor



Financial Variables VDCs: note GZ <—> GFC



Real Variables VDCs



Historical Decomposition of the GFC Factor

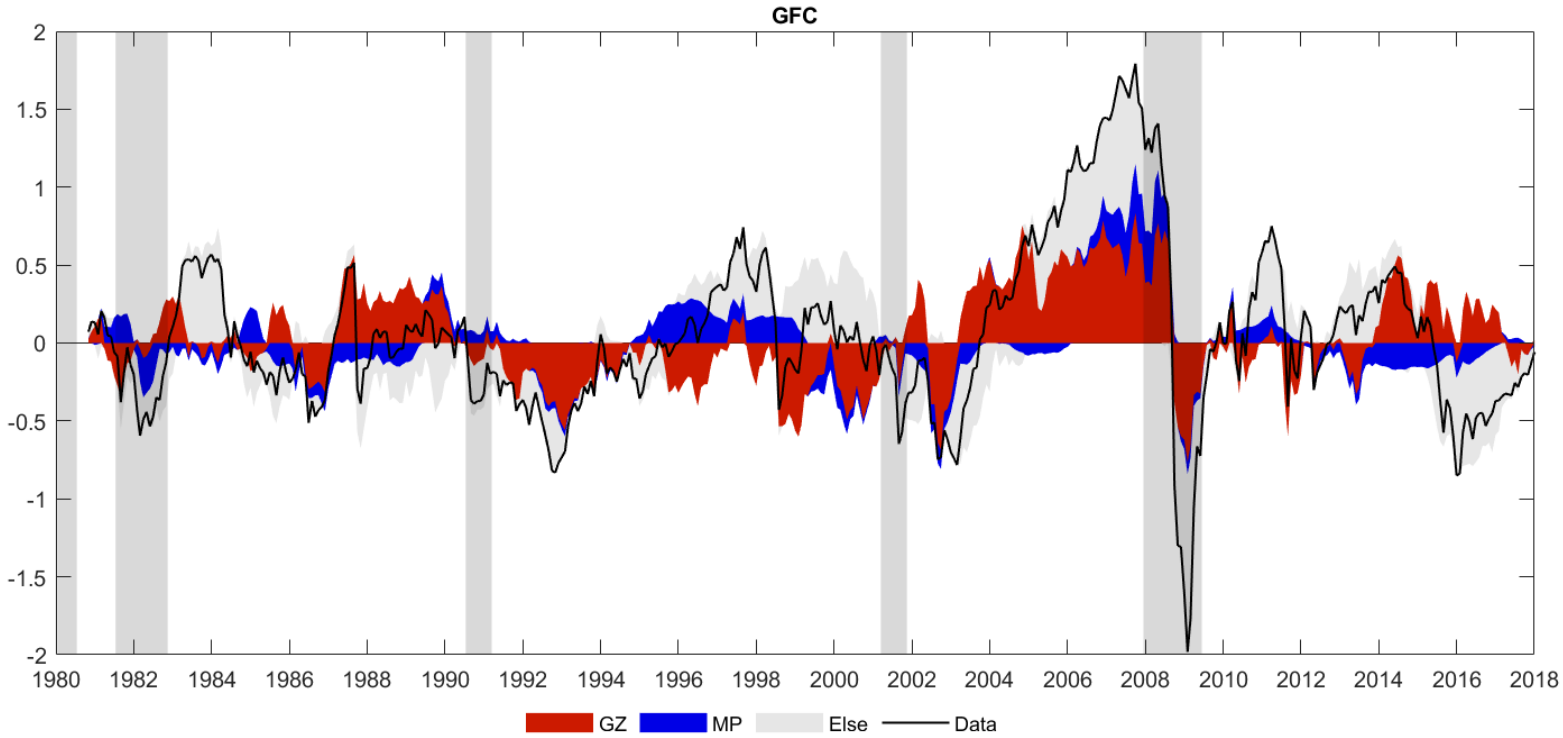
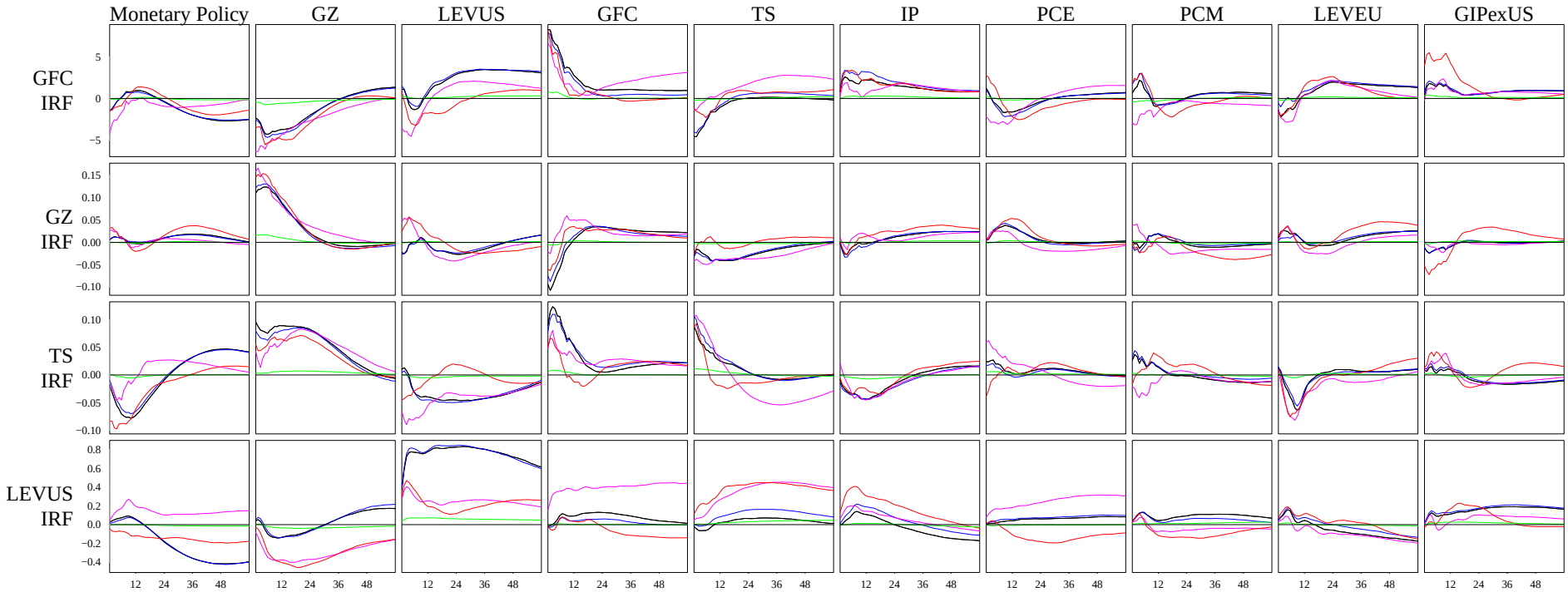


Figure: Role of shocks to U.S. monetary policy, GZ credit spreads, and all others

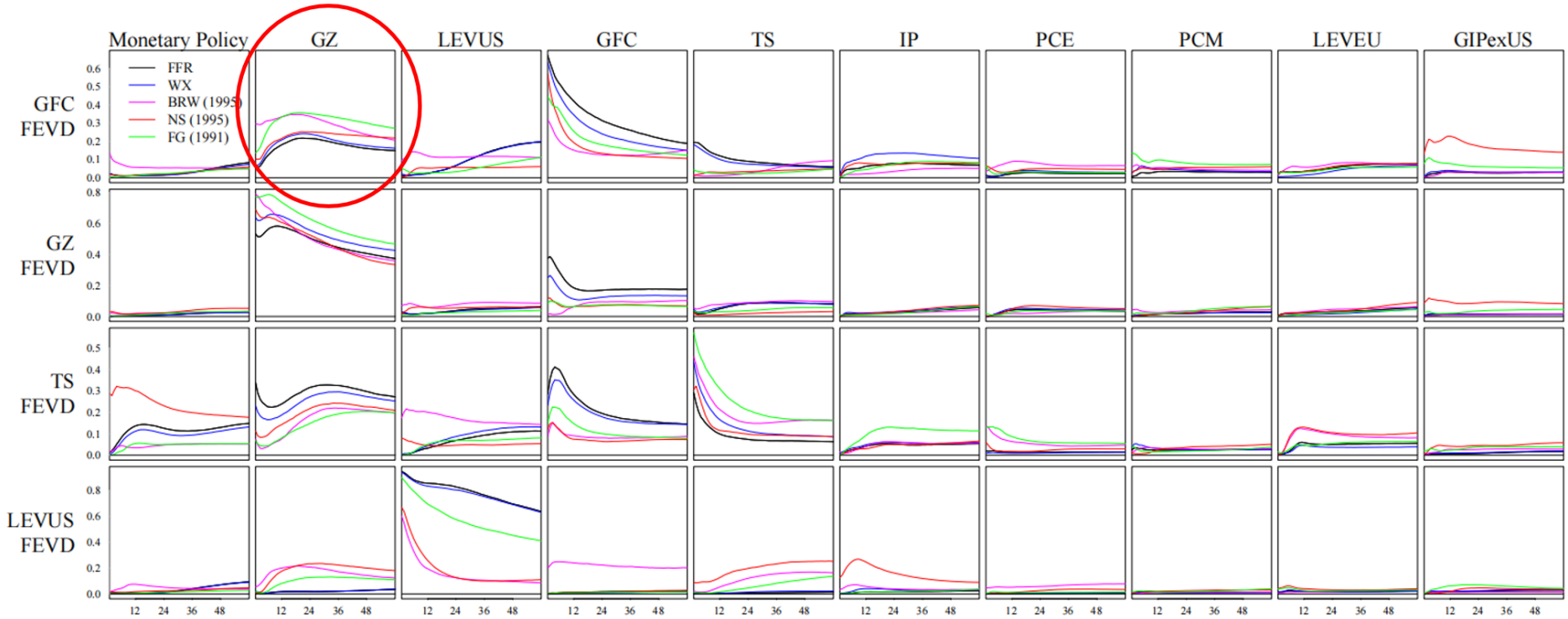
Robustness: Monetary Policy Shocks

(i) Wu-Xia shadow rate, (ii) Bu-Rogers-Wu "unified" measure,
(iii) Nakamura-Steinsson "policy news" shock, (iv) Swanson FG shock



Impulse Responses of GFC, GZ, TS, and LevUS

Robustness: Monetary Policy Shocks



Variance Decompositions of GFC, GZ, TS, and LevUS

Robustness: Regime Choices

	Start	End	Description
			Global Regime 1
1	Jan 1988	Dec 1996	Great Moderation
2	Jan 1997	Dec 2002	Asian Financial Crisis/LCTM/Dot-com Bubble
3	Jan 2003	Dec 2007	Great Moderation & Pre-crisis
4	Jan 2008	Dec 2015	Financial Crisis and ZLB
5	Jan 2016	Apr 2019	Monetary Normalization
			Global Regime 2
1	Jan 1988	Dec 1989	Recovery from the 1980s recessions
2	Jan 1990	Mar 2000	Great Moderation
3	Apr 2000	Oct 2002	Dot-com Bubble
4	Nov 2002	Dec 2007	Great Moderation & Pre-crisis
5	Jan 2008	Dec 2010	Great Recession
6	Jan 2011	Apr 2019	ZLB; recovery from Great Recession

Other Robustness

- Use EBP component of GZ spread
- Subsamples
- Identification approach
  - SV-SVAR (Bertsche & Braun (JBES)), proxy SVARs
  - asked selves "what if we just did Cholesky?"
- Control for uncertainty, for exchange rate
- Analyze global financial cycle in capital flows

Summary of Robustness Checks (VDC shares)

Shocks to:	**Monetary Policy**					**GZ**				
Horizons	**1**	**6**	**12**	**24**	**36**	**1**	**6**	**12**	**24**	**36**
					Panel A: Alternative Regimes					
Baseline	4.35	1.64	2.28	3.39	8.07	6.12	11.73	17.32	22.45	21.11
Alt. Regime 1	2.60	1.03	2.44	3.31	7.26	10.59	12.61	10.67	8.02	6.77
Alt. Regime 2	13.20	8.35	5.76	4.79	7.81	9.42	13.87	14.90	14.44	13.30
					Panel B: Alternative Specifications					
EBP	2.20	0.95	1.39	1.88	3.46	6.46	6.06	14.61	22.16	20.44
ECB Rate	5.58	3.52	2.92	3.59	4.94	2.42	6.35	8.37	8.90	8.52
WUI	3.28	1.73	1.46	1.95	3.62	1.90	7.25	10.83	12.17	10.78
TFU	2.15	1.11	1.06	1.47	3.76	8.93	12.46	12.36	12.47	11.67
Risk Aversion	1.50	0.80	0.85	1.74	4.17	2.19	7.60	10.73	10.73	9.53
EER	0.91	0.44	0.63	1.44	3.61	5.80	11.14	15.11	16.49	14.66
					Panel C: Alternative Identification Procedures					
SV-SVAR	0.25	0.58	0.96	2.47	5.22	44.25	42.94	41.85	33.67	25.41
Cholesky	1.96	1.78	1.95	1.42	3.60	37.78	33.38	28.56	24.67	21.96
					Panel D: Excluding the GZ index					
Shocks to:	**Policy Rate (FFR)**					**GFC**				
Excluding GZ	1.47	0.71	1.04	1.46	3.18	80.67	67.45	57.76	46.78	40.00

Channels

- GZ shocks to GFC
  - risk appetite and sentiment (Bauer, Bernanke, Milstein, 2023)
  - amplification from Fed policy and cross-border spillovers? Not much
  - financial spillovers through global banks and investors
- GZ-GFC feedbacks
  - are strong; reflect interaction between fin. mkts and real economy?
- Global domestic credit shocks (in place of GZ)
  - key predictor of financial crises (Gourinchas and Obstfeld, 2012)
- Dollar centrality/exchange rates
  - find "independently floating" countries *not* more insulated than "fixed" exchange rate countries; as in Rey's work

GZ shocks and BBM Risk Appetite Shocks (in place of GZ)

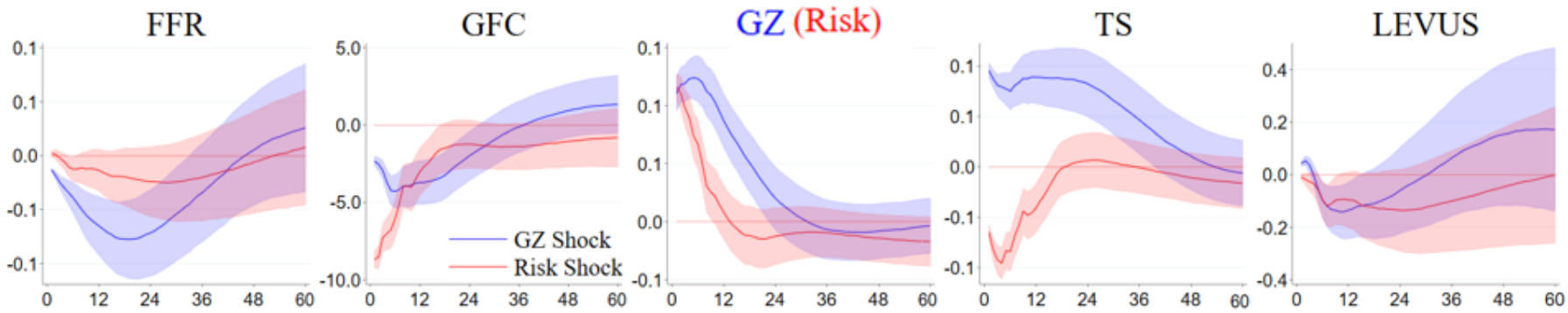
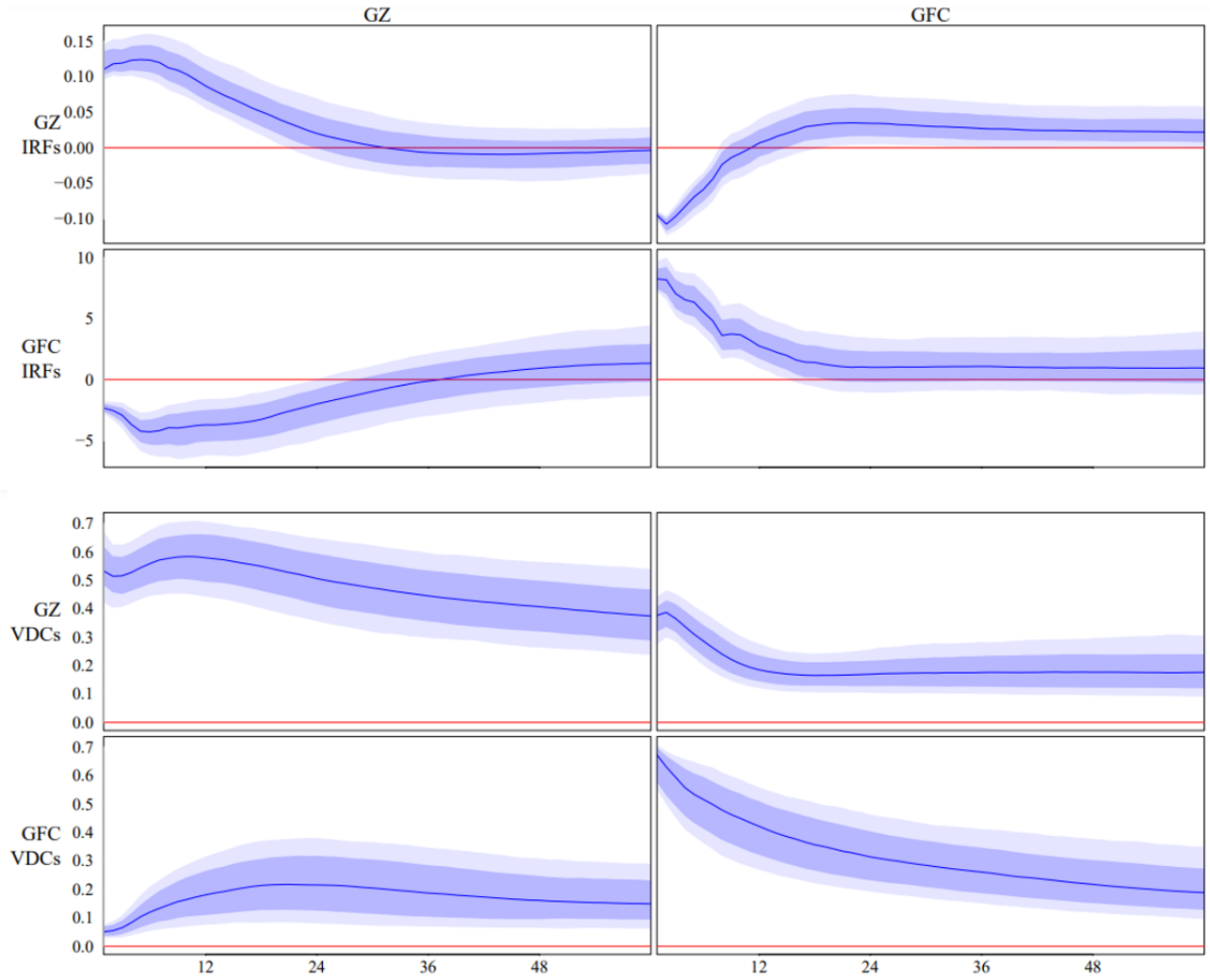
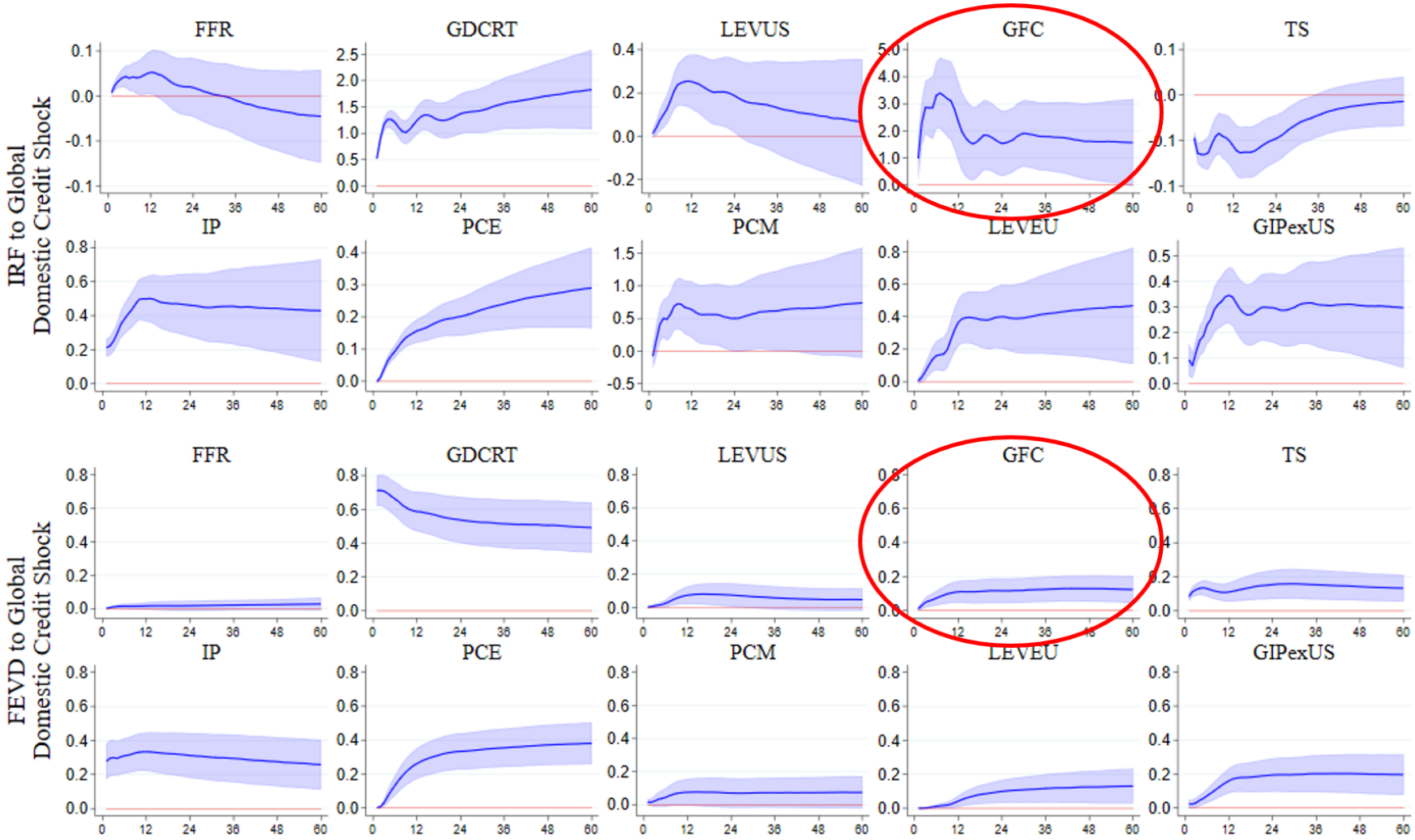


Figure: Responses to (positive) GZ Shocks and to (negative) Risk Appetite Shocks

Feedbacks: IRF, VDC from baseline model GZ-GFC block



Global Domestic Credit Shock IRFs, VDCs (replaces GZ)



Equity responses in fixed vs flexible exchange rate countries

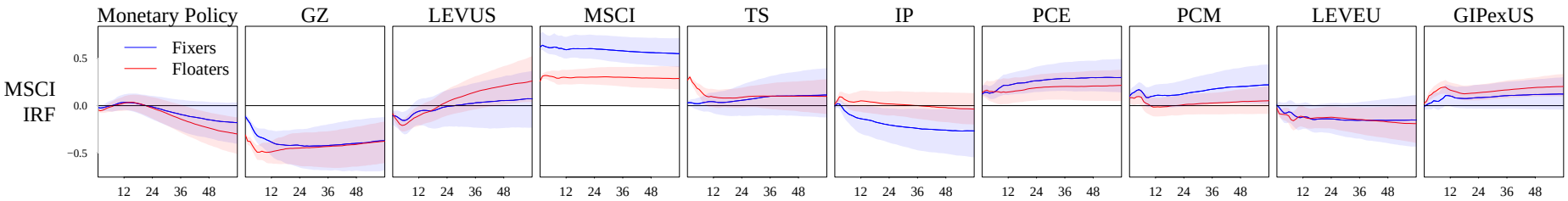


Figure: Impulse Responses to all shocks of the MSCI (Fixers) vs. MSCI (Floaters)

Potential "GFC own shock" events

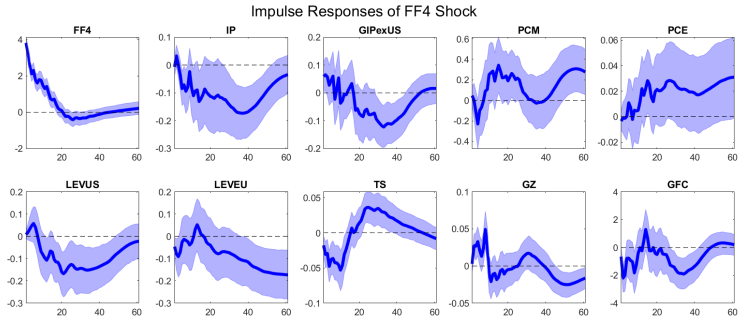
Events related to geopolitical tensions, terrorist attacks, election/referendum outcomes, natural disasters, trade policy disputes, and commodity (oil, in particular) price changes that trigger broad declines in global asset prices:

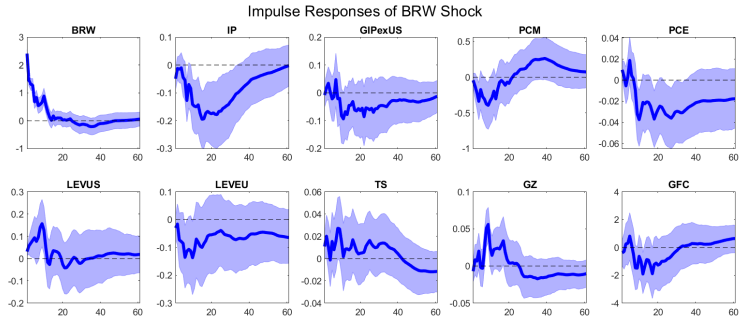
- 1990 Gulf War
- 1992 ERM crisis
- 1994 Peso crisis
- 2001 Stepmber 11
- 2003 Iraq war
- 2010 European sovereign crisis
- 2011 Japan Earthquake and Tsunami
- 2015 China stock market crash
- 2016 Brexit
- 2018 US-China trade disputes

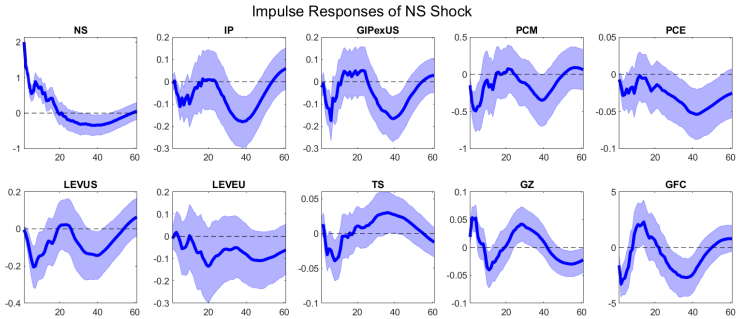
Conclusions

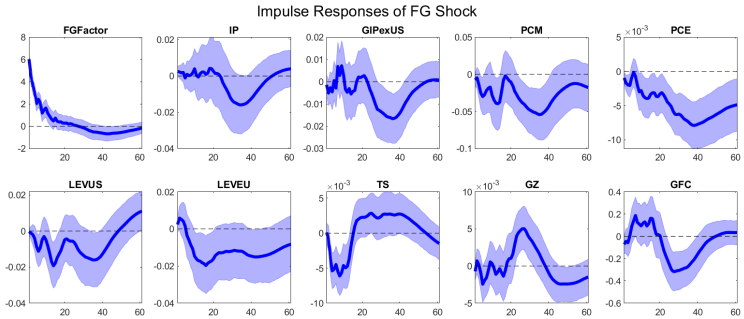
- Literature: U.S. monetary policy plays a key role in driving GFC
- Our paper: BVAR identified by heteroskedasticity; simultaneous identification of multiple shocks
- Main driver of the global financial cycle is not U.S. monetary policy, either directly or in an amplification role
- Considerably more important are shocks to (i) U.S. corporate bond spreads (EBP), (ii) leverage of U.S. banks, and (iii) U.S. term premium
- Relationship between U.S. bond spreads and the global financial cycle features a feedback loop that produces amplification effects

Monetary Policy Shocks with Cholesky Identification









VDC of GFC in Cholesky VAR, MP and GZ shocks share

Model	FF4 Surprise		BRW		NS		SS-FG	
Horizon	FF4	GZ	BRW	GZ	NS	GZ	SS-FG	GZ
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.30	0.42	0.01	0.25	0.01	0.02	0.44	0.15
2	0.43	0.61	0.46	0.50	0.46	0.02	1.86	0.30
3	1.27	0.46	1.15	0.41	0.39	0.14	4.57	0.26
4	1.25	0.66	1.82	0.52	0.36	0.98	5.85	0.36
5	1.27	1.75	1.59	1.09	0.32	3.08	7.59	1.22
6	1.76	3.16	1.55	1.71	0.31	5.04	11.50	2.29
12	4.00	17.26	9.33	12.18	1.13	17.15	22.07	17.52
16	4.47	22.13	12.56	18.26	1.16	19.45	21.14	24.01
20	4.68	23.61	12.36	19.47	2.77	18.27	19.85	24.59

Start dates

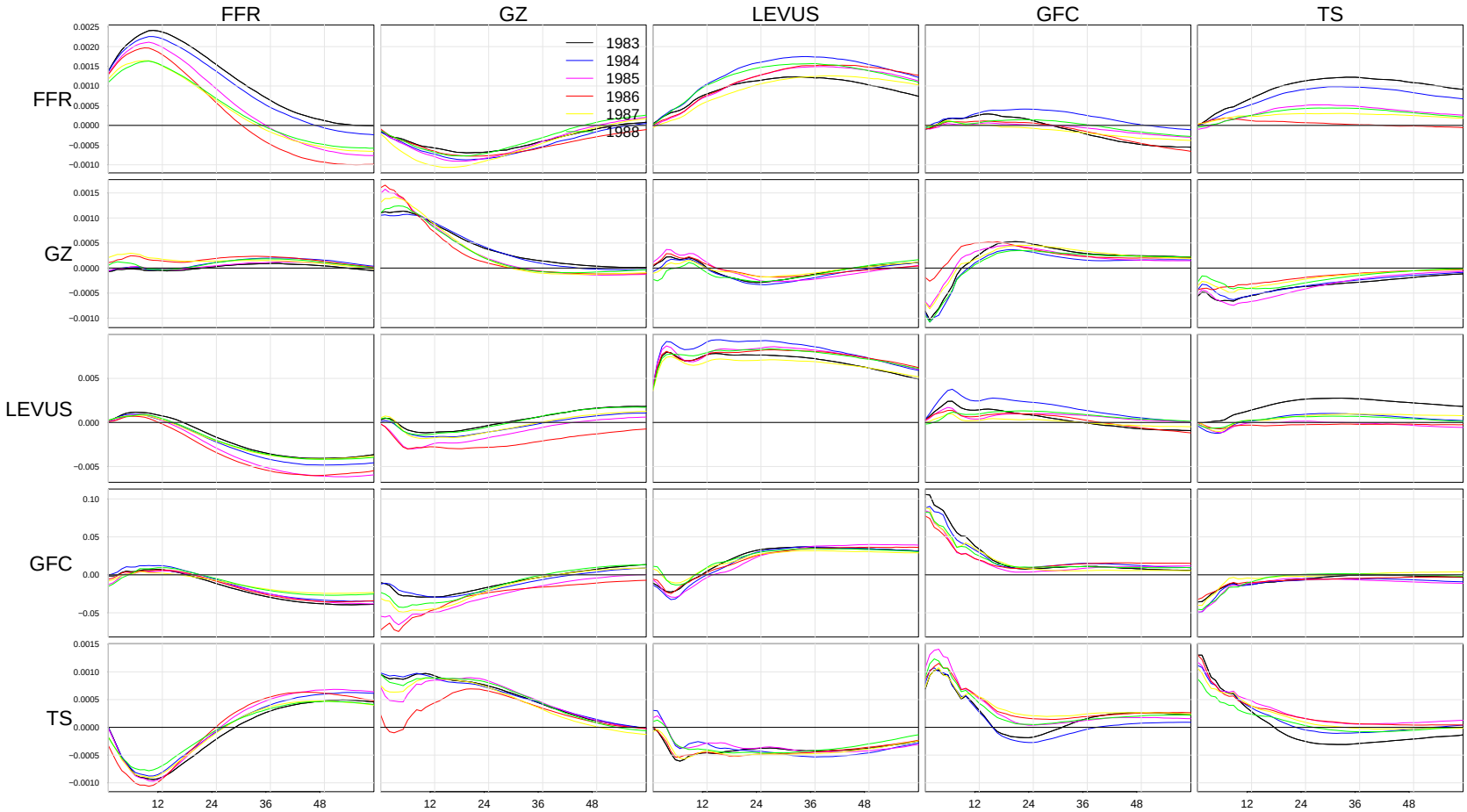


Figure: HB-SVAR Impulse Responses: 1983-1988 VARs, Baseline (1/4)

Start dates

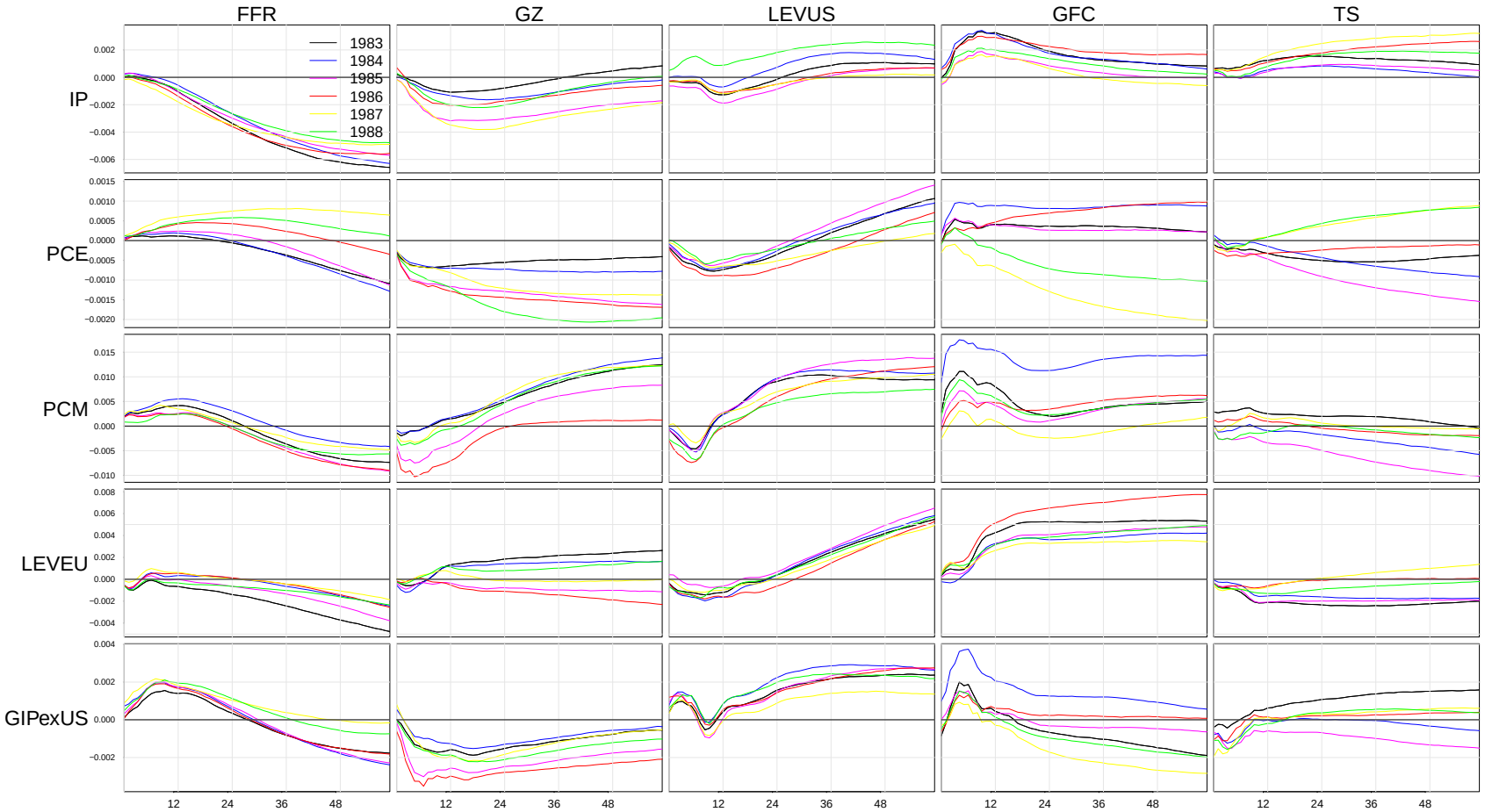


Figure: HB-SVAR Impulse Responses: 1983-1988 VARs, Baseline (2/4)

Start dates

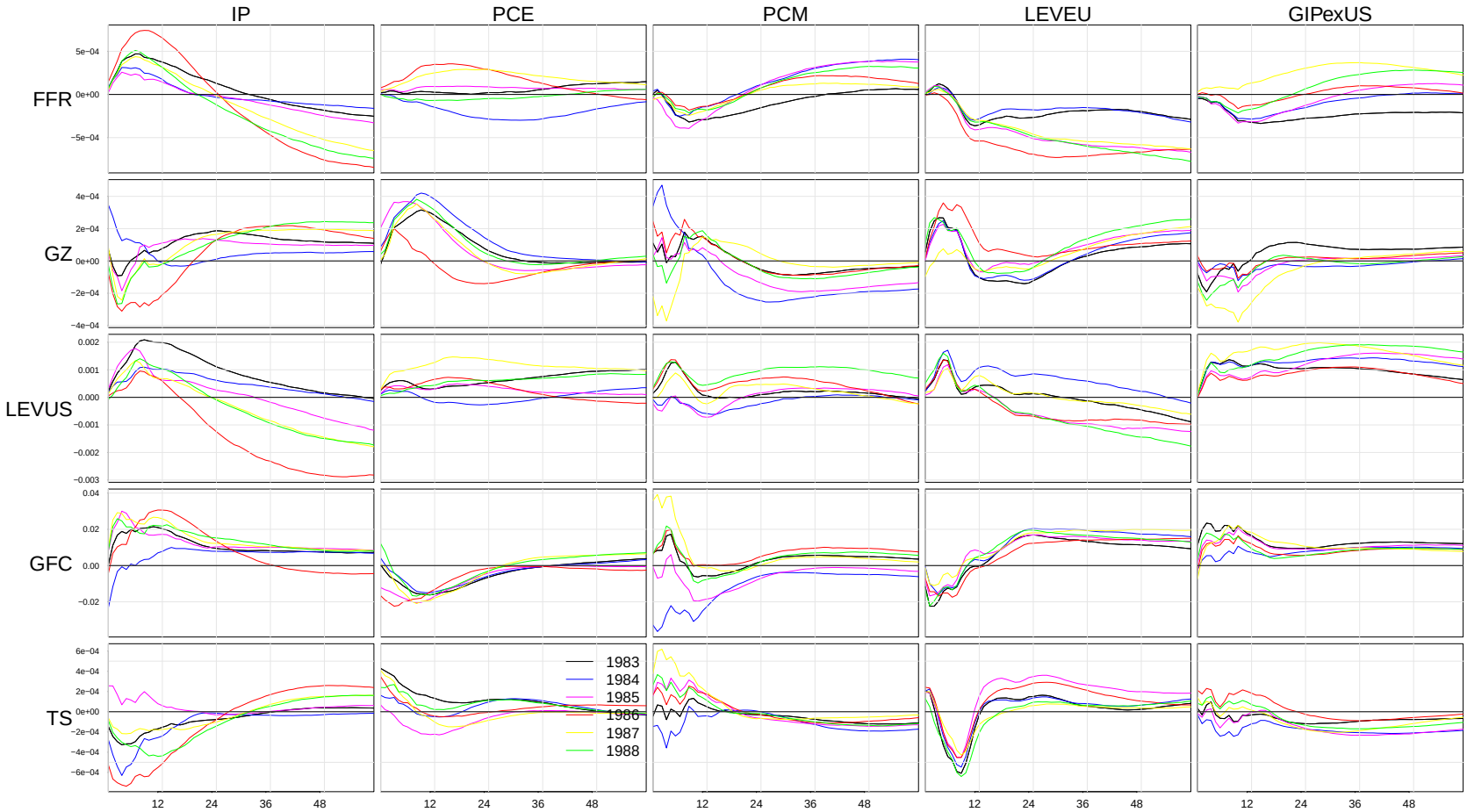


Figure: HB-SVAR Impulse Responses: 1983-1988 VARs, Baseline (3/4)

Start dates

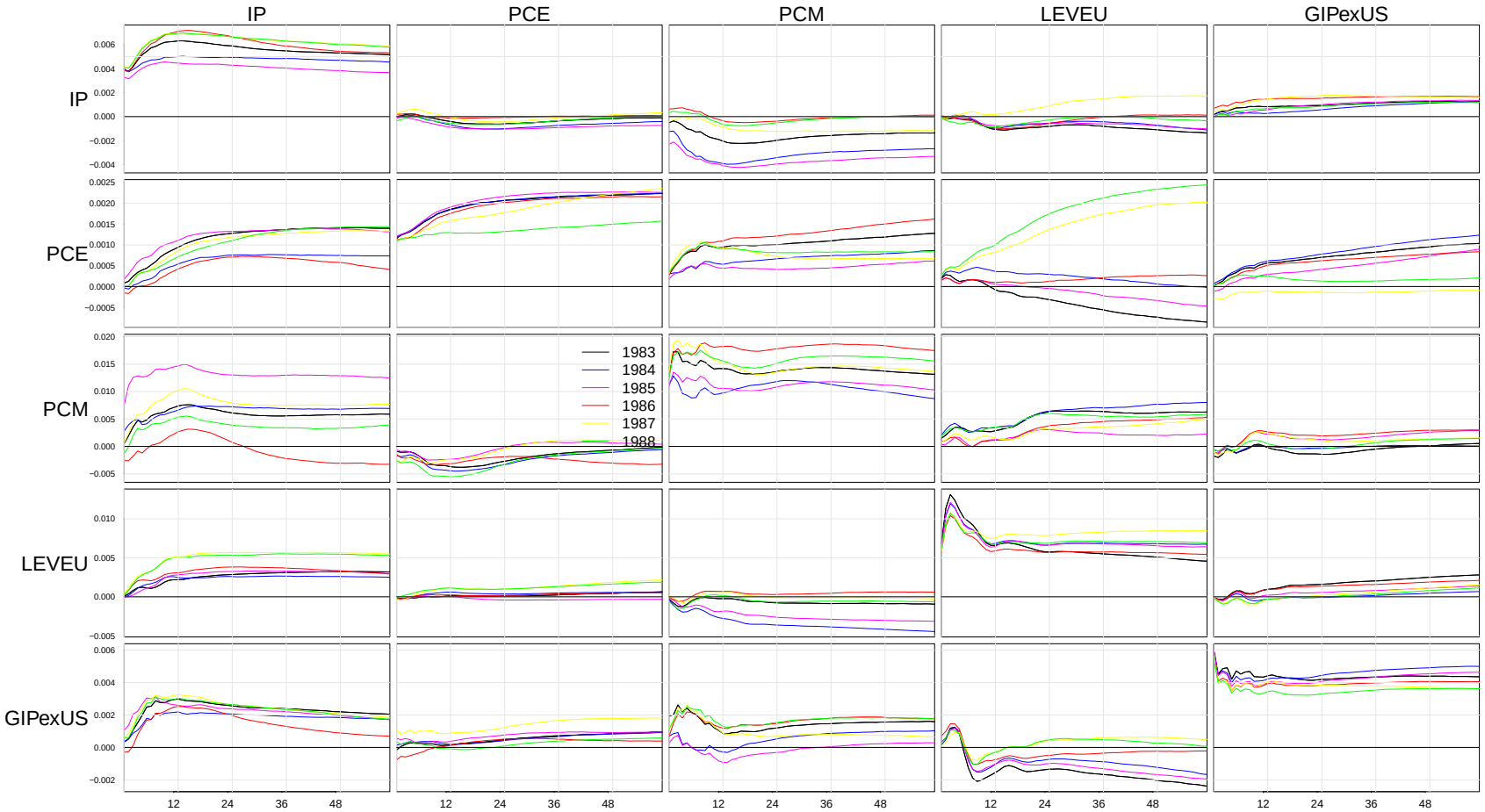


Figure: HB-SVAR Impulse Responses: 1983-1988 VARs, Baseline (4/4)

Start dates

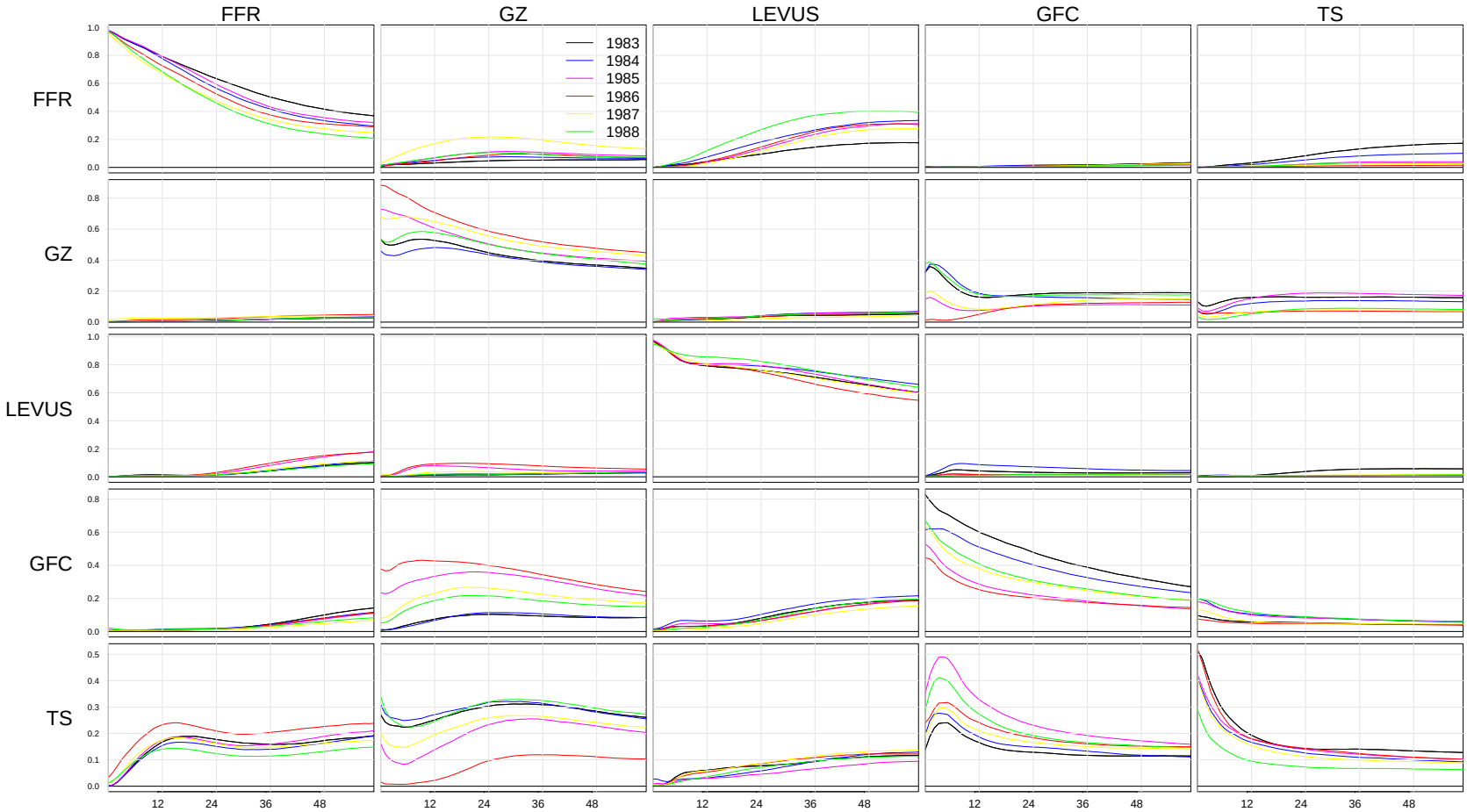


Figure: HB-SVAR Variance Decompositions: 1983-1988 VARs, Baseline (1/4)

Start dates

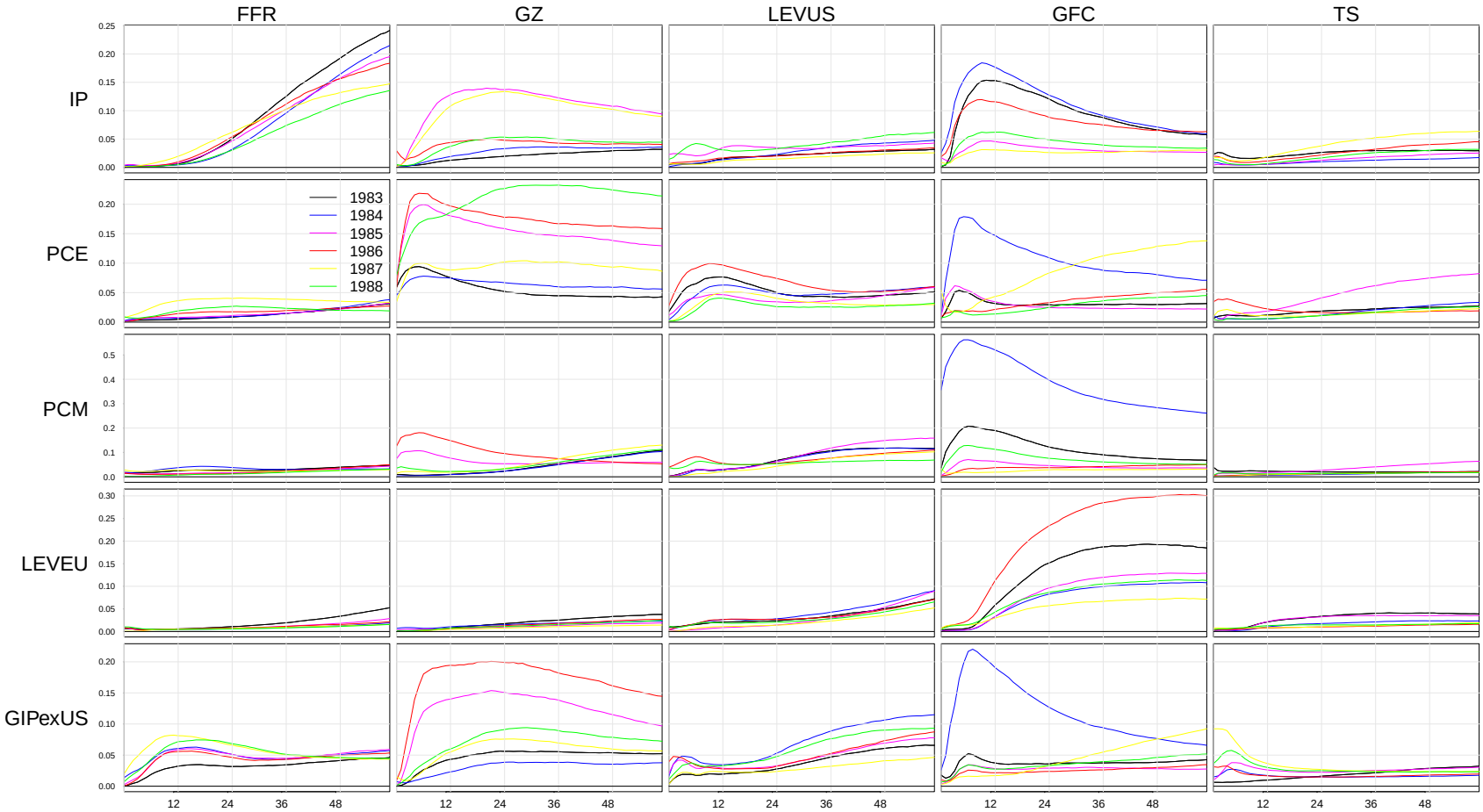


Figure: HB-SVAR Variance Decompositions: 1983-1988 VARs, Baseline (2/4)

Start dates

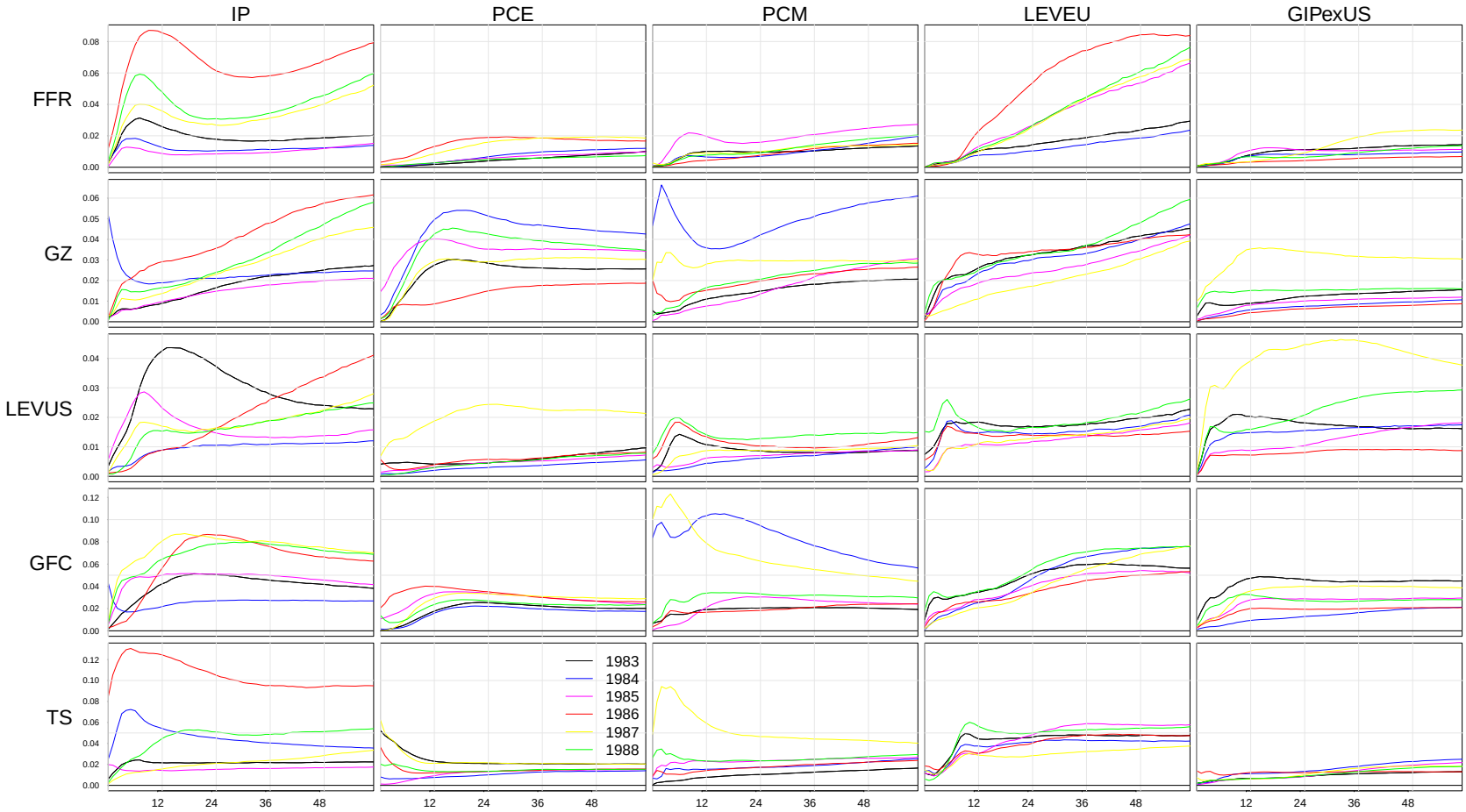


Figure: HB-SVAR Variance Decompositions: 1983-1988 VARs, Baseline (3/4)

Start dates

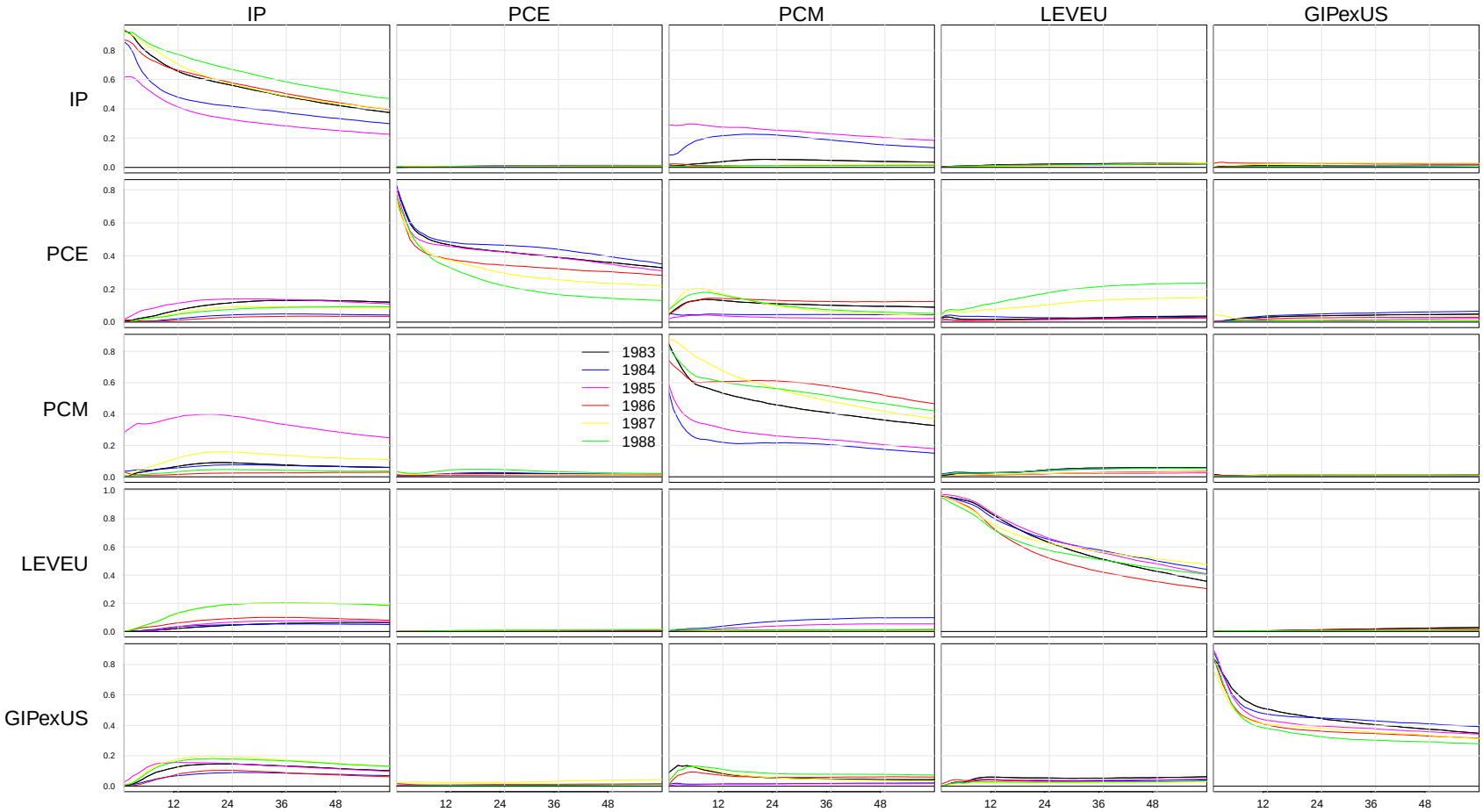


Figure: HB-SVAR Variance Decompositions: 1983-1988 VARs, Baseline (4/4)

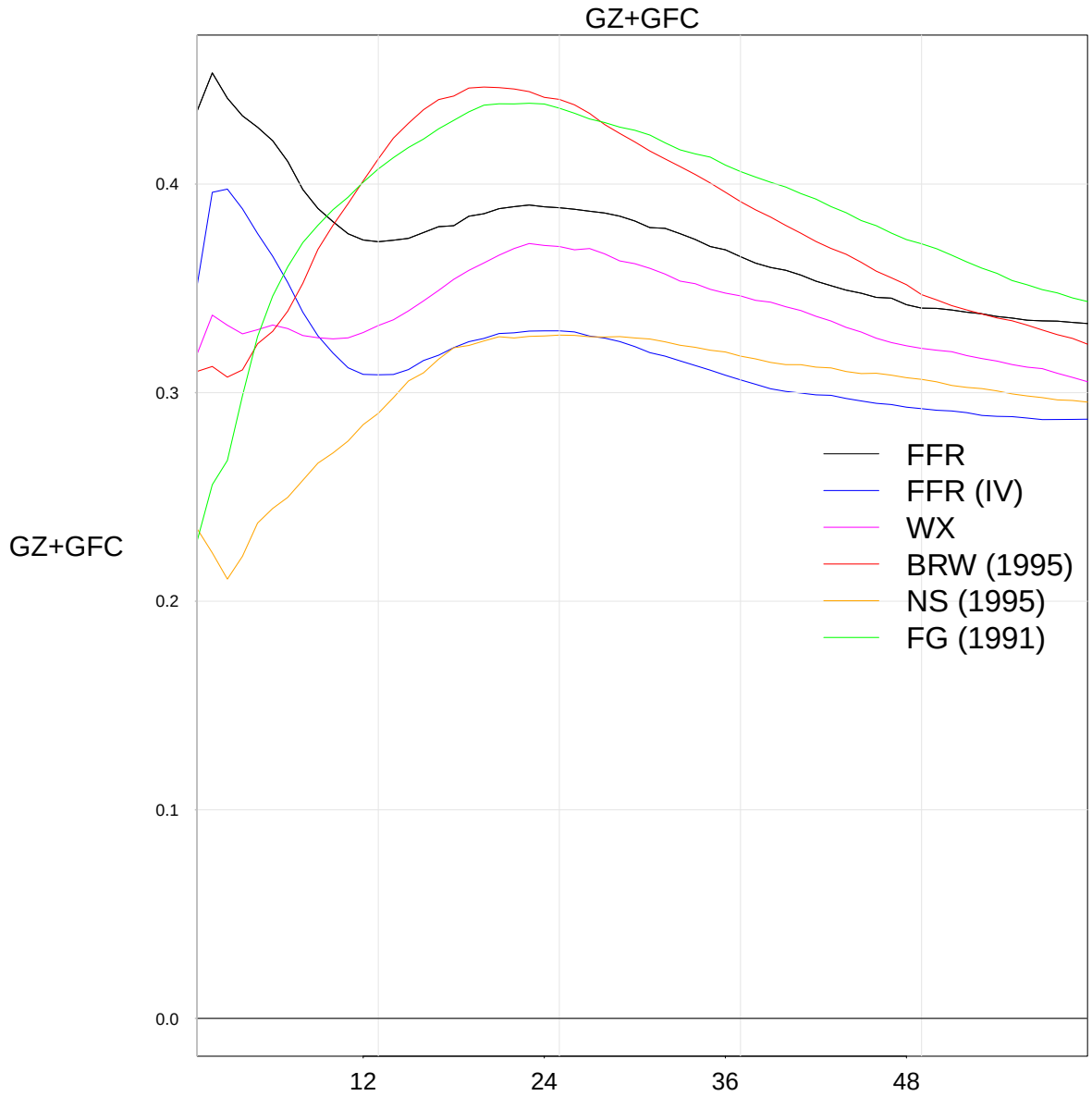


Figure: RS Statistics: All MP shocks

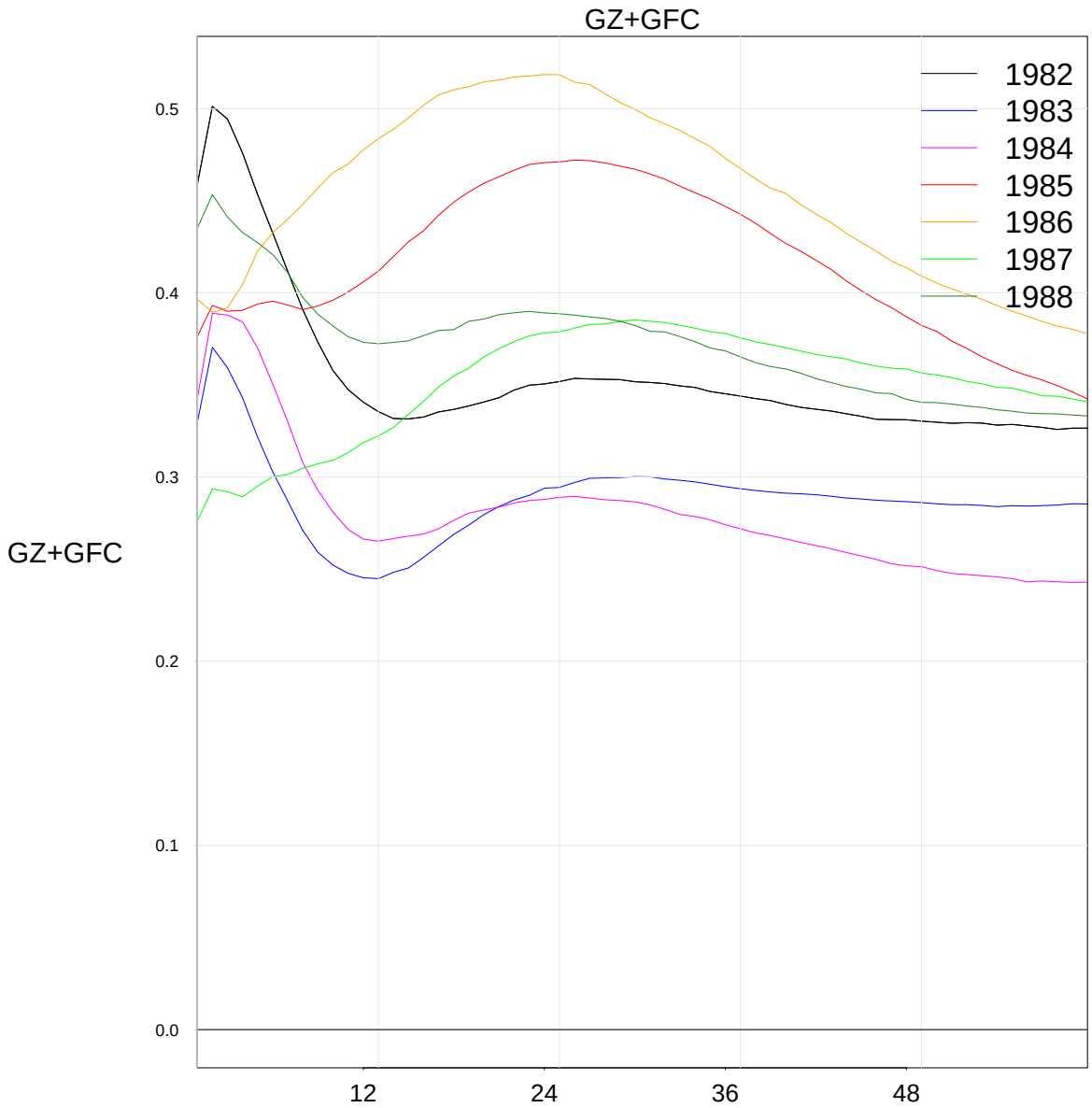


Figure: RS Statistics: Breakdates

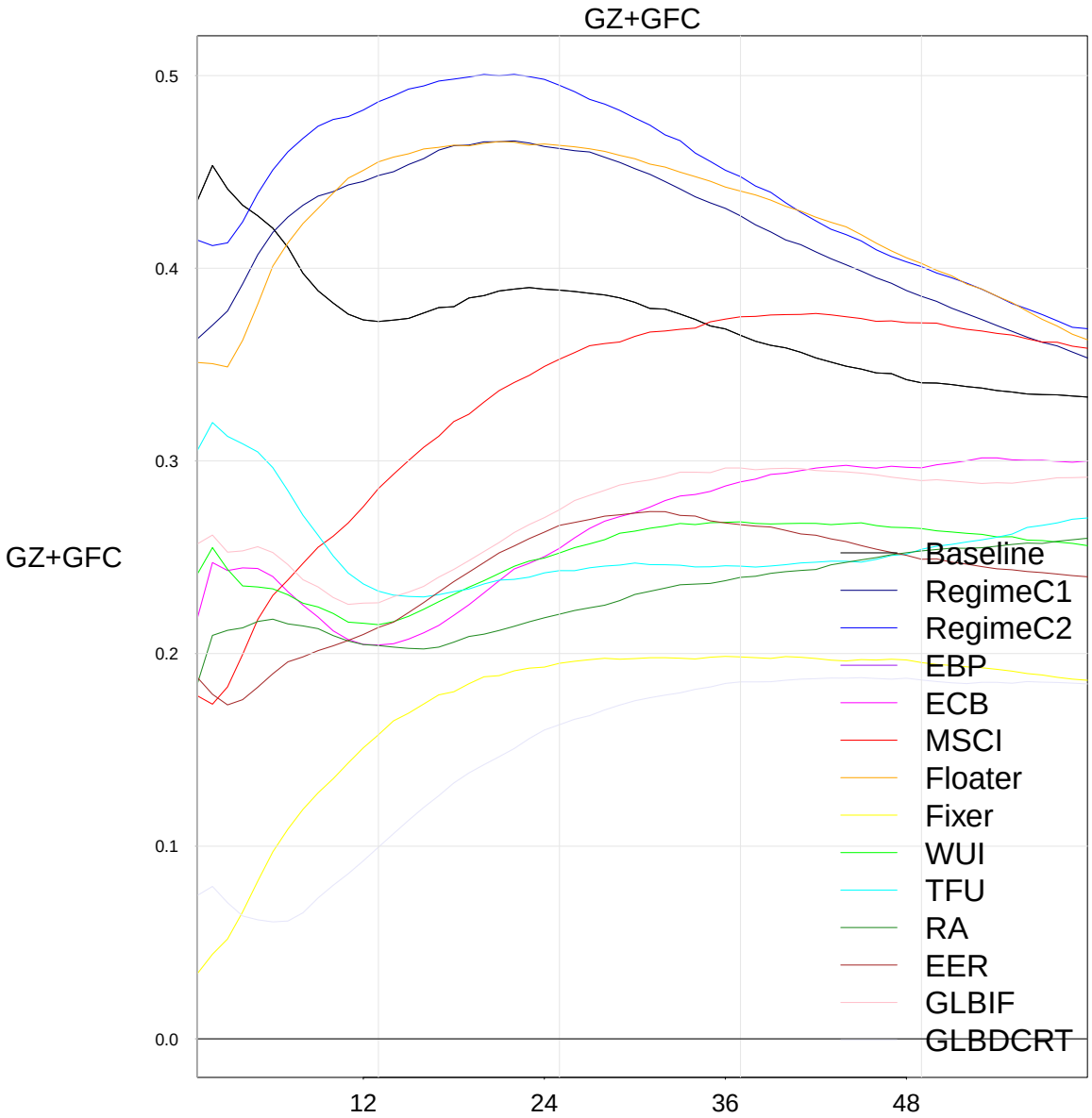


Figure: RS Statistics: All Robustness