Monetary Policy, Inflation, and Crises: Evidence from History and Administrative Data

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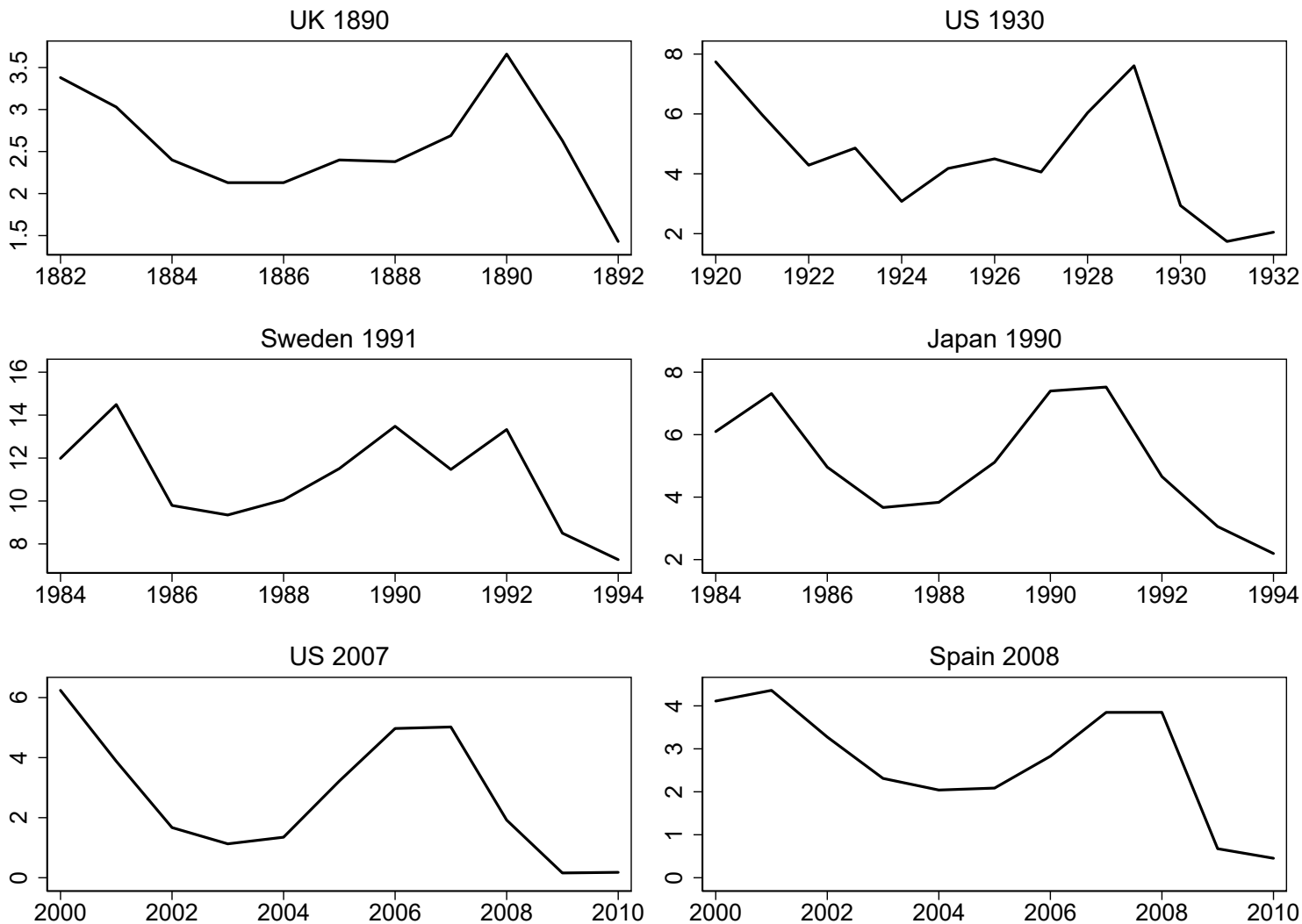
Motivation

- Current environment: high inflation, rising policy rates
- Policymakers are balancing risks of inflation vs recession
  - We know a lot about these inflation–GDP trade-offs (Blinder, 2023)
- But raising rates can also trigger a financial crisis (Jiang, Matvos, Piskorski, and Seru, 2023)
  - Especially after a period of low rates (Acharya et al., 2022; Kashyap and Stein, 2023; IMF, 2023; ECB, 2023; Rajan, 2023)
- We know much less about the links between the path of monetary policy and banking crises

Case studies of important banking crises



y axis: nominal monetary policy rate

This paper

- Impact of monetary policy (MP) dynamics on banking crises
  - What is the full path of the MP rate before a crisis?
  - Does raising rates in an environment like today (U-shaped path) increase crisis risk?
  - What are the underlying mechanisms?
- Data: two-pronged approach
  - A panel of historical crises to establish the results & mechanisms (17 countries, 1870–2016, 60–80 crises)
  - Credit registry data to dig further into the mechanisms (Spain, 1995–2020)
- MP rate: short-term nominal rate; international finance trilemma IV (Jordà et al., 2020)

Findings

1. Banking crises preceded by a U in monetary policy (MP) rates
   - Raising MP rates materially increases crisis risk, but only if rates were previously cut over a long period
   - Different for non-crisis recessions; weak/non-robust for inflation, real rates, long-term rates

2. Mechanism: increases in credit & asset prices as MP rates are cut (first half of the U), reversal as MP rates are raised
   - Red-zone (R-zone) booms (Greenwood et al., 2022) especially after (large) MP rate cuts
   - Higher crisis risk within R-zone only if MP rate hikes
   - Combination of U-MP & R-zone crucial for crises
   - Boom-bust in bank performance around U-MP & R-zones
   - Microdata: loan defaults higher after U-MP, especially for ex-ante riskier firms & banks

Literature on monetary policy & financial stability

1. Empirical
   - Low rates $\rightarrow$ higher asset prices/credit/risk taking (Rajan, 2006; Adrian and Shin, 2010; Jiménez et al., 2014; Becker and Ivashina, 2015; Martinez-Miera and Repullo, 2017; Di Maggio and Kacperczyk, 2017; Acharya et al., 2020; Grimm et al., 2023)
   - Link between rate hikes & crises (Schularick, ter Steege, and Ward, 2021)
   - We show: the full path matters; cuts followed by raises generate financial instability
2. Theoretical
   - Focus on low rates creating financial vulnerability (Stein, 2012; Ajello, Boyarchenko, Gourio, and Tambalotti, 2022)
   - Recent work on combination of loose policy & subsequent tightening as trigger (Diamond and Rajan, 2012; Boissay, Collard, Galí, and Manea, 2021; Acharya, Chauhan, Rajan, and Steffen, 2022)

Monetary policy and inflation around crises

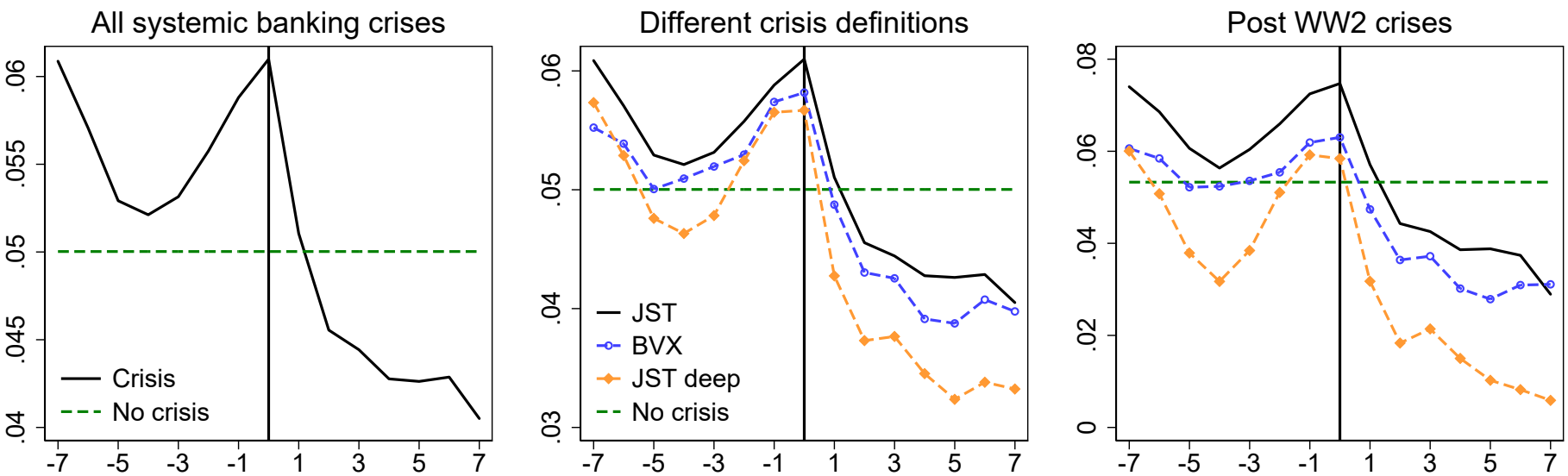
Data

- 17 advanced economies (13 European countries, USA, Canada, Australia, Japan), 1870–2016 (Jordà et al., 2016)
- Narrative crisis definition (Schularick and Taylor, 2012) (bank runs / defaults / forced mergers)
  - Robust to Baron et al. (2021) chronology: narrative + sharp declines in bank stock returns
- Monetary policy rate: short-term interest rate (central bank / interbank / t-bill rate)

Event window analysis

1. Window averages
   - Average levels of rates, inflation, etc 7 years, 6 years, ... before & after a crisis
2. Crisis window regressions
   - Change relative to year t: regress level of the variable on the crisis year for horizons $h = -7, ..., 7$

Monetary policy rates around crises

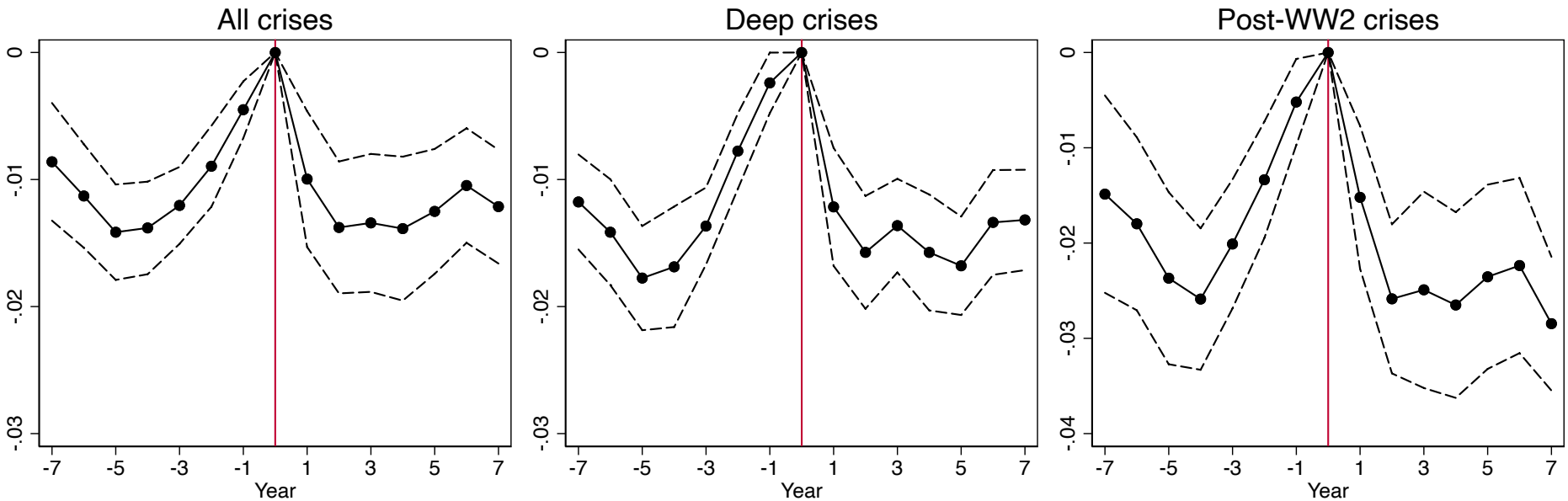


Crisis definitions. JST: Jordà et al. (2016), BVX: Baron et al. (2021),
JST deep: JST & low GDP growth

▸ Inflation & real rates

Crisis window regressions: monetary policy rates

$$r_{i,t+h} - r_{i,t} = \alpha_{i,h} + \alpha_{d,h} + \beta_h \mathbb{1}_{Crisis_{i,t}=1} + \epsilon_{i,t+h} \quad h \in \{-7, ..., 7\}.$$



▸ Residualised interest rates

Crisis window regressions: other variables

- No clear / strong pattern for
  - Inflation
  - Real rates
  - Long-term rates ▸ Graphs
- Different pattern for non-crisis recessions
  - Rate increases but no U ▸ Recessions

The path of policy rates and crisis risk

Frequency of crises after different MP rate paths

- Sort data in 2×2 groups by time window ($t-8$ to $t-3$ & $t-3$ to t) and monetary rate change (cut vs raise)
- Compute crisis during 3 years after each shape (t to $t+2$)
- Crises are more than twice as frequent after the U shape

	(1)	(2)	(3)	(4)
	Crisis	Deep crisis	Post-WW2 crisis	Post-WW2 deep crisis
U shape (cut, raise)	0.20	0.13	0.18	0.14
Raise, raise	0.08	0.04	0.03	0.00
Raise, cut	0.05	0.02	0.01	0.00
Cut, cut	0.04	0.02	0.02	0.00
Unconditional	0.10	0.05	0.06	0.03

▸ With numbers of crises ▸ 1-year crisis window ▸ Symmetric U ▸ Non-financial recessions

Trilemma instrument

- Countries with fixed exchange rate and open capital accounts are forced to track base country interest rates (Mundell, 1963)
- Use base country interest rate changes to look at exogenous policy responses (Jordà et al., 2020, see also Maddaloni and Peydro, 2011; Jiménez et al., 2012, 2014)

$$\text{Trilemma IV} = \Delta \text{Rate}^{\text{Residual}}_{b(i),t} * \text{PEG}_{i,t} * \text{PEG}_{i,t-1} * \text{KOPEN}_{i,t}.$$

- $\text{Rate}^{\text{Residual}}_{b(i),t}$: change in the base country residual rate
  - Controls: inflation, GDP, consumption, investment, current account, short-term rates, long-term rates

U-shaped monetary policy rates and crises

$$\text{Crisis}_{i,t \text{ to } t+2} = \alpha_i + \beta_1 \Delta_3 \text{Rate}_{i,t} + \beta_2 \text{Cut}_{i,t-8,t-3} + \beta_3 \Delta_3 \text{Rate}_{i,t} \times \text{Cut}_{i,t-8,t-3} + \gamma X_{i,t} + u_{i,t \text{ to } t+2}.$$

	Dependent variable: $\text{Crisis}_{t \text{ to } t+2}$					
	OLS			IV		
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_3 \text{Rate}_t$	0.02***	0.02***	0.01*	0.03**	0.02*	0.00
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
$\text{Cut Rate}_{t-8,t-3}$		0.07**	0.07**		0.06***	0.06***
		(0.02)	(0.02)		(0.02)	(0.02)
$\Delta_3 \text{Rate}_t \times \text{Cut Rate}_{t-8,t-3}$			0.03***			0.06**
			(0.01)			(0.03)
Country fixed effects	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Kleibergen-Paap Weak ID				82.26	82.72	36.08
Observations	1624	1624	1624	1624	1624	1624

$X_{i,t}$ contains 8 lags of yearly real GDP growth, inflation, and crisis dummy

Robustness & additional specifications

- Holds across a range of robustness tests
  - Holds for 1-year ahead crises, post-WW2, adjusted s.e., additional controls, probit ▸ Overview Robustness ▸ Probit
  - Holds for 1-year (rather than 3-year) rate changes ▸ 1-year changes
  - Holds for other crisis chronologies ▸ BVX
- A longer and deeper U increases crisis risk
  - Keeping rates low for longer increases crisis risk once rates are raised ▸ Low for long
  - A deeper U associated with higher crisis risk ▸ U depth
- Paths of inflation & real rates don't predict crises ▸ Inflation

No U-shape effects for (deep) non-crisis recessions

	Dependent variable: Recession$_{t \text{ to } t+2}$				Deep recession$_{t \text{ to } t+2}$	
	OLS		IV		OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_3 \text{Rate}_t$	0.02***	0.02**	0.06***	0.06***	0.01*	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
Cut Rate$_{t-8,t-3}$		-0.02		-0.05	-0.00	-0.02
		(0.03)		(0.03)	(0.02)	(0.02)
$\Delta_3 \text{Rate}_t \times$ Cut Rate$_{t-8,t-3}$		0.02		-0.00	-0.00	-0.01
		(0.01)		(0.02)	(0.01)	(0.02)
Country fixed effects	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Kleibergen-Paap Weak ID			88.99	41.98		39.21
Observations	1624	1624	1624	1624	1624	1624

$X_{i,t}$ contains 8 lags of yearly real GDP growth, inflation, and recession dummy

Understanding the mechanisms

Why does U-shaped policy increase crisis risk?

- Low rates: create financial vulnerabilities (Jiménez et al., 2014; Acharya and Rajan, 2022; Kashyap and Stein, 2000)
  - Reach for yield
  - Build-up of leverage
  - Excessive maturity transformation

▸ Boom LPs

- Rate increases may crystallize these vulnerabilities

Policy rate path and the financial "red zone"

- Banking crises are related to ex ante credit & asset price dynamics (Borio and Lowe, 2002; Sufi and Taylor, 2021)
- Define financial "red zone" (R-zone) as in Greenwood, Hanson, Shleifer, and Sørensen (2022)

$$\text{R-zone}_{i,j,t} = \text{High-Credit-Growth}_{i,j,t} * \text{High-Price-Growth}_{i,j,t}$$

$$\text{High-Cred.-Growth}_{i,j,t} = 1\left\{\Delta_3(\text{Credit/GDP})_{i,j,t} > 80^{\text{th}} \text{ percentile}\right\}$$

$$\text{High-Price-Growth}_{i,j,t} = 1\left\{\Delta_3 \ln(\text{Asset Price})_{i,j,t} > 66.7^{\text{th}} \text{ percentile}\right\}$$

(Large) rate cuts increase the likelihood of ending up in the R-zone

- Policy rate cuts increase the likelihood of ending up in the R-zone over the next 3 years
  - Especially large cuts (Δ_5Rate in the lowest quartile)

Dependent variable:	R-Zone BUS$_{t+1 \text{ to } t+3}$		R-Zone HH$_{t+1 \text{ to } t+3}$		R-Zone Either$_{t+1 \text{ to } t+3}$	
	(1)	(2)	(3)	(4)	(5)	(6)
Cut Rate$_{t-5,t}$	0.06**	0.01	0.12***	0.07**	0.11***	0.04
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Large Cut Rate$_{t-5,t}$		0.08***		0.08**		0.13***
		(0.03)		(0.03)		(0.03)
Country fixed effects	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Observations	1693	1693	1521	1521	1750	1750

Raising rates in the R-zone triggers crises

- Raising rates in R-zone increases crisis risk, but only if the R-zone was preceded by a rate cut ▸ Frequency table
- Also: raising in R-zone predicts lower GDP growth 1–5 years ahead ▸ R-zone LPs

	Dependent variable: $\text{Crisis}_{t \text{ to } t+2}$								
	R-zone			R-zone, pre cut			R-zone, pre raise		
	OLS		IV	OLS		IV	OLS		IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\text{R-Zone}_{t-3 \text{ to } t-1}$	0.12***	0.04*	-0.08	0.17***	0.06*	-0.03	0.01	-0.01	-0.08
	(0.02)	(0.02)	(0.08)	(0.04)	(0.03)	(0.10)	(0.04)	(0.02)	(0.12)
$I(\Delta_3 \text{Rate}_t \geq 0)$		0.05**	-0.10		0.06**	-0.07		0.10***	0.04
		(0.02)	(0.07)		(0.02)	(0.08)		(0.02)	(0.08)
$\text{R-Zone}_{t-3 \text{ to } t-1} \times I(\Delta_3 \text{Rate}_t \geq 0)$		0.16***	0.41**		0.20***	0.41**		0.04	0.19
		(0.05)	(0.17)		(0.07)	(0.20)		(0.08)	(0.27)
Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓
Kleibergen-Paap Weak ID			21.14			17.36			2.71
Observations	1474	1474	1474	1474	1474	1474	1474	1474	1474

Combination of U-MP & R-zone is crucial for banking crises

- Sort data by U-MP (over $t-8$ to t) and R-zone ($t-3$ to t)
- Compute crisis frequency for 3 years after each shape (t to $t+2$)

	(1)	(2)	(3)	(4)
	Crisis	Deep crisis	Post-WW2 crisis	Post-WW2 deep crisis
U-shaped MP & R-zone	0.38	0.26	0.40	0.32
U-shaped MP & no R-zone	0.09	0.08	0.04	0.04
No U-shaped MP & R-zone	0.09	0.05	0.04	0.00
No U-shaped MP & no R-zone	0.05	0.02	0.02	0.00
Unconditional	0.09	0.06	0.06	0.03

▸ With number of crises ▸ Broader R-zone window

U-shaped monetary policy and bank stock returns

- Banking sector key to MP transmission & crises
- Below: U-shape in MP rates leads to declines in bank stock returns ▸ Bank equity crises

	Dependent variable: real bank stock return, t to t + 2					
	OLS			IV		
	(1)	(2)	(3)	(4)	(5)	(6)
Δ_3 Rate$_t$	-4.03***	-3.99***	-2.95***	-3.89**	-3.80**	-1.45
	(0.49)	(0.51)	(0.63)	(1.66)	(1.73)	(1.77)
Cut Rate$_{t-8,t-3}$		-1.34	-1.62		-1.49	-1.99
		(2.77)	(2.72)		(2.98)	(2.48)
Δ_3 Rate$_t$ × Cut Rate$_{t-8,t-3}$			-2.74**			-6.92*
			(1.26)			(4.12)
Country fixed effects	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Kleibergen-Paap Weak ID				69.51	66.68	26.88
Observations	1296	1296	1296	1296	1296	1296

U-shaped monetary policy and bank profitability

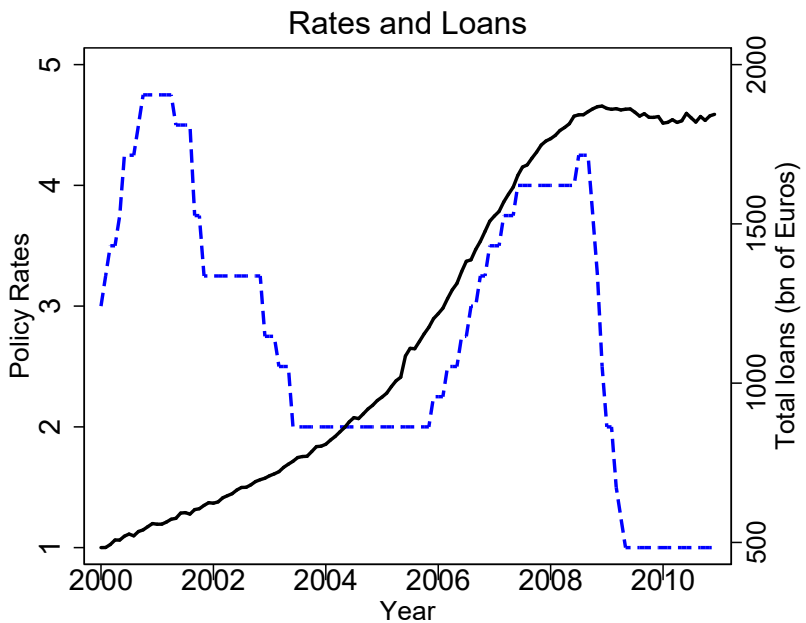
- Mixed evidence on link between MP rates and bank profits (Altavilla et al., 2018; Zimmermann, 2019)
- We show: U-MP leads to declines in bank profitability
- Low rates lead to R-zone vulnerabilities, rate hikes expose them with banks key to transmission ▸ R-zone window

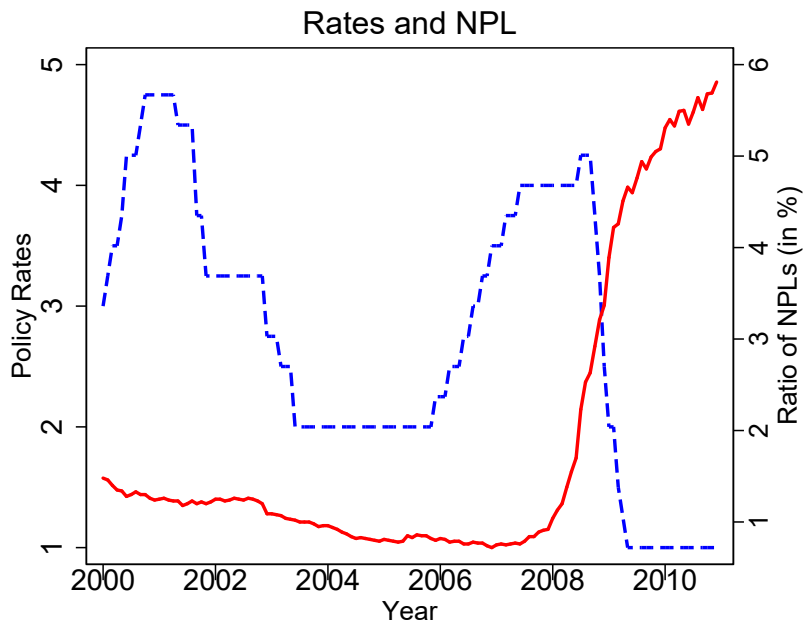
	Dependent variable: Change in $RoE_{t \text{ to } t+2}$					
	OLS			IV		
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_3 Rate_t$	-0.30***	-0.29***	-0.06	-0.80**	-0.80**	0.09
	(0.09)	(0.08)	(0.11)	(0.37)	(0.38)	(0.20)
Cut $Rate_{t-8,t-3}$		-0.26	-0.26		0.08	0.15
		(0.55)	(0.55)		(0.53)	(0.52)
$\Delta_3 Rate_t \times$ Cut $Rate_{t-8,t-3}$			-0.67***			-2.78***
			(0.23)			(1.04)
Country fixed effects	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Kleibergen-Paap Weak ID				56.05	55.07	22.43
Observations	1368	1368	1368	1368	1368	1368

Loan-level evidence from the Spanish credit register

Data and setting

- Sample: all new loans extended by banks to businesses 1995-2008 (robustness: 1995–2016); follow loan defaults over a 3-year period
- Exogenous monetary policy set in Frankfurt
- Spain has a bank-dominated financial system





Specifications

1. Predict loan default 3 years ahead: $\text{Loan Default}_{i,j,t,t+3}$

$$\begin{aligned}\text{Loan Default}_{i,j,t,t+3} = {} & \beta_1 \Delta_3 \text{Rate}_{t,t+3} + \beta_2 \text{Cut}_{t-5,t} \\ & + \beta_3 \Delta_3 \text{Rate}_{t,t+3} \times \text{Cut}_{t-5,t} \\ & + \gamma_1 F_{i,t-1} + \gamma_2 B_{j,t-1} + \gamma_3 M_t + u_{i,j,t,t+1}\end{aligned}$$

   where F, B, M are firm, bank, and macro controls.

2. Heterogeneity: include triple interactions of rate, cut, and firm/bank characteristics

▸ Summary statistics

Monetary policy path & loan-level defaults in Spain

- Loans extended when rates were cut have much higher default rates when rates are raised

	Dependent variable: Loan default$_{t+1 \text{ to } t+3}$								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ_3Rate$_{t,t+3}$	0.001*	0.000	0.000	0.002**	0.001	0.002**	0.001	0.002*	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Cut Rate$_{t-5,t}$	0.012***	0.010***	0.010***	0.006***	0.007***	0.007**	0.007***	0.007***	0.012***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Δ_3Rate$_{t,t+3}$ × Cut Rate$_{t-5,t}$		0.003**	0.004***	0.003***	0.003***	0.002**	0.003***	0.004***	0.007***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Industry × Location FE	No	No	Yes	Yes	-	Yes	-	-	-
Bank Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	No	No	Yes	Yes	-	-
Firm FE	No	No	No	No	Yes	No	Yes	-	-
Firm × Bank FE	No	No	No	No	No	No	No	Yes	Yes
Firm Controls	No	No	No	No	No	No	No	No	Yes
Observations	1.1m	1.1m	1.1m	1.1m	1.1m	1.1m	1.1m	1.1m	0.7m
R^2	0.031	0.031	0.220	0.220	0.353	0.221	0.354	0.551	0.584

▸ Demeaned ▸ 1995–2020 sample ▸ Economic Effects

Heterogeneous effects

- Effects much stronger for riskier firms & weaker banks

	Dependent variable: Loan default$_{t+1 \text{ to } t+3}$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ_3Rate$_{t,t+3}$	0.003***	0.003***	0.001*	0.002**			
	(0.001)	(0.001)	(0.001)	(0.001)			
Cut Rate$_{t-5,t}$	0.008***	0.007***	0.007***	0.007***			
	(0.003)	(0.003)	(0.003)	(0.003)			
Δ_3Rate$_{t,t+3}$ × Cut Rate$_{t-5,t}$	0.004***	0.004***	0.005***	0.005***			
	(0.001)	(0.001)	(0.001)	(0.001)			
Δ_3Rate × Cut × Real estate firm	0.012***			0.012***	0.012***	0.010***	0.011***
	(0.002)			(0.002)	(0.002)	(0.001)	(0.001)
Δ_3Rate × Cut × Firm not audited		0.002*		0.002*	0.002**		
		(0.001)		(0.001)	(0.001)		
Δ_3Rate × Cut × Firm cost of credit						0.002***	0.001***
						(0.000)	(0.000)
Δ_3Rate × Cut × Bank NPL ratio			0.003***	0.003***	0.002***	0.002***	0.002***
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Δ_3Rate × Cut × Bank NPL × Real estate							0.003*
							(0.002)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm × Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	No	No	No	Yes	Yes	Yes
Firm Controls	No	No	No	No	No	Yes	Yes
Observations	1.1m	1.1m	1.1m	1.1m	1.1m	0.7m	0.7m
R^2	0.552	0.551	0.551	0.552	0.552	0.586	0.586

▸ 1995–2020 sample

Conclusion

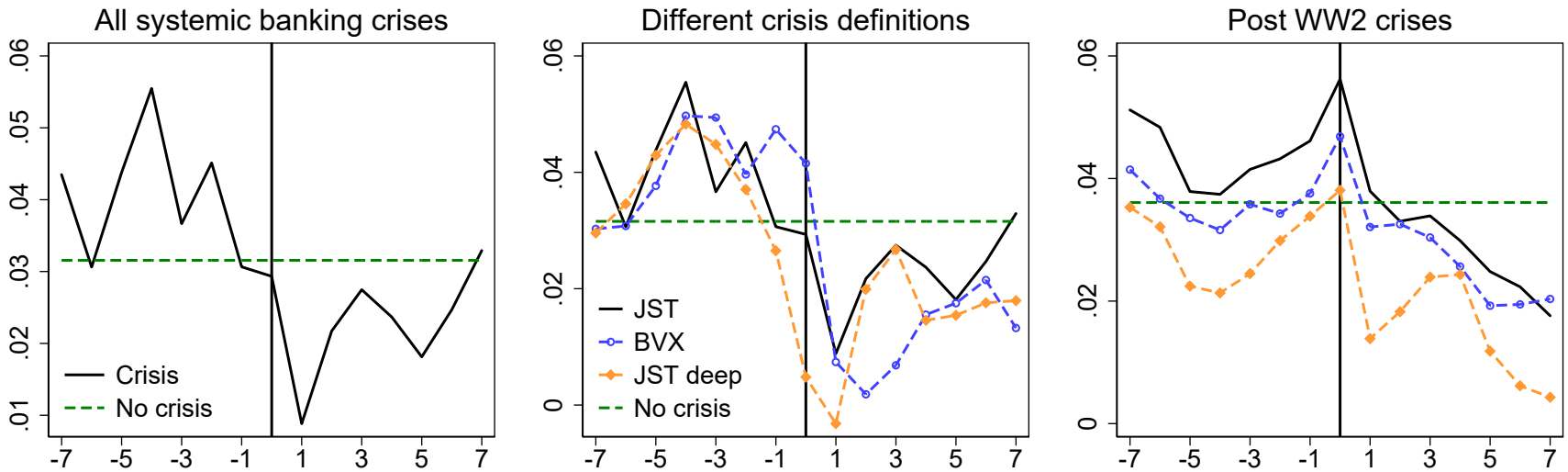
- Banking crises are preceded by U-shaped monetary policy (MP)
  - Raising MP rates materially increases crisis risk, but only if rates were previously cut over a long period
  - This link appears unique to banking crises, and short-term nominal MP rates
- Mechanism: financial boom as MP rates $\downarrow$, reversal as rates $\uparrow$
  - Red-zone booms especially after (large) MP rate cuts
  - Higher crisis risk after MP raises in the red zone, but only for red-zones preceded by cuts
  - Also, boom-bust & U-MP effects for bank returns & profits
  - Microdata: defaults $\uparrow$ after U, esp. for worse firms & banks
- Bigger-picture implications
  - Effects of policy on crises are path-dependent
  - To prevent financial booms from turning into crises, MP (or/and macropru) needs to act before the red zone
  - If in red zone & need higher MP rates, macropru crucial

Appendix

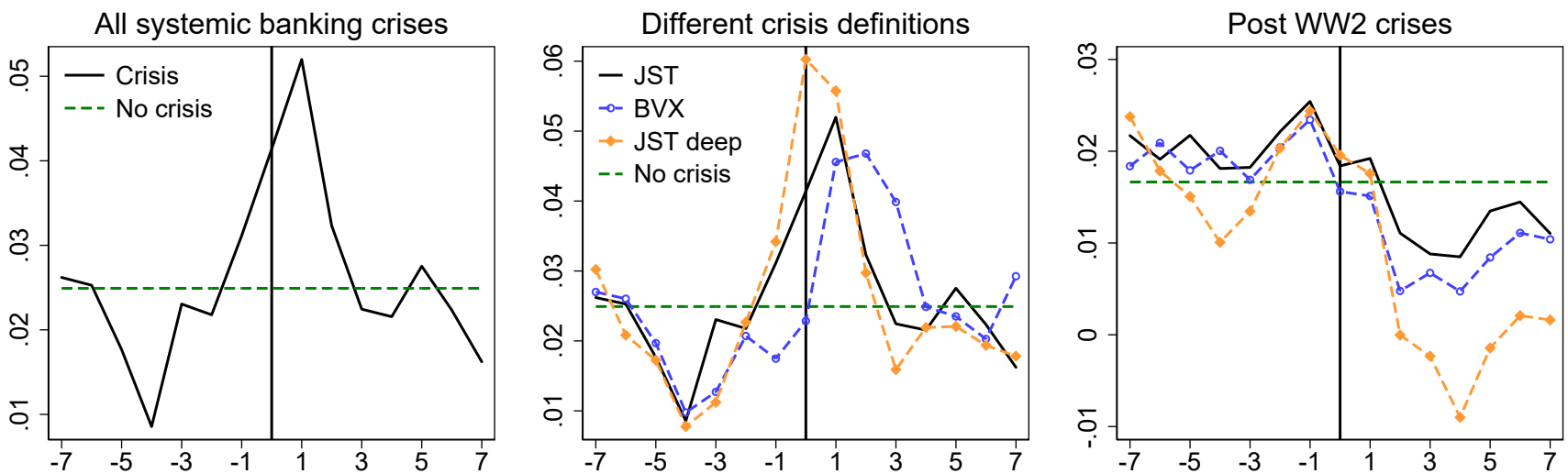
Inflation and real interest rates around crises

back

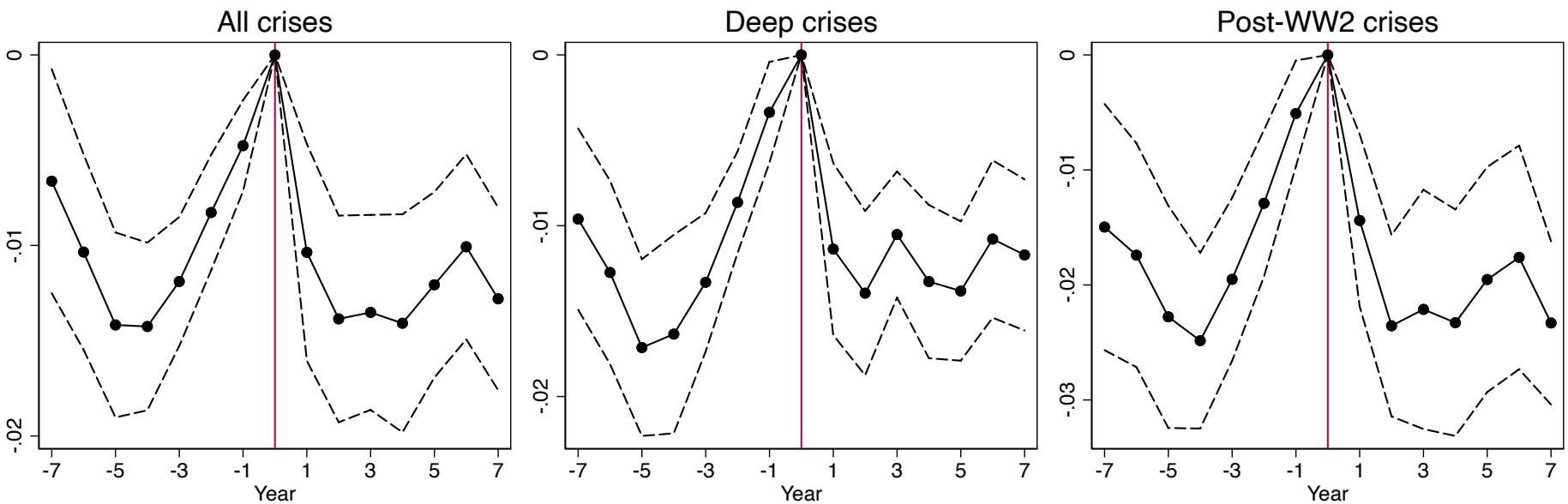
(a) Inflation:



(b) Real interest rates:



Residual interest rates around crises



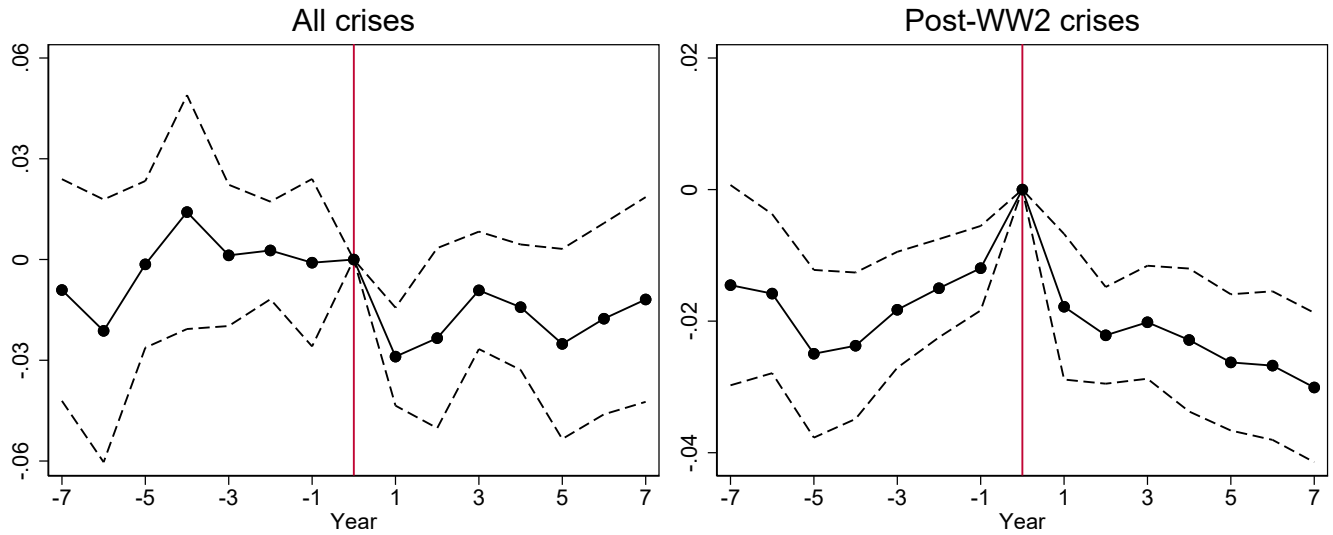
Residual rate:

1. Regress change in MP rates on lagged changes in short & long rates, inflation, GDP, consumption, investment, current account
2. Cumulate the changes

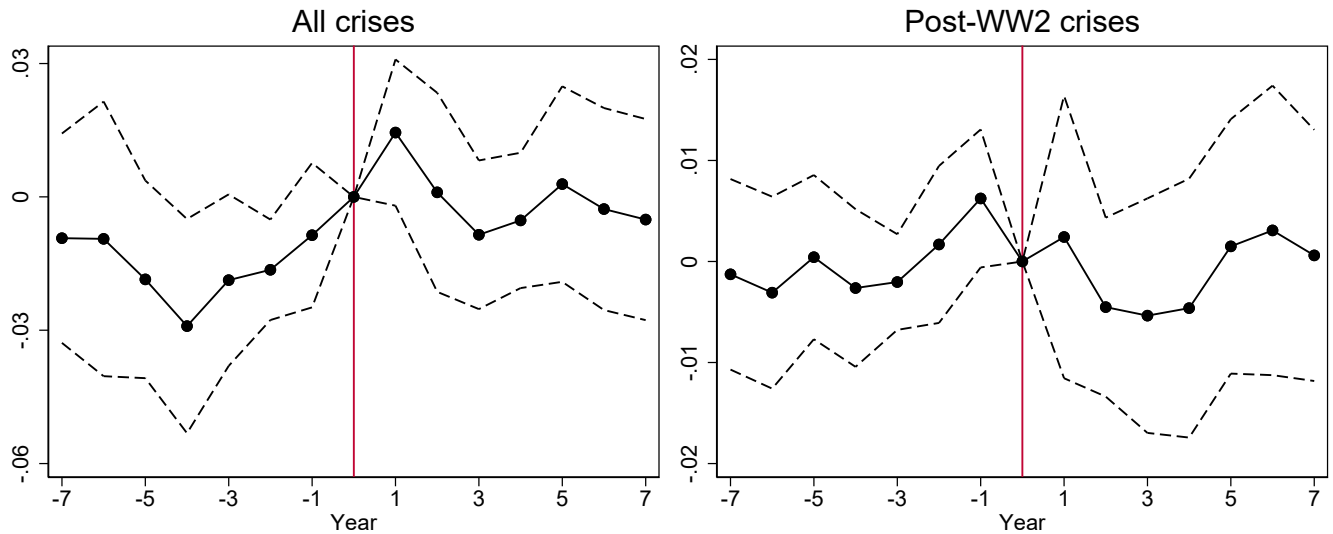
▸ Back

Crisis window regressions: inflation & real rates

(a) Inflation:



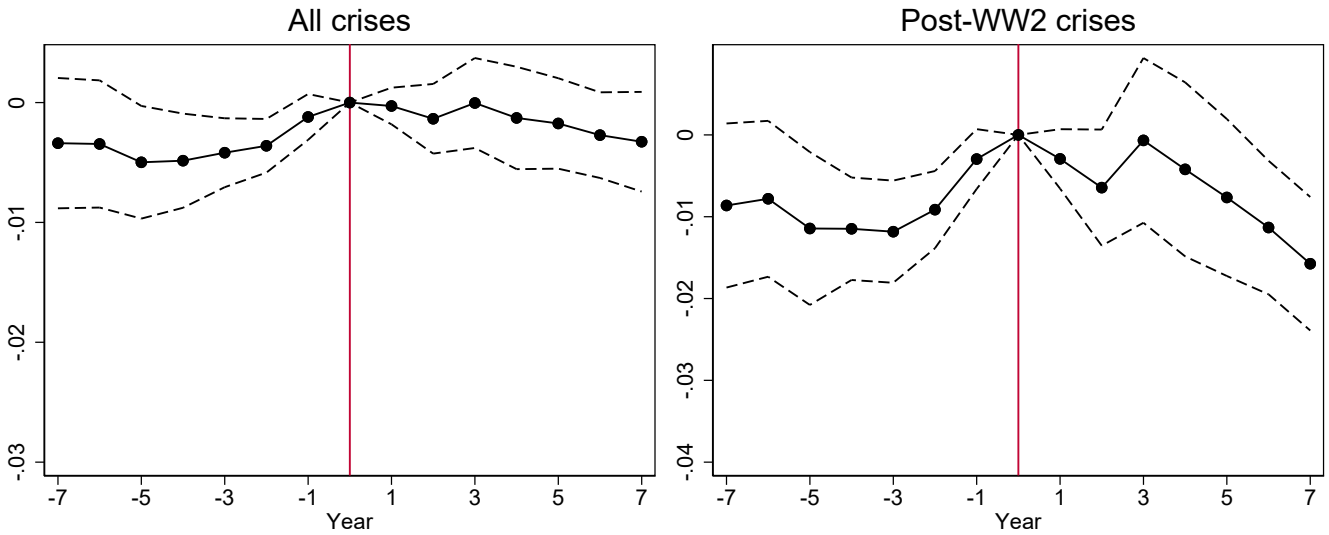
(b) Real interest rate:



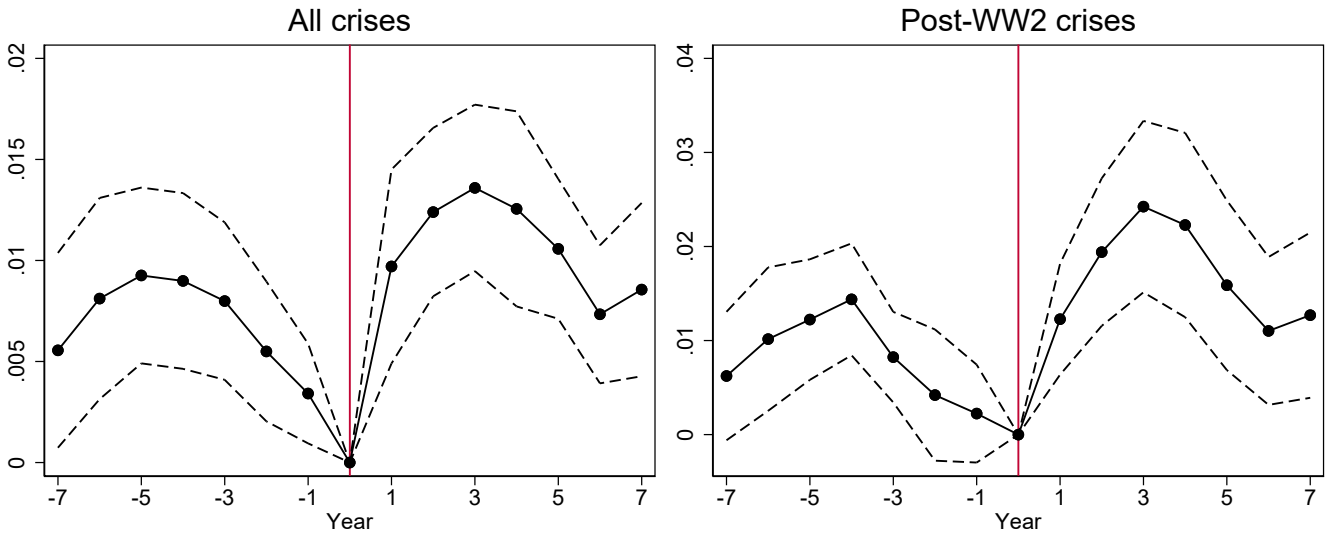
Back

Crisis window regressions: long rates & term premia

(a) Long-term rate around crises:

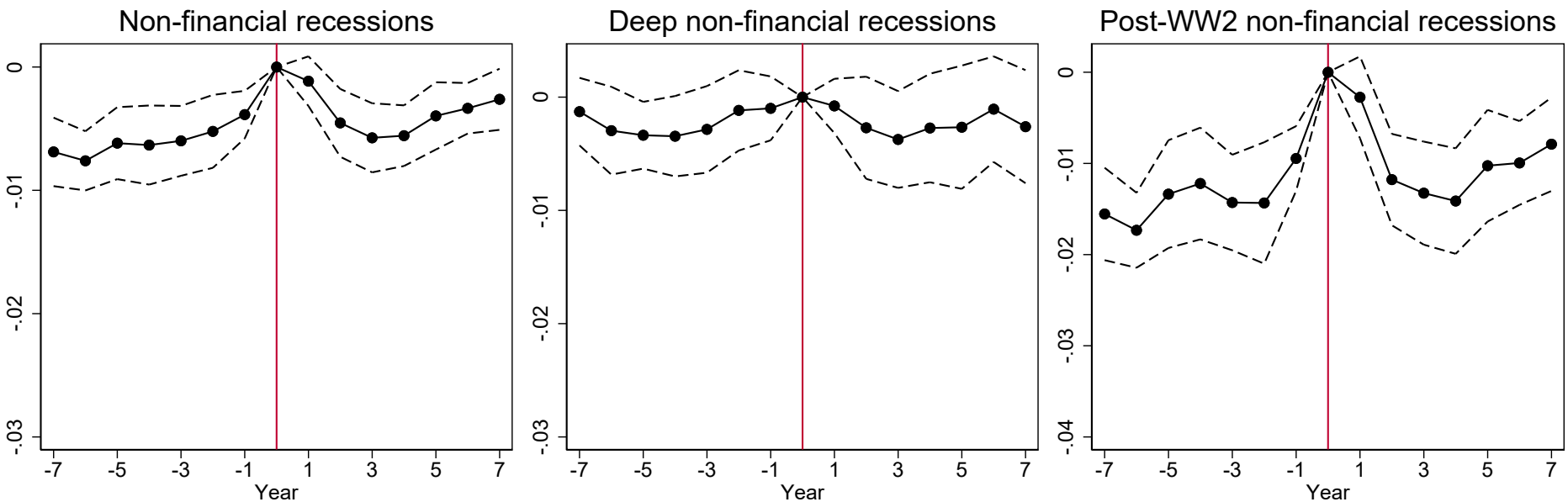


(b) Term premium (long – short rate):



Back

No U but rate hikes before non-crisis recessions

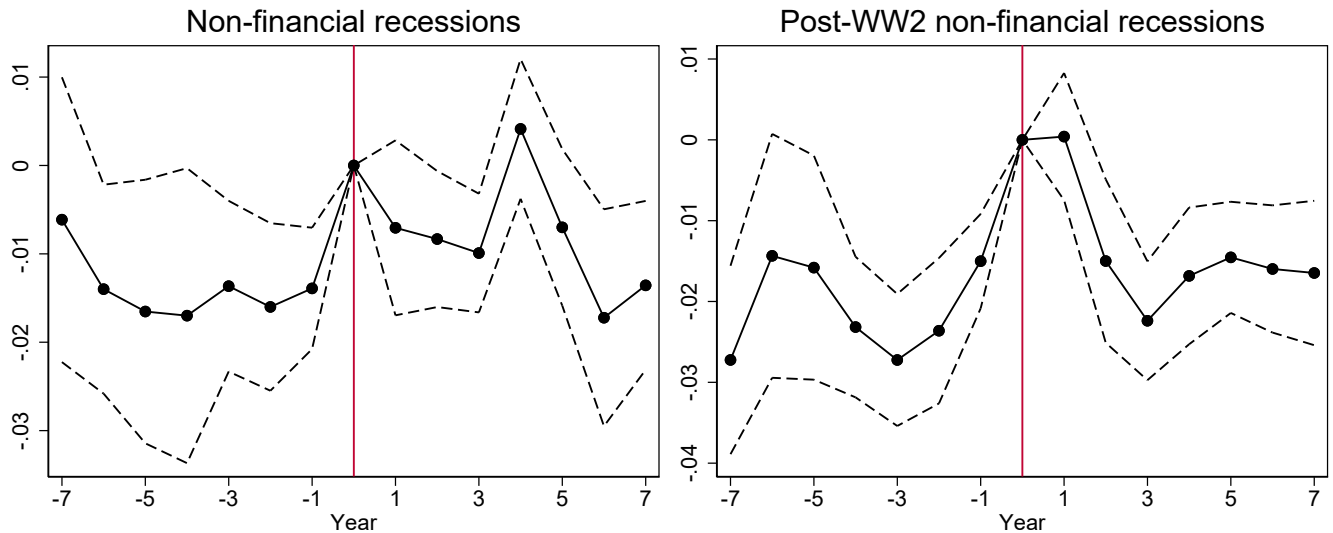


Back

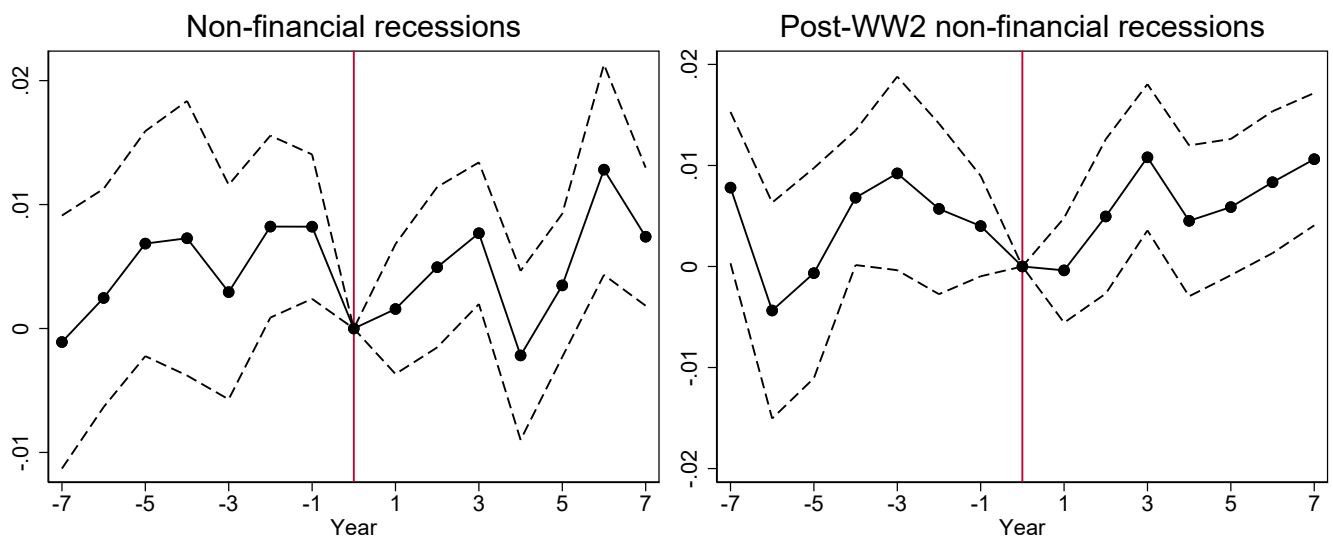
Recession window regressions: real rates & inflation

back

(a) Inflation:



(b) Real interest rate:



Frequency of crises – with numbers of crises

	(1)	(2)	(3)	(4)
	Crisis	Deep crisis	Post-WW2 crisis	Post-WW2 deep crisis
U shape (cut, raise)	0.20 (39/199)	0.13 (25/199)	0.18 (17/95)	0.14 (13/95)
Raise, raise	0.08 (14/169)	0.04 (6/169)	0.03 (3/107)	0.00 (0/107)
Raise, cut	0.05 (9/184)	0.02 (4/184)	0.01 (1/92)	0.00 (0/92)
Cut, cut	0.04 (6/160)	0.02 (4/160)	0.02 (2/93)	0.00 (0/93)
Unconditional	0.10 (68/713)	0.05 (39/713)	0.06 (23/387)	0.03 (13/387)

back

Frequency of crises by policy rate path: 1 year ahead crises

	(1)	(2)	(3)	(4)
	Crisis	Deep crisis	Post-WW2 crisis	Post-WW2 deep crisis
U shape (cut, raise)	0.07	0.04	0.06	0.05
Raise, raise	0.03	0.01	0.01	0.00
Raise, cut	0.02	0.01	0.00	0.00
Cut, cut	0.01	0.01	0.01	0.00
Unconditional	0.03	0.02	0.02	0.01

Back

Frequency of crises by policy rate path: symmetric U window ($t-6$ to $t-3$ and $t-3$ to t)

	(1)	(2)	(3)	(4)
	Crisis	Deep crisis	Post-WW2 crisis	Post-WW2 deep crisis
U shape (cut, raise)	0.19	0.11	0.16	0.12
Raise, raise	0.07	0.05	0.03	0.01
Raise, cut	0.05	0.02	0.01	0.00
Cut, cut	0.05	0.03	0.02	0.00
Unconditional	0.10	0.05	0.06	0.03

Back

Frequency of recessions by policy rate path

	(1)	(2)	(3)	(4)
	Non-crisis recession	Deep non-crisis recession	Post-WW2 non-crisis recession	Post-WW2 deep non-crisis recession
U shape (cut, raise)	0.37	0.15	0.25	0.04
Raise, raise	0.30	0.12	0.27	0.05
Raise, cut	0.28	0.11	0.21	0.02
Cut, cut	0.26	0.15	0.09	0.00
Unconditional	0.31	0.13	0.21	0.03

Recession: non-financial business cycle peak in the 3-year window after the policy shape (t to $t + 2$)

▸ Back

U-shaped policy and crises: robustness ▸ back

- U-shaped policy predicts crises across wide variety of specifications (results below all for JST IV)

	Dependent variable: $\text{Crisis}_{t \text{ to } t+2}$							
	1-year ahead		Post-WW2		Driscoll-Kraay		Decade FE + Controls	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta_3 \text{Rate}_t$	0.01	0.00	0.02**	-0.00	0.02	0.00	0.02	0.00
	(0.01)	(0.00)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)
$\text{Cut Rate}_{t-8,t-3}$	0.02**	0.02**	0.08***	0.07***	0.06*	0.06*	0.04	0.04*
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.02)
$\Delta_3 \text{Rate}_t \times \text{Cut Rate}_{t-8,t-3}$		0.02**		0.09***		0.06*		0.04**
		(0.01)		(0.03)		(0.03)		(0.02)
Country fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Kleibergen-Paap Weak ID	82.72	36.08	78.55	38.13	42.91	23.61	47.48	16.60
Observations	1624	1624	949	949	1624	1624	1198	1198

U-shaped policy and crises: 1-year changes

back

$$\text{Crisis}_{i,t \text{ to } t+2} = \alpha_i + \beta_1 \Delta\text{Rate}_{i,t} + \beta_2 \text{Cut}_{i,t-8,t-3} + \beta_3 \Delta\text{Rate}_{i,t} \times \text{Cut}_{i,t-8,t-3} + \gamma X_{i,t} + u_{i,t \text{ to } t+2}.$$

	OLS			IV		
	(1)	(2)	(3)	(4)	(5)	(6)
ΔRate_t	0.02***	0.02***	0.01	0.01	0.02	-0.01
	(0.00)	(0.00)	(0.00)	(0.02)	(0.02)	(0.01)
$\text{Cut Rate}_{t-8,t-3}$		0.08***	0.08***		0.08***	0.08***
		(0.02)	(0.02)		(0.02)	(0.02)
$\Delta\text{Rate}_t \times \text{Cut Rate}_{t-8,t-3}$			0.04***			0.05*
			(0.01)			(0.03)
Country fixed effects	✓	✓	✓	✓	✓	✓
Kleibergen-Paap Weak ID				49.52	49.33	16.25
Observations	1673	1673	1673	1673	1673	1673

U-shaped policy and crises: probit

back

	Dependent variable: $\text{Crisis}_{t \text{ to } t+2}$					
	Probit			Probit IV		
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_3 \text{Rate}_t$	0.02***	0.02***	0.01*	0.03**	0.03*	0.00
	(0.00)	(0.00)	(0.01)	(0.01)	(0.02)	(0.02)
$\text{Cut Rate}_{t-8,t-3}$		0.07***	0.06**		0.06**	0.07**
		(0.03)	(0.02)		(0.03)	(0.03)
$\Delta_3 \text{Rate}_t \times \text{Cut Rate}_{t-8,t-3}$			0.02***			0.05**
			(0.00)			(0.03)
Country fixed effects	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Kleibergen-Paap Weak ID				70.49	75.14	31.80
Observations	1563	1563	1563	1563	1563	1563

U-shaped policy and crises: economic effects

back

Economic effects based on IV estimation in column (6):

- Δ_3Rate is zero and statistically insignificant.
- Cuts between t − 8 and t − 3 are associated with a 6% higher crisis probability.
- A 1 percentage point 3-year increase in monetary rates following a five-year cut is associated with a subsequent 6 percentage point higher crisis probability.
- A sequence of a cut from t − 8 to t − 3 and then increasing rates by 1 percentage point over three years is associated with a 12 percentage points increase in crisis risk (the sum of the above), more than doubling the crisis probability compared to the sample mean of 10%

Baron, Verner and Xiong (2021) crises

back

	Dependent variable: Crisis (BVX definition)$_{t \text{ to } t+2}$					
	OLS			IV		
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_3 \text{Rate}_t$	0.02***	0.02***	0.01*	0.06***	0.06***	0.03***
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Cut $\text{Rate}_{t-8,t-3}$		0.04*	0.04*		0.02	0.02
		(0.02)	(0.02)		(0.02)	(0.02)
$\Delta_3 \text{Rate}_t \times$ Cut $\text{Rate}_{t-8,t-3}$			0.03***			0.06*
			(0.01)			(0.03)
Country fixed effects	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Kleibergen-Paap Weak ID				77.77	79.56	37.45
Observations	1624	1624	1624	1624	1624	1624

Crisis risk and duration of the U

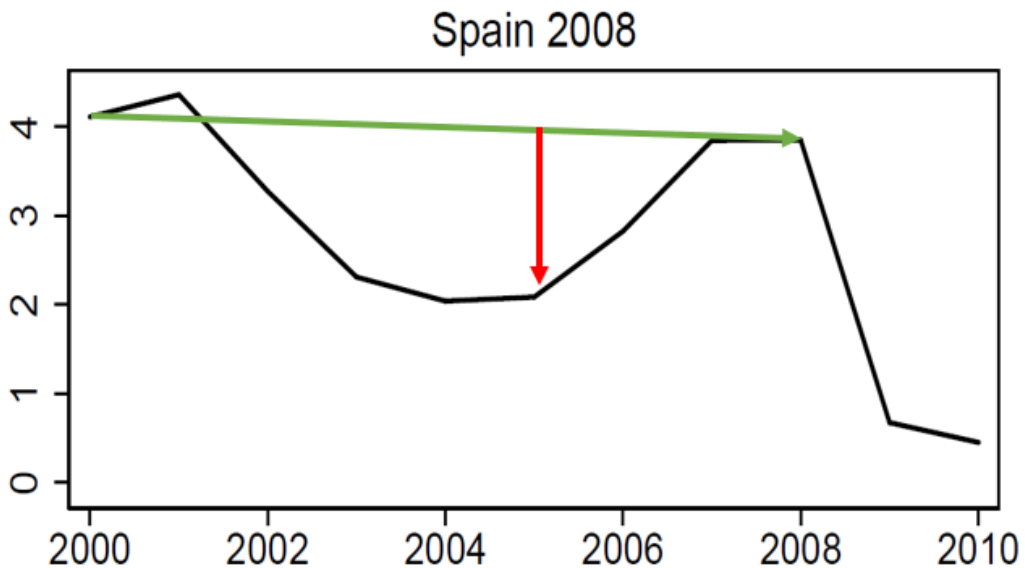
back

- Low rate dummy: rate below 10-year backward MA

	Dependent variable: $\text{Crisis}_{t \text{ to } t+2}$					
	OLS		IV		OLS	
	(1)	(2)	(3)	(4)	(5)	(6)
ΔRate_{t-1}	0.04***	0.01	0.04	-0.05		
	(0.01)	(0.01)	(0.03)	(0.04)		
$\log(\text{No. years (low rate)}_{t-2})$	0.01	0.01	0.02	0.01		0.00
	(0.02)	(0.02)	(0.02)	(0.02)		(0.02)
$\Delta\text{Rate}_{t-1} \times \log(\text{No. years (low rate)}_{t-2})$		0.03**		0.07***		
		(0.01)		(0.03)		
$\text{End of low rate spell}_{t-1}$					0.06***	-0.01
					(0.01)	(0.03)
$\text{End}_{t-1} \times \log(\text{No. years (low rate)}_{t-2})$						0.06***
						(0.02)
Country fixed effects	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Kleibergen-Paap Weak ID			47.20	14.95		
Observations	976	976	836	836	976	976

U depth

- 8-year window, t = 2008 in this example
- Assume a constant trend (green line) from t – 8 to t
- U dummy: if actual rate (black) below green line at time t – 3
- Deep U dummy: if actual rate more than 1 percentage point below green line (red arrow larger than 1) at time t – 3



Crisis risk and the depth of the U

back

	Dependent variable: $\text{Crisis}_{t \text{ to } t+2}$			
	(1)	(2)	(3)	(4)
$\Delta\text{Rate}_{t-8,t}$	0.01**	0.01**	0.01**	0.01**
	(0.00)	(0.00)	(0.00)	(0.00)
$U_{t-8,t-3,t}$	0.07***	0.03*	0.07***	0.04*
	(0.02)	(0.02)	(0.02)	(0.02)
Deep $U_{t-8,t-3,t}$		0.09***		0.07***
		(0.02)		(0.02)
Country fixed effects	✓	✓	✓	✓
Controls	✓	✓	✓	✓
Observations	1903	1903	1835	1835

Path of real rates, inflation, and crisis risk

back

- Dependent variable is again a financial crisis in t to t + 2
- Path of real rates or inflation does not predict crises

	Dependent variable: $\text{Crisis}_{\text{t to t+2}}$					
	Real rates			Inflation		
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_3 \text{Var}_t$	0.002	0.002	0.001	0.000	0.001	-0.000
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$1(\Delta \text{Var}_{t-8,t-3} < 0)$		0.009	0.009		-0.006	-0.006
		(0.024)	(0.024)		(0.024)	(0.024)
$\Delta_3 \text{Var}_t \times 1(\Delta \text{Var}_{t-8,t-3} < 0)$			0.002			0.002
			(0.003)			(0.002)
Country fixed effects	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Observations	1624	1622	1622	1622	1622	1622

LP set up

$$\Delta_h y_{i,t+h} = \alpha_{i,h} + \alpha_{d,h} + \beta_h \Delta \text{Rate}_{i,t} + \sum_{L=0}^{L=4} \gamma_L X_{i,t-L} + \epsilon_{i,t+h}, \quad h \in \{1, ..., 5\}.$$

- $\Delta_h y_{i,t+h}$ is the change in credit or asset prices
- Controls: credit, asset prices, GDP, inflation (contemporaneous + 4 lags); interest rates (4 lags)
- We reverse the sign on ΔRate

▸ back

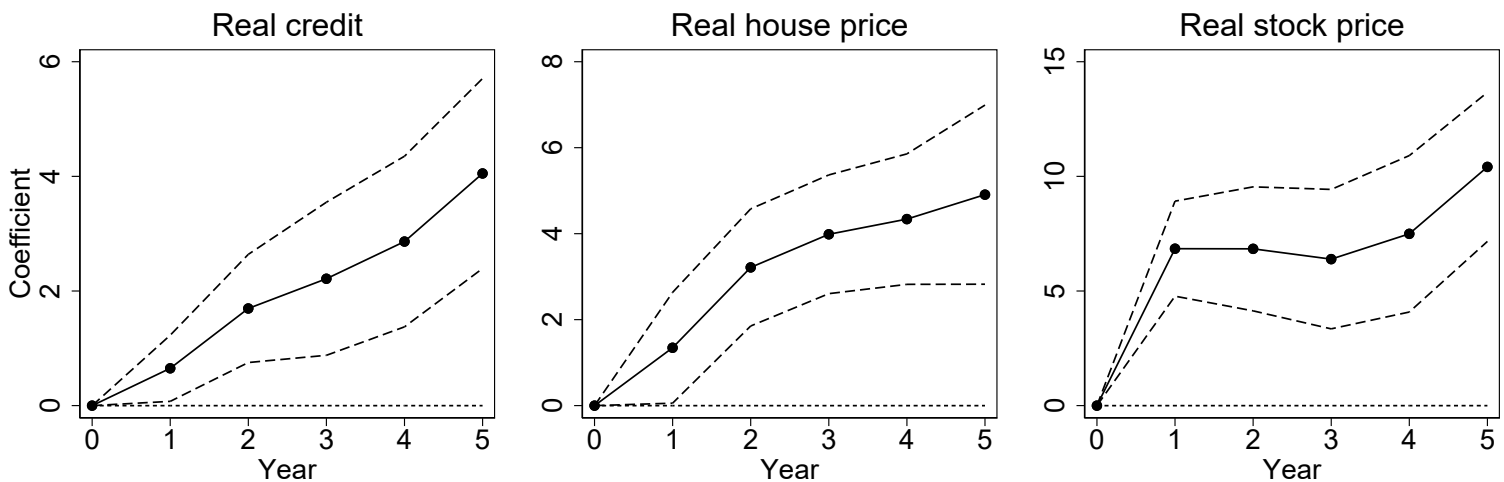
Boom: credit & AP response to rate cuts

back

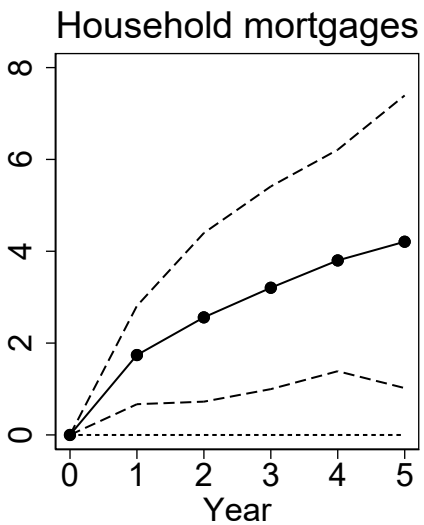
$$\Delta_h y_{i,t+h} = \alpha_{i,h} + \alpha_{d,h} + \beta_h \Delta \text{Rate}_{i,t} + \sum_{L=0}^{L=4} \gamma_L X_{i,t-L} + \epsilon_{i,t+h}, \quad h \in \{1, ..., 5\}.$$

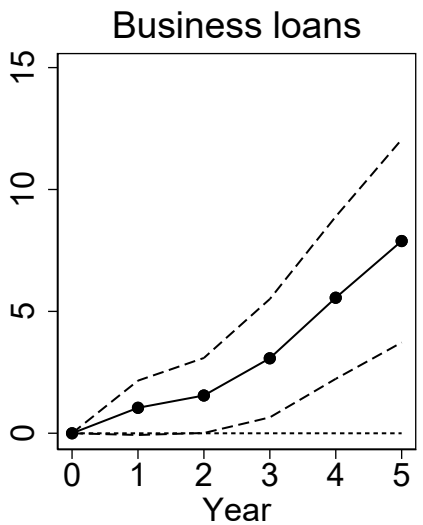
(a) Raw:

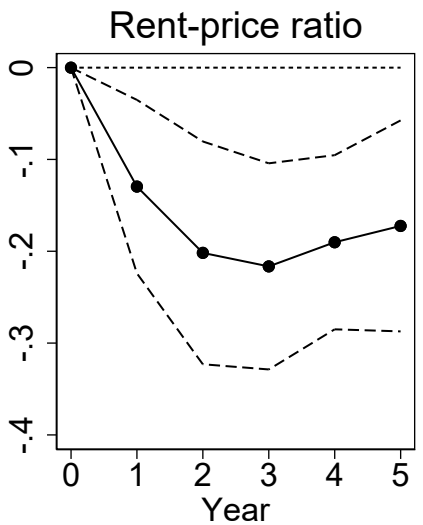
(b) Instrumented:

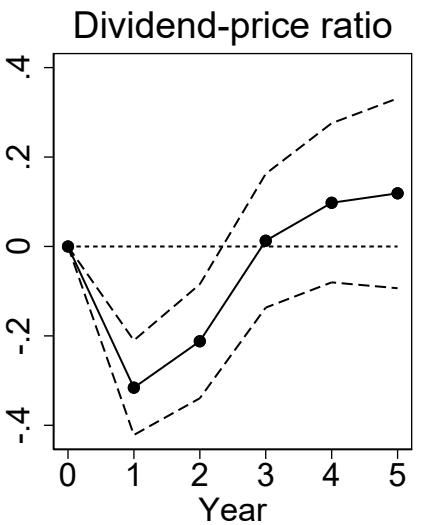


Boom: Types of loans and risk premia









back

Duration of low environment predicts R-zone

	R-Zone Bus$_{t+1 \text{ to } t+3}$ (1)	R-Zone HH$_{t+1 \text{ to } t+3}$ (2)	R-Zone Either$_{t+1 \text{ to } t+3}$ (3)
No. years (low spell)$_{t-1}$	0.01**	0.02***	0.02***
	(0.00)	(0.01)	(0.01)
Country fixed effects	✓	✓	✓
Controls	✓	✓	✓
Observations	1673	1507	1720

MP rates in the R zone and crisis frequencies

	(1)	(2)	(3)	(4)
	Crisis	Deep crisis	Post-WW2 crisis	Post-WW2 deep crisis
Raise in R-zone	0.26 (11/42)	0.19 (8/42)	0.26 (9/35)	0.20 (7/35)
Cut in R-zone	0.06 (2/36)	0.00 (0/36)	0.04 (1/27)	0.00 (0/27)
Raise outside of R-zone	0.10 (23/233)	0.05 (12/233)	0.04 (6/135)	0.02 (3/135)
Cut outside of R-zone	0.04 (13/325)	0.02 (8/325)	0.02 (3/187)	0.00 (0/187)
Unconditional	0.08 (49/636)	0.04 (28/636)	0.05 (19/383)	0.03 (10/383)

back

MP rates before the R zone & crisis frequencies

	(1)	(2)	(3)	(4)
	Crisis	Deep crisis	Post-WW2 crisis	Post-WW2 deep crisis
R-zone preceded by cut	0.29 (15/52)	0.19 (10/52)	0.29 (12/41)	0.19 (8/41)
R-zone preceded by raise	0.04 (1/27)	0.00 (0/27)	0.05 (1/21)	0.00 (0/21)
Cut not followed by R-zone	0.09 (23/269)	0.06 (16/269)	0.05 (7/148)	0.03 (5/148)
Raise not followed by R-zone	0.07 (19/283)	0.04 (12/283)	0.02 (3/173)	0.00 (0/173)
Unconditional	0.09 (58/631)	0.06 (38/631)	0.06 (23/383)	0.03 (13/383)

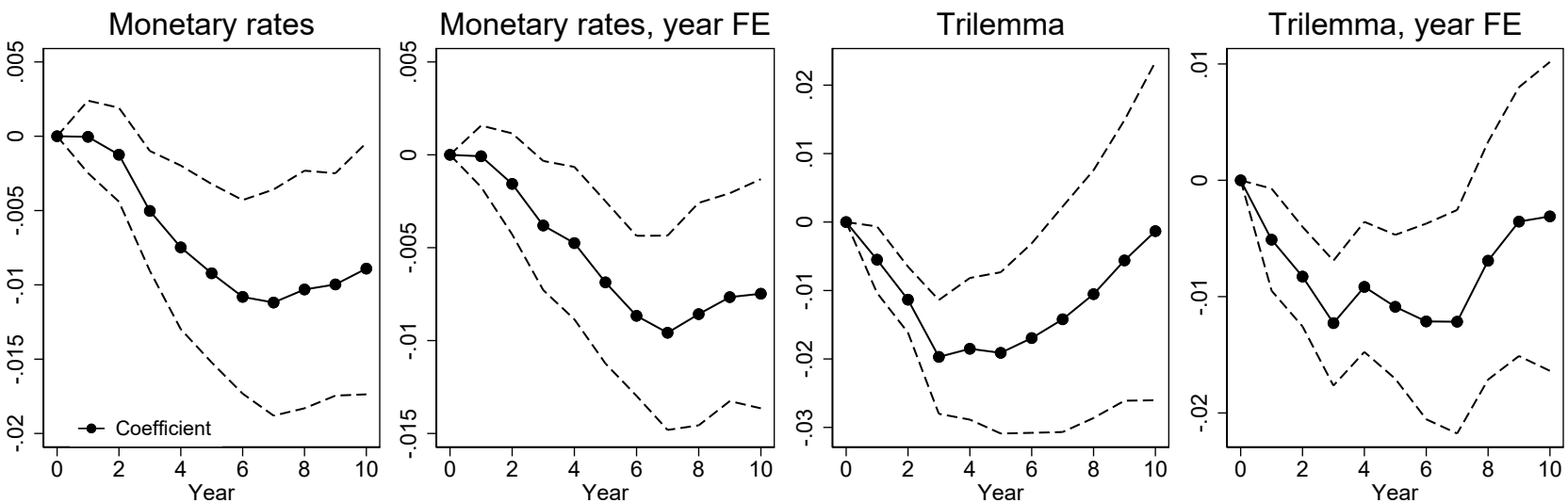
back

Raising in the R-zone and output: local projections

back

$$\Delta_h y_{i,t+h} = \alpha_{i,h} + \sum_{j=0}^{5} \beta^{R}_{h,j} \text{R-zone}_{i,t-j-1} + \sum_{j=0}^{5} \beta^{MP}_{h,j} \Delta \text{MP}_{i,t-j}$$

$$+ \sum_{j=0}^{5} \beta^{R \times MP}_{h,j} \Delta \text{MP}_{i,t-j} \times \text{R-zone}_{i,t-j-1} + \sum_{j=0}^{5} \gamma^{X}_{h,j} X_{i,t-j} + \epsilon_{i,t+h}$$



Crisis frequencies: U-MP & R zone

	(1)	(2)	(3)	(4)
	Crisis	Deep crisis	Post-WW2 crisis	Post-WW2 deep crisis
U-shaped MP & R-zone	0.38 (19/50)	0.26 (13/50)	0.40 (14/35)	0.32 (11/35)
U-shaped MP & no R-zone	0.09 (10/116)	0.08 (9/116)	0.04 (2/57)	0.04 (2/57)
No U-shaped MP & R-zone	0.09 (9/97)	0.05 (5/97)	0.04 (3/70)	0.00 (0/70)
No U-shaped MP & no R-zone	0.05 (17/362)	0.02 (9/362)	0.02 (4/220)	0.00 (0/220)
Unconditional	0.09 (55/625)	0.06 (36/625)	0.06 (23/381)	0.03 (13/381)

back

Crisis frequencies: U-MP & R zone alternative timing $t-5$ to t

	(1)	(2)	(3)	(4)
	Crisis	Deep crisis	Post-WW2 crisis	Post-WW2 deep crisis
U-shaped MP & R-zone	0.34 (21/61)	0.21 (13/61)	0.35 (15/42)	0.26 (11/42)
U-shaped MP & no R-zone	0.08 (9/106)	0.08 (8/106)	0.04 (2/50)	0.04 (2/50)
No U-shaped MP & R-zone	0.09 (13/147)	0.05 (8/147)	0.03 (3/101)	0.00 (0/101)
No U-shaped MP & no R-zone	0.04 (14/318)	0.02 (7/318)	0.02 (4/189)	0.00 (0/189)
Unconditional	0.09 (57/632)	0.06 (36/632)	0.06 (24/382)	0.03 (13/382)

back

Policy rate path and the risk of bank equity crises

back

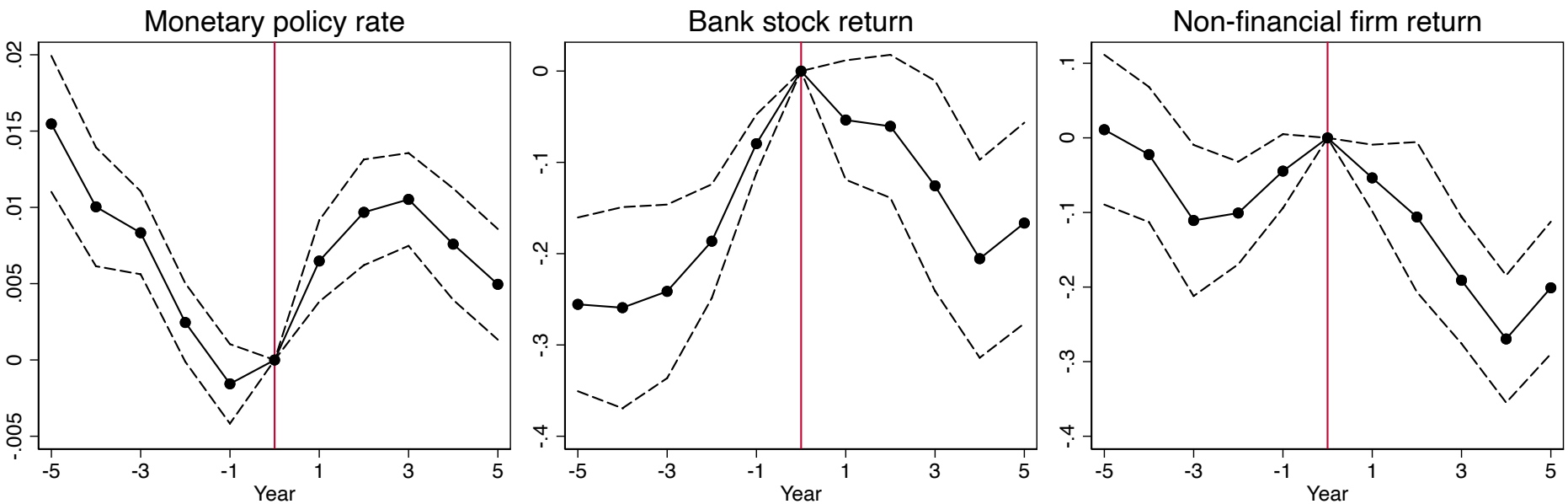
- Dependent variable: dummy = 1 if cumulative bank stock return $\leq -30\%$ (Baron et al., 2021)

	Dependent variable: Bank equity crisis$_{t \text{ to } t+2}$					
	OLS			IV		
	(1)	(2)	(3)	(4)	(5)	(6)
Δ_3Rate$_t$	0.01***	0.01***	0.00	0.02**	0.02**	-0.00
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Cut Rate$_{t-8,t-3}$		0.04**	0.04**		0.03**	0.04**
		(0.02)	(0.02)		(0.02)	(0.02)
Δ_3Rate$_t$ $\times$ Cut Rate$_{t-8,t-3}$			0.02***			0.06**
			(0.01)			(0.03)
Country fixed effects	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓
Kleibergen-Paap Weak ID				81.57	83.26	36.60
Observations	1624	1624	1624	1624	1624	1624

Bank & non-fin. returns & MP rates around R-zones

$$y_{i,t+h} - y_{i,t} = \alpha_{i,h} + \alpha_{d,h} + \beta_h \mathbb{1}_{\text{Enter Pre-cut R-zone}_{i,t}=1} + \epsilon_{i,t+h}$$

- Conditional on entering pre-cut R-zone at $t = 0$: MP rate U, bank stock boom before, bank & non-fin. crash after
- Also: little change in capital ratios, boom-bust in bank equity sentiment ▸ All r-zones ▸ Bank capital ratio & sentiment ▸ Back

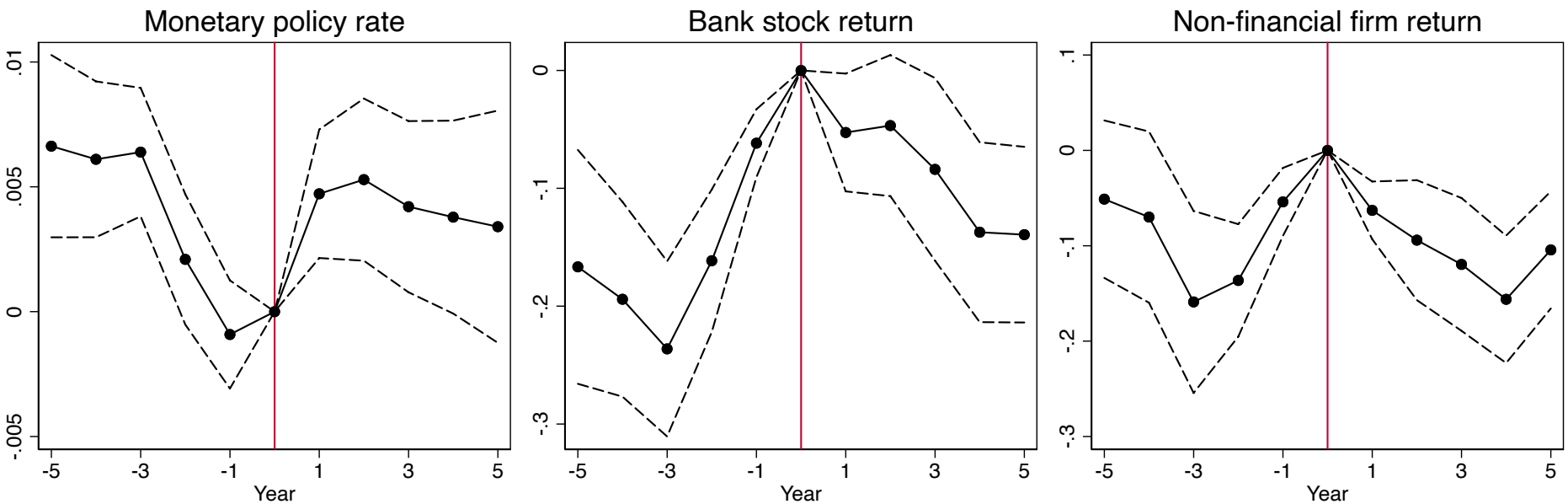


▸ back

Bank & non-fin. returns & MP rates around all R-zones

back

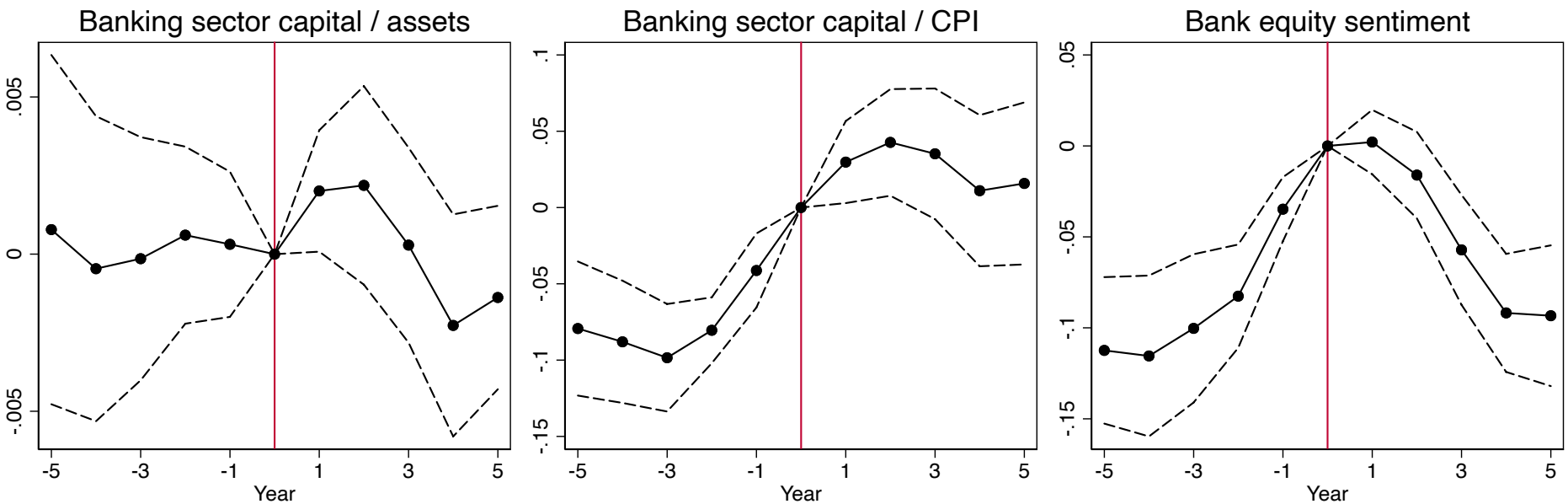
$$y_{i,t+h} - y_{i,t} = \alpha_{i,h} + \alpha_{d,h} + \beta_h \mathbb{1}_{\text{Enter R-zone}_{i,t}=1} + \epsilon_{i,t+h}$$



Bank capital and bank equity sentiment around R-zones

back

$$y_{i,t+h} - y_{i,t} = \alpha_{i,h} + \alpha_{d,h} + \beta_h \mathbb{1}_{\text{Enter pre-cut R-zone}_{i,t}=1} + \epsilon_{i,t+h}$$



- Bank equity market sentiment: (minus) predictable component of bank stock return (using past credit growth & price-dividend ratios, see Baron and Xiong, 2017; López-Salido et al., 2017)
- High sentiment means predictably low future returns

Administrative data: summary statistics

back

		Mean (1)	S.D. (2)	P25 (3)	Median (4)	P75 (5)
Loan default$_{t,t+1}$	0/1	0.019	0.135	0.000	0.000	0.000
ΔRate$_{t,t+1}$	%	-0.326	1.093	-0.906	-0.143	0.245
Cut Rate$_{t-5,t}$	0/1	0.427	0.495	0.000	0.000	1.000
Short maturity	0/1	0.503	0.500	0.000	1.000	1.000
Firm bad credit history	0/1	0.109	0.311	0.000	0.000	0.000
Construction & real estate firm	0/1	0.214	0.410	0.000	0.000	0.000
Firm not in Mercantile Register the previous year	0/1	0.246	0.431	0.000	0.000	0.000
Firm average cost of credit	%	3.190	2.801	1.052	2.597	4.610
Bank NPL Ratio	0.0x	0.043	0.051	0.008	0.017	0.061

Monetary policy path & loan-level defaults in Spain – demeaned variables

▸ back

	Dependent variable: Loan default$_{t+1 \text{ to } t+3}$								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ_3 Rate$_{t,t+3}$	0.001*	0.001**	0.002***	0.003***	0.003***	0.003***	0.003***	0.003***	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Cut Rate$_{t-5,t}$	0.012***	0.010***	0.011***	0.007***	0.007***	0.007**	0.008***	0.008***	0.014***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Δ_3 Rate$_{t,t+3}$ × Cut Rate$_{t-5,t}$		0.003**	0.004***	0.003**	0.003***	0.002**	0.003***	0.004***	0.007***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Industry × Location FE	No	No	Yes	Yes	-	Yes	-	-	-
Bank Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	No	No	Yes	Yes	-	-
Firm FE	No	No	No	No	Yes	No	Yes	-	-
Firm × Bank FE	No	No	No	No	No	No	No	Yes	Yes
Firm Controls	No	No	No	No	No	No	No	No	Yes
Observations	1.1m	1.1m	1.1m	1.1m	1.1m	1.1m	1.1m	1.1m	0.7m
R^2	0.031	0.031	0.220	0.220	0.353	0.221	0.354	0.551	0.584

Monetary policy path & loan-level defaults in Spain – full 1995–2020 sample

back

	Dependent variable: Loan default$_{t+1 \text{ to } t+3}$								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ_3Rate$_{t,t+3}$	0.005***	0.005***	0.004***	0.005***	0.003*	0.005***	0.005***	0.005***	0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Cut Rate$_{t-5,t}$	0.007***	0.006***	0.009***	0.006***	0.009***	0.005**	0.008***	0.008***	0.008***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)
Δ_3Rate$_{t,t+3}$ × Cut Rate$_{t-5,t}$		0.000	0.002	0.002*	0.004**	0.002**	0.003**	0.004**	0.003**
		(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Industry × Location FE	No	No	Yes	Yes	-	Yes	-	-	-
Bank Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	No	No	Yes	Yes	-	-
Firm FE	No	No	No	No	Yes	No	Yes	-	-
Firm × Bank FE	No	No	No	No	No	No	No	Yes	Yes
Firm Controls	No	No	No	No	No	No	No	No	Yes
Observations	1.6m	1.6m	1.6m	1.6m	1.6m	1.6m	1.6m	1.6m	1.1m
R^2	0.038	0.038	0.220	0.220	0.353	0.221	0.354	0.551	0.526

Heterogeneous effects: full sample

back

	Dependent variable: Loan default$_{t+1 \text{ to } t+3}$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ_3Rate$_{t,t+3}$	0.006***	0.007***	0.007***	0.007***			
	(0.001)	(0.001)	(0.001)	(0.001)			
Cut Rate$_{t-5,t}$	0.008***	0.008***	0.008***	0.009***			
	(0.003)	(0.003)	(0.003)	(0.003)			
Δ_3Rate$_{t,t+3}$ × Cut Rate$_{t-5,t}$	0.003**	0.005**	0.004**	0.005**			
	(0.001)	(0.002)	(0.001)	(0.002)			
Δ_3Rate × Cut × Real estate firm	0.007**			0.007**	0.007**	0.004	0.001
	(0.003)			(0.003)	(0.003)	(0.003)	(0.009)
Δ_3Rate × Cut × Firm not audited			0.003**	0.001	0.001		
			(0.001)	(0.001)	(0.001)		
Δ_3Rate × Cut × Firm cost of credit						0.002***	0.002***
						(0.000)	(0.000)
Δ_3Rate × Cut × Bank NPL ratio		0.001		0.001*	0.001	0.001	0.001
		(0.001)		(0.001)	(0.001)	(0.001)	(0.001)
Δ_3Rate × Cut × Bank NPL × Real estate							-0.002
							(0.003)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm × Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	No	No	No	Yes	Yes	Yes
Firm Controls	No	No	No	No	No	Yes	Yes
Observations	1.6m	1.6m	1.6m	1.6m	1.6m	1.1m	1.1m
R-squared	0.497	0.496	0.497	0.500	0.500	0.528	0.530

U-shaped policy and defaults: economic effects

back

- A 1 percentage point change in the monetary interest rate after loan origination increases the 3-year probability of loan delinquency by 7.4% in relative terms (given that the average default probability equals 4.5 percentage points).
- The probability of loan delinquency increases by 17.1% if monetary rates were cut around loan origination (from the coefficient on the Cut dummy).
- A 1 percentage point increase in the monetary policy rate after periods of declining policy rates raises the probability of loan default by 8.1%.
- Summing together the coefficients, the probability of delinquency increases by 32.6% if at origination, the Cut dummy is one, and monetary rates increase by 1 percentage point over the following three years.