Online Appendix to "Does Monetary Tightening Improve Banking Stability? The Role of Bank Cost Efficiency"

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For current version

This Online Appendix provides supplementary material for the paper. It contains additional tables, sub-sample robustness analyses, the bank-competition heterogeneity analysis, the portfolio rebalancing channel, and supplementary DSGE derivations.

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A LIST OF COUNTRIES, NUMBER OF BANKS AND OBSERVATIONS

The list of countries along with the number of banks and observations are presented in Table A.1

Table A.1. List of countries, number of banks and observations

Country (banks, obs)	Country (banks, obs)	Country (banks, obs)
Argentina (14, 62)	Guyana (4, 44)	Paraguay (9, 88)
Australia (36, 435)	Honduras (17, 182)	Peru (44, 406)
Austria (28, 338)	Hong Kong SAR, China (21, 234)	Philippines (34, 372)
Azerbaijan (12, 102)	Hungary (5, 60)	Poland (31, 390)
Bahamas (3, 35)	India (147, 1,865)	Portugal (12, 134)
Bahrain (16, 75)	Indonesia (83, 965)	Qatar (10, 114)
Bangladesh (102, 1,043)	Ireland (8, 104)	Republic of Korea (62, 654)
Belgium (7, 81)	Israel (11, 161)	Republic of Moldova (8, 87)
Bolivia (6, 77)	Italy (76, 856)	Romania (9, 99)
Botswana (10, 110)	Jamaica (17, 159)	Russian Federation (84, 640)
Brazil (53, 510)	Japan (85, 980)	Saudi Arabia (16, 206)
Bulgaria (12, 120)	Jordan (22, 292)	Serbia (23, 262)
Canada (11, 138)	Kazakhstan (36, 284)	Singapore (10, 127)
Chile (10, 148)	Kenya (19, 190)	Slovakia (7, 104)
China (108, 1,105)	Kuwait (25, 230)	Slovenia (10, 116)
Colombia (22, 251)	Kyrgyzstan (5, 33)	South Africa (19, 251)
Costa Rica (4, 64)	Lebanon (7, 66)	Spain (23, 296)
Croatia (27, 298)	Lithuania (6, 73)	Sri Lanka (62, 428)
Cyprus (7, 76)	Luxembourg (10, 146)	Sweden (21, 220)
Czech Republic (7, 105)	Malaysia (35, 447)	Switzerland (48, 642)
Côte d'Ivoire (7, 51)	Malta (10, 141)	Thailand (60, 545)
Denmark (39, 487)	Mauritius (10, 113)	Trinidad and Tobago (8, 86)
Ecuador (10, 86)	Mexico (9, 59)	Turkiye (52, 646)
Egypt (47, 454)	Mongolia (5, 45)	Uganda (4, 20)
El Salvador (14, 127)	Morocco (17, 187)	Ukraine (82, 125)
Estonia (5, 79)	Nepal (178, 1,177)	United Kingdom (45, 521)
Finland (11, 125)	Netherlands (18, 225)	Tanzania (8, 69)
France (71, 1,021)	Nigeria (45, 465)	U.S. (1257, 15,984)
Georgia (6, 70)	North Macedonia (17, 204)	Uzbekistan (22, 147)
Germany (64, 735)	Norway (74, 840)	Vietnam (57, 655)
Ghana (14, 163)	Oman (20, 141)	Zambia (8, 56)
Greece (13, 170)	Pakistan (50, 453)	

B OTHER SUB-SAMPLE STOCHASTIC METAFRONTIER RESULTS

Table B.1. Stochastic metafrontier results – regional groups

	R1	R2	R3	R4	R5	R6	R7
Frontier							
ln(Loans)	0.605***	0.340***	0.925***	0.095***	0.669***	0.827***	0.902***
	(0.021)	(0.012)	(0.022)	(0.029)	(0.001)	(0.007)	(0.039)
ln(w2/w1)	-0.005	0.101***	0.126***	0.223***	0.193***	0.440***	0.259***
	(0.025)	(0.013)	(0.030)	(0.042)	(0.002)	(0.017)	(0.060)
ln(w3/w1)	0.150***	0.187***	0.158***	0.319***	0.114***	-0.053**	1.040***
	(0.040)	(0.015)	(0.051)	(0.037)	(0.002)	(0.022)	(0.082)
ln(Loans) × ln(w2/w1)	0.004***	-0.003***	-0.007***	-0.013***	-0.010***	-0.026***	-0.021***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.000)	(0.001)	(0.003)
ln(Loans) × ln(w3/w1)	-0.008***	-0.010***	-0.008***	-0.022***	-0.003***	0.005***	-0.044***
	(0.002)	(0.001)	(0.003)	(0.002)	(0.000)	(0.001)	(0.004)
ln(w2/w1) × ln(w3/w1)	0.010***	-0.009***	0.004	0.012***	-0.006***	-0.006***	-0.093***
	(0.002)	(0.001)	(0.004)	(0.004)	(0.000)	(0.002)	(0.009)
$0.5[\ln(\text{Loans})]^2$	0.019***	0.039***	0.005***	0.061***	0.026***	0.016***	0.010***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.000)	(0.000)	(0.002)
$0.5[\ln(w2/w1)]^2$	0.002	0.006***	0.016***	0.007	-0.011***	0.026***	0.042***
	(0.003)	(0.001)	(0.003)	(0.005)	(0.000)	(0.003)	(0.012)
$0.5[\ln(w3/w1)]^2$	0.038***	0.006***	0.083***	0.005	0.057***	0.009***	0.149***
	(0.003)	(0.001)	(0.007)	(0.003)	(0.000)	(0.002)	(0.011)
Constant	4.090***	5.650***	0.880***	6.808***	2.553***	0.665***	1.028***
	(0.212)	(0.104)	(0.214)	(0.257)	(0.010)	(0.083)	(0.373)
Mu							
GDP p.c. growth	-0.024***	-0.008***	-0.008*	-0.057***	0.017***	-0.091***	-0.109***
	(0.008)	(0.003)	(0.005)	(0.006)	(0.001)	(0.015)	(0.012)
Inflation	-0.096***	-0.008***	0.004**	0.000	-0.159***	-0.025**	-0.000
	(0.021)	(0.002)	(0.002)	(0.002)	(0.003)	(0.011)	(0.001)
Usigma							
Constant	-0.373***	-0.604***	-0.704***	0.017	-5.445***	-1.004***	-0.110**
	(0.080)	(0.020)	(0.041)	(0.038)	(0.026)	(0.101)	(0.047)
Vsigma							
Constant	-3.050***	-3.286***	-3.310***	-2.530***	-7.186***	-4.108***	-3.636***
	(0.110)	(0.041)	(0.077)	(0.078)	(0.013)	(0.071)	(0.148)
Observations	6,872	12,392	2,826	4,026	16,756	5,414	1,806
Log Likelihood	-4468.153	-7557.901	-1678.136	-3826.647	33800.153	-807.326	-1348.248
Wald χ^2	577243.81	597737.63	292378.85	105668.48	68871893.50	1623993.71	73588.09

Note: Standard errors in parentheses. R1: East Asia & Pacific, R2: Europe & Central Asia, R3: Latin America & Caribbean. R4: Middle East & North Africa, R5: North America, R6:South Asia, R7: Sub-Saharan Africa.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.2. Stochastic metafrontier results – development status

	Developed	Developing
Frontier		
ln(Loans)	0.747***	0.844***
	(0.004)	(0.006)
ln(w2/w1)	-0.017**	0.190***
	(0.007)	(0.014)
ln(w3/w1)	0.023***	-0.104***
	(0.007)	(0.015)
ln(Loans) $\times$ ln(w2/w1)	0.005***	-0.007***
	(0.000)	(0.001)
ln(Loans) $\times$ ln(w3/w1)	-0.001	0.001
	(0.000)	(0.001)
ln(w2/w1) $\times$ ln(w3/w1)	-0.004***	0.013***
	(0.001)	(0.001)
$0.5[\ln(\text{Loans})]^2$	0.014***	0.010***
	(0.000)	(0.000)
$0.5[\ln(\text{w2/w1})]^2$	-0.001	0.002
	(0.001)	(0.002)
$0.5[\ln(\text{w3/w1})]^2$	0.006***	-0.001
	(0.001)	(0.002)
Constant	2.476***	1.284***
	(0.038)	(0.065)
Mu		
GDP p.c. growth	-0.057***	-0.115***
	(0.003)	(0.003)
Inflation	-0.042***	-0.001
	(0.003)	(0.001)
Usigma		
Constant	-0.867***	0.090***
	(0.012)	(0.014)
Vsigma		
Constant	-4.864***	-3.570***
	(0.028)	(0.044)
Observations	30,243	19,616
Log Likelihood	-9009.575	-15661.108
Wald χ^2	4942193.91	1562177.59

Note: Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.3. Stochastic metafrontier results – ECB membership

	Non-ECB	ECB
Frontier		
ln(Loans)	0.809***	0.225***
	(0.003)	(0.014)
ln(w2/w1)	0.032***	0.349***
	(0.007)	(0.018)
ln(w3/w1)	-0.009	0.226***
	(0.006)	(0.020)
ln(Loans) × ln(w2/w1)	0.002***	-0.017***
	(0.000)	(0.001)
ln(Loans) × ln(w3/w1)	-0.003***	-0.011***
	(0.000)	(0.001)
ln(w2/w1) × ln(w3/w1)	0.010***	-0.006***
	(0.001)	(0.002)
$0.5[\ln(\text{Loans})]^2$	0.011***	0.052***
	(0.000)	(0.001)
$0.5[\ln(w2/w1)]^2$	-0.001	0.002
	(0.001)	(0.002)
$0.5[\ln(w3/w1)]^2$	0.001	0.005***
	(0.001)	(0.001)
Constant	1.825***	5.750***
	(0.035)	(0.133)
Mu		
GDP p.c. growth	-0.073***	0.010*
	(0.002)	(0.006)
Inflation	0.003***	-0.124***
	(0.000)	(0.015)
Usigma		
Constant	-0.484***	-0.333***
	(0.008)	(0.031)
Vsigma		
Constant	-4.351***	-4.464***
	(0.020)	(0.108)
Observations	44,921	4,938
Log Likelihood	-23966.248	-2782.731
Wald χ^2	7696152.33	312575.47

Note: Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

C ROBUSTNESS: SUB-SAMPLE ANALYSIS USING GLOBAL METFRONTIER COST EFFICIENCY

This section presents the results of the sub-group analysis using the global metfrontier cost efficiency scores. These results are already discussed under subsection 5.3 in the main paper.

Table C.1. Impact of monetary policy on banking stability, regional analysis – FE Results

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$Policy^{z}_{j,t-1}$ × East Asia&Pacific	0.1311	0.0176	0.1606*	0.0640
	(0.0856)	(0.0831)	(0.0843)	(0.0829)
$Policy^{z}_{j,t-1}$ × Europe & Central Asia	-0.0954**	-0.0893*	-0.0738	-0.0633
	(0.0477)	(0.0469)	(0.0469)	(0.0459)
$Policy^{z}_{j,t-1}$ × Latin America & Caribbean	0.1455	0.1609	0.1855*	0.2038**
	(0.1016)	(0.0995)	(0.0996)	(0.0979)
$Policy^{z}_{j,t-1}$ × Middle East & North Africa	0.0981	-0.0181	0.2481***	0.1488*
	(0.0768)	(0.0775)	(0.0935)	(0.0867)
$Policy^{z}_{j,t-1}$ × North America	0.3791***	0.4226***	0.4400***	0.4865***
	(0.0631)	(0.0637)	(0.0675)	(0.0681)
$Policy^{z}_{j,t-1}$ × South Asia	0.1547	0.0426	0.1165	0.0167
	(0.1256)	(0.0987)	(0.1047)	(0.0896)
$Policy^{z}_{j,t-1}$ × Sub-Saharan Africa	0.2960***	0.3015***	0.2852***	0.2774***
	(0.1042)	(0.0976)	(0.1017)	(0.0947)
Cost efficiency	4.299***	2.628***	4.294***	2.611***
	(0.8221)	(0.7867)	(0.8225)	(0.7869)
Bank liquidity	0.0297***	0.0162***	0.0297***	0.0162***
	(0.0030)	(0.0022)	(0.0030)	(0.0022)
Size	-2.740***	-1.842***	-2.736***	-1.836***
	(0.1981)	(0.1782)	(0.1981)	(0.1782)
Asset structure	0.1078***	0.0565	0.1080***	0.0566
	(0.0404)	(0.0384)	(0.0404)	(0.0383)
Bank Concentration	0.0277**	0.0450***	0.0280**	0.0453***
	(0.0109)	(0.0121)	(0.0109)	(0.0121)
GDP growth	0.0508***	0.0400***	0.0483***	0.0377***
	(0.0160)	(0.0146)	(0.0161)	(0.0146)
Inflation (CPI)	0.0299**	0.0005	0.0286**	-0.0008
	(0.0117)	(0.0111)	(0.0117)	(0.0111)
Institutional Quality	2.710***	2.955***	2.598***	2.817***
	(0.7148)	(0.7278)	(0.7134)	(0.7268)
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,903	3,773	3,903	3,773
N	42,519	39,170	42,519	39,170
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4).
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

Table C.2. Impact of monetary policy on banking stability, regional analysis – FE Results

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^{z}_{j,t-1}$ × High Income	0.1009**	0.1172***	0.1322***	0.1534***
	(0.0452)	(0.0453)	(0.0470)	(0.0469)
$\text{Policy}^{z}_{j,t-1}$ × Low Income	1.176***	1.385***	1.053***	1.116***
	(0.3270)	(0.2023)	(0.2766)	(0.1943)
$\text{Policy}^{z}_{j,t-1}$ × Lower Middle	0.1185*	-0.0156	0.1872***	0.0799
	(0.0688)	(0.0704)	(0.0697)	(0.0692)
$\text{Policy}^{z}_{j,t-1}$ × Upper Middle	0.0604	-0.0193	0.0902	0.0186
	(0.0799)	(0.0714)	(0.0754)	(0.0689)
Cost efficiency	4.313***	2.636***	4.289***	2.611***
	(0.8211)	(0.7864)	(0.8218)	(0.7867)
Bank liquidity	0.0297***	0.0161***	0.0297***	0.0160***
	(0.0030)	(0.0022)	(0.0030)	(0.0022)
Size	-2.754***	-1.853***	-2.755***	-1.854***
	(0.1980)	(0.1780)	(0.1981)	(0.1781)
Asset structure	0.1086***	0.0568	0.1086***	0.0569
	(0.0404)	(0.0382)	(0.0404)	(0.0382)
Bank Concentration	0.0276**	0.0441***	0.0283***	0.0447***
	(0.0109)	(0.0121)	(0.0109)	(0.0121)
GDP growth	0.0425***	0.0350**	0.0392**	0.0323**
	(0.0153)	(0.0142)	(0.0154)	(0.0142)
Inflation (CPI)	0.0357***	0.0071	0.0355***	0.0072
	(0.0116)	(0.0109)	(0.0116)	(0.0109)
Institutional Quality	2.959***	3.288***	2.904***	3.199***
	(0.7147)	(0.7277)	(0.7138)	(0.7267)
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,903	3,773	3,903	3,773
N	42,519	39,170	42,519	39,170
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4).
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

Table C.3. Impact of monetary policy on banking stability, development status – FE results

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^{z}_{j,t-1}$ × Developed	0.1202***	0.1408***	0.1502***	0.1734***
	(0.0456)	(0.0456)	(0.0472)	(0.0470)
$\text{Policy}^{z}_{j,t-1}$ × Developing	0.1717***	0.0694	0.2109***	0.1220***
	(0.0517)	(0.0463)	(0.0508)	(0.0467)
Cost efficiency	4.297***	2.625***	4.291***	2.613***
	(0.8219)	(0.7866)	(0.8220)	(0.7869)
Bank liquidity	0.0298***	0.0161***	0.0298***	0.0161***
	(0.0030)	(0.0022)	(0.0030)	(0.0022)
Size	-2.753***	-1.856***	-2.751***	-1.853***
	(0.1980)	(0.1781)	(0.1980)	(0.1781)
Asset structure	0.1087***	0.0578	0.1089***	0.0577
	(0.0405)	(0.0384)	(0.0404)	(0.0383)
Bank Concentration	0.0273**	0.0440***	0.0276**	0.0443***
	(0.0109)	(0.0121)	(0.0109)	(0.0121)
GDP growth	0.0416***	0.0347**	0.0384**	0.0322**
	(0.0153)	(0.0142)	(0.0154)	(0.0142)
Inflation (CPI)	0.0366***	0.0082	0.0363***	0.0080
	(0.0116)	(0.0109)	(0.0116)	(0.0109)
Institutional Quality	2.931***	3.216***	2.876***	3.150***
	(0.7135)	(0.7262)	(0.7126)	(0.7252)
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,903	3,773	3,903	3,773
N	42,519	39,170	42,519	39,170
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4).
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

Table C.4. Impact of monetary policy on banking stability, ECB *vs* Non-ECB – FE results

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^{z}_{j,t-1} \times$ Non-ECB	0.1525***	0.1283***	0.1896***	0.1700***
	(0.0417)	(0.0406)	(0.0423)	(0.0413)
$\text{Policy}^{z}_{j,t-1} \times$ ECB	0.0709	0.0573	0.0881*	0.0764
	(0.0537)	(0.0525)	(0.0534)	(0.0522)
Cost efficiency	4.295***	2.616***	4.288***	2.603***
	(0.8223)	(0.7871)	(0.8225)	(0.7875)
Bank liquidity	0.0298***	0.0161***	0.0298***	0.0161***
	(0.0030)	(0.0022)	(0.0030)	(0.0022)
Size	-2.751***	-1.852***	-2.748***	-1.849***
	(0.1981)	(0.1782)	(0.1982)	(0.1782)
Asset structure	0.1087***	0.0577	0.1089***	0.0576
	(0.0405)	(0.0384)	(0.0405)	(0.0383)
Bank Concentration	0.0272**	0.0441***	0.0275**	0.0444***
	(0.0109)	(0.0121)	(0.0109)	(0.0121)
GDP growth	0.0427***	0.0361**	0.0399***	0.0337**
	(0.0154)	(0.0142)	(0.0155)	(0.0143)
Inflation (CPI)	0.0360***	0.0087	0.0354***	0.0083
	(0.0116)	(0.0110)	(0.0116)	(0.0109)
Institutional Quality	2.900***	3.233***	2.832***	3.157***
	(0.7142)	(0.7258)	(0.7129)	(0.7245)
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,903	3,773	3,903	3,773
N	42,519	39,170	42,519	39,170
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4).
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

D ROBUSTNESS USING GROUP-SPECIFIC METAFRONTIER COST EFFICIENCY

This section presents the results of the sub-group analysis using the various group-specific metafrontier cost efficiency. These results are discussed under subsection 5.3 in the main paper.

Table D.1. Impact of monetary policy on banking stability, regional analysis – FE results

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^{z}_{j,t-1}$ × East Asia &Pacific	0.1378	0.0262	0.1672**	0.0720
	(0.0856)	(0.0829)	(0.0843)	(0.0827)
$\text{Policy}^{z}_{j,t-1}$ × Europe & Central Asia	-0.0963**	-0.0897*	-0.0750	-0.0639
	(0.0478)	(0.0469)	(0.0470)	(0.0459)
$\text{Policy}^{z}_{j,t-1}$ × Latin America & Caribbean	0.1625	0.1607	0.2022**	0.2032**
	(0.1016)	(0.0994)	(0.0997)	(0.0978)
$\text{Policy}^{z}_{j,t-1}$ × Middle East & North Africa	0.1029	-0.0143	0.2535***	0.1524*
	(0.0774)	(0.0775)	(0.0943)	(0.0867)
$\text{Policy}^{z}_{j,t-1}$ × North America	0.3905***	0.4334***	0.4511***	0.4968***
	(0.0629)	(0.0633)	(0.0673)	(0.0677)
$\text{Policy}^{z}_{j,t-1}$ × South Asia	0.1552	0.0438	0.1175	0.0186
	(0.1254)	(0.0986)	(0.1045)	(0.0896)
$\text{Policy}^{z}_{j,t-1}$ × Sub-Saharan Africa	0.2833***	0.3033***	0.2745***	0.2798***
	(0.1041)	(0.0975)	(0.1017)	(0.0947)
Cost efficiency	3.779***	2.242***	3.782***	2.237***
	(0.6910)	(0.6522)	(0.6911)	(0.6522)
Bank liquidity	0.0295***	0.0160***	0.0295***	0.0160***
	(0.0030)	(0.0022)	(0.0030)	(0.0022)
Size	-2.747***	-1.845***	-2.743***	-1.839***
	(0.1976)	(0.1778)	(0.1977)	(0.1779)
Asset structure	0.1099***	0.0574	0.1102***	0.0575
	(0.0410)	(0.0387)	(0.0410)	(0.0386)
Bank Concentration	0.0266**	0.0447***	0.0270**	0.0451***
	(0.0109)	(0.0121)	(0.0109)	(0.0121)
GDP growth	0.0514***	0.0404***	0.0488***	0.0381***
	(0.0160)	(0.0146)	(0.0160)	(0.0146)
Inflation (CPI)	0.0284**	-0.0001	0.0271**	-0.0014
	(0.0117)	(0.0111)	(0.0117)	(0.0111)
Institutional Quality	2.912***	3.079***	2.798***	2.939***
	(0.7147)	(0.7281)	(0.7134)	(0.7271)
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,903	3,773	3,903	3,773
N	42,519	39,170	42,519	39,170
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4).
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

Table D.2. Impact of monetary policy on banking stability, regional analysis – FE results

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^{z}_{j,t-1}$ × East Asia & Pacific	0.1367	0.0331	0.1664**	0.0782
	(0.0857)	(0.0826)	(0.0844)	(0.0824)
$\text{Policy}^{z}_{j,t-1}$ × Europe & Central Asia	-0.0914*	-0.0897*	-0.0696	-0.0640
	(0.0476)	(0.0469)	(0.0468)	(0.0460)
$\text{Policy}^{z}_{j,t-1}$ × Latin America & Caribbean	0.1462	0.1380	0.1873*	0.1810*
	(0.1015)	(0.1006)	(0.0995)	(0.0990)
$\text{Policy}^{z}_{j,t-1}$ × Middle East & North Africa	0.1008	-0.0102	0.2549***	0.1524*
	(0.0790)	(0.0776)	(0.0962)	(0.0865)
$\text{Policy}^{z}_{j,t-1}$ × North America	0.3907***	0.4324***	0.4526***	0.4953***
	(0.0628)	(0.0635)	(0.0672)	(0.0678)
$\text{Policy}^{z}_{j,t-1}$ × South Asia	0.1584	0.0470	0.1235	0.0208
	(0.1282)	(0.0988)	(0.1090)	(0.0897)
$\text{Policy}^{z}_{j,t-1}$ × Sub-Saharan Africa	0.2591**	0.2950***	0.2586**	0.2777***
	(0.1073)	(0.0987)	(0.1041)	(0.0960)
Cost efficiency × East Asia & Pacific	4.658**	3.282	4.677**	3.324
	(2.180)	(2.086)	(2.180)	(2.085)
Cost efficiency × Europe & Central Asia	4.672***	0.7531	4.689***	0.7608
	(1.227)	(1.140)	(1.227)	(1.140)
Cost efficiency × Latin America & Caribbean	-1.162	-3.361	-1.139	-3.347
	(2.040)	(2.059)	(2.043)	(2.064)
Cost efficiency × MiddleEast & North Africa	9.105	8.853	9.143	8.834
	(6.110)	(5.440)	(6.104)	(5.442)
Cost efficiency × North America	3.068***	2.306***	3.055***	2.282***
	(0.9375)	(0.8630)	(0.9373)	(0.8621)
Cost efficiency × South Asia	2.864	3.039	2.851	3.012
	(2.904)	(2.843)	(2.912)	(2.843)
Cost efficiency × Sub-Saharan Africa	10.03***	7.670***	10.10***	7.716***
	(2.350)	(2.208)	(2.348)	(2.213)
Bank liquidity	0.0297***	0.0160***	0.0297***	0.0160***
	(0.0030)	(0.0022)	(0.0030)	(0.0022)
Size	-2.730***	-1.845***	-2.726***	-1.839***
	(0.1975)	(0.1785)	(0.1976)	(0.1786)
Asset structure	0.1116***	0.0596	0.1118***	0.0597
	(0.0417)	(0.0393)	(0.0417)	(0.0393)
Bank Concentration	0.0277**	0.0457***	0.0281***	0.0461***
	(0.0109)	(0.0122)	(0.0109)	(0.0122)
GDP growth	0.0490***	0.0383***	0.0464***	0.0361**
	(0.0159)	(0.0145)	(0.0160)	(0.0146)
Inflation (CPI)	0.0297**	-0.0006	0.0284**	-0.0019
	(0.0116)	(0.0110)	(0.0116)	(0.0110)
Institutional Quality	2.903***	3.100***	2.787***	2.959***
	(0.7101)	(0.7255)	(0.7088)	(0.7244)
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,903	3,773	3,903	3,773
N	42,519	39,170	42,519	39,170
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4).
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

Table D.3. Impact of monetary policy on banking stability, income groups using global metafrontier cost efficiency – FE results

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^{z}_{j,t-1}$ × High Income	0.1096**	0.1212***	0.1411***	0.1573***
	(0.0451)	(0.0452)	(0.0470)	(0.0467)
$\text{Policy}^{z}_{j,t-1}$ × Low Income	1.148***	1.350***	1.033***	1.088***
	(0.3278)	(0.2008)	(0.2771)	(0.1931)
$\text{Policy}^{z}_{j,t-1}$ × Lower Middle	0.1135*	-0.0119	0.1834***	0.0843
	(0.0689)	(0.0702)	(0.0698)	(0.0690)
$\text{Policy}^{z}_{j,t-1}$ × Upper Middle	0.0698	-0.0138	0.0993	0.0238
	(0.0801)	(0.0714)	(0.0756)	(0.0689)
Cost efficiency	3.991***	2.211***	3.980***	2.207***
	(0.7565)	(0.7140)	(0.7569)	(0.7141)
Bank liquidity	0.0297***	0.0158***	0.0297***	0.0158***
	(0.0030)	(0.0022)	(0.0030)	(0.0022)
Size	-2.743***	-1.845***	-2.743***	-1.846***
	(0.1976)	(0.1777)	(0.1978)	(0.1779)
Asset structure	0.1093***	0.0564	0.1094***	0.0566
	(0.0408)	(0.0382)	(0.0407)	(0.0382)
Bank Concentration	0.0252**	0.0428***	0.0259**	0.0434***
	(0.0109)	(0.0120)	(0.0109)	(0.0120)
GDP growth	0.0421***	0.0353**	0.0388**	0.0326**
	(0.0153)	(0.0142)	(0.0154)	(0.0143)
Inflation (CPI)	0.0338***	0.0060	0.0336***	0.0061
	(0.0116)	(0.0110)	(0.0116)	(0.0109)
Institutional Quality	3.084***	3.372***	3.026***	3.283***
	(0.7141)	(0.7279)	(0.7133)	(0.7270)
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,903	3,773	3,903	3,773
N	42,519	39,170	42,519	39,170
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4).
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

Table D.4. Impact of monetary policy on banking stability, income groups using income group metafrontier cost efficiency – FE results

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^{z}_{j,t-1}$ × High Income	0.1059**	0.1159**	0.1349***	0.1499***
	(0.0449)	(0.0451)	(0.0467)	(0.0466)
$\text{Policy}^{z}_{j,t-1}$ × Low Income	1.131***	1.313***	1.023***	1.028***
	(0.3294)	(0.2260)	(0.2814)	(0.2132)
$\text{Policy}^{z}_{j,t-1}$ × Lower Middle	0.1130	-0.0180	0.1809***	0.0771
	(0.0689)	(0.0699)	(0.0698)	(0.0686)
$\text{Policy}^{z}_{j,t-1}$ × Upper Middle	0.0985	0.0206	0.1189	0.0495
	(0.0808)	(0.0722)	(0.0761)	(0.0696)
Cost efficiency × High Income	3.691***	1.737**	3.688***	1.735**
	(0.7544)	(0.7139)	(0.7543)	(0.7138)
Cost efficiency × Low Income	3.315**	2.215	3.295**	2.484
	(1.438)	(1.529)	(1.437)	(1.525)
Cost efficiency × Lower Middle	3.005**	1.990	2.975**	1.957
	(1.402)	(1.323)	(1.405)	(1.324)
Cost efficiency × Upper Middle	6.220***	4.817***	6.194***	4.784***
	(1.089)	(1.056)	(1.089)	(1.056)
Bank liquidity	0.0294***	0.0156***	0.0294***	0.0156***
	(0.0030)	(0.0022)	(0.0030)	(0.0022)
Size	-2.739***	-1.836***	-2.740***	-1.833***
	(0.2001)	(0.1791)	(0.2002)	(0.1791)
Asset structure	0.1097***	0.0567	0.1098***	0.0569
	(0.0408)	(0.0384)	(0.0408)	(0.0384)
Bank Concentration	0.0268**	0.0443***	0.0274**	0.0446***
	(0.0109)	(0.0120)	(0.0109)	(0.0120)
GDP growth	0.0440***	0.0374***	0.0410***	0.0349**
	(0.0151)	(0.0140)	(0.0152)	(0.0140)
Inflation (CPI)	0.0361***	0.0087	0.0359***	0.0086
	(0.0116)	(0.0109)	(0.0115)	(0.0109)
Institutional Quality	2.932***	3.244***	2.879***	3.184***
	(0.7130)	(0.7292)	(0.7125)	(0.7291)
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,903	3,773	3,903	3,773
N	42,519	39,170	42,519	39,170
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4).
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

Table D.5. Impact of monetary policy on banking stability, development status using global metafrontier cost efficiency – FE results

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^{z}_{j,t-1}$ × Developed	0.1249***	0.1405***	0.1548***	0.1732***
	(0.0456)	(0.0456)	(0.0471)	(0.0471)
$\text{Policy}^{z}_{j,t-1}$ × Developing	0.1702***	0.0706	0.2097***	0.1237***
	(0.0517)	(0.0463)	(0.0508)	(0.0467)
Cost efficiency	3.882***	2.114***	3.877***	2.102***
	(0.7859)	(0.7504)	(0.7859)	(0.7507)
Bank liquidity	0.0295***	0.0156***	0.0295***	0.0156***
	(0.0030)	(0.0022)	(0.0030)	(0.0022)
Size	-2.745***	-1.850***	-2.743***	-1.847***
	(0.1979)	(0.1781)	(0.1980)	(0.1781)
Asset structure	0.1078***	0.0562	0.1080***	0.0562
	(0.0403)	(0.0381)	(0.0403)	(0.0380)
Bank Concentration	0.0270**	0.0438***	0.0273**	0.0441***
	(0.0109)	(0.0121)	(0.0109)	(0.0121)
GDP growth	0.0415***	0.0349**	0.0384**	0.0323**
	(0.0153)	(0.0142)	(0.0154)	(0.0142)
Inflation (CPI)	0.0359***	0.0075	0.0355***	0.0073
	(0.0116)	(0.0109)	(0.0116)	(0.0109)
Institutional Quality	2.964***	3.246***	2.908***	3.181***
	(0.7141)	(0.7267)	(0.7132)	(0.7257)
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,903	3,773	3,903	3,773
N	42,519	39,170	42,519	39,170
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4).
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

Table D.6. Impact of monetary policy on banking stability, development status using development status metafrontier cost efficiency – FE results

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^{z}_{j,t-1}$ × Developed	0.1269***	0.1399***	0.1568***	0.1726***
	(0.0455)	(0.0456)	(0.0471)	(0.0471)
$\text{Policy}^{z}_{j,t-1}$ × Developing	0.1675***	0.0714	0.2066***	0.1237***
	(0.0523)	(0.0464)	(0.0513)	(0.0467)
Cost efficiency × Developed	3.260***	1.335*	3.259***	1.324*
	(0.8458)	(0.7943)	(0.8458)	(0.7943)
Cost efficiency × Developing	5.138***	3.785**	5.126***	3.772**
	(1.604)	(1.539)	(1.604)	(1.540)
Bank liquidity	0.0293***	0.0153***	0.0293***	0.0153***
	(0.0030)	(0.0022)	(0.0030)	(0.0022)
Size	-2.746***	-1.854***	-2.744***	-1.851***
	(0.1980)	(0.1781)	(0.1981)	(0.1781)
Asset structure	0.1085***	0.0570	0.1087***	0.0570
	(0.0405)	(0.0383)	(0.0405)	(0.0382)
Bank Concentration	0.0284**	0.0453***	0.0287***	0.0456***
	(0.0110)	(0.0122)	(0.0110)	(0.0122)
GDP growth	0.0403***	0.0346**	0.0372**	0.0321**
	(0.0154)	(0.0142)	(0.0155)	(0.0142)
Inflation (CPI)	0.0378***	0.0098	0.0374***	0.0096
	(0.0117)	(0.0110)	(0.0117)	(0.0110)
Institutional Quality	2.914***	3.164***	2.858***	3.098***
	(0.7089)	(0.7220)	(0.7080)	(0.7209)
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,903	3,773	3,903	3,773
N	42,519	39,170	42,519	39,170
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4).
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

Table D.7. Impact of monetary policy on banking stability, ECB membership using global metafrontier cost efficiency – FE results

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^z_{j,t-1}$ × Non-ECB Member	0.1518***	0.1280***	0.1890***	0.1698***
	(0.0417)	(0.0406)	(0.0423)	(0.0413)
$\text{Policy}^z_{j,t-1}$ × ECB Member	0.0860	0.0583	0.1030*	0.0773
	(0.0538)	(0.0526)	(0.0535)	(0.0523)
Cost efficiency	4.375***	2.697***	4.368***	2.684***
	(0.8024)	(0.7645)	(0.8026)	(0.7650)
Bank liquidity	0.0299***	0.0162***	0.0299***	0.0162***
	(0.0030)	(0.0022)	(0.0030)	(0.0022)
Size	-2.753***	-1.854***	-2.750***	-1.851***
	(0.1983)	(0.1782)	(0.1983)	(0.1782)
Asset structure	0.1090***	0.0578	0.1092***	0.0578
	(0.0405)	(0.0384)	(0.0405)	(0.0383)
Bank Concentration	0.0269**	0.0439***	0.0272**	0.0443***
	(0.0109)	(0.0121)	(0.0109)	(0.0121)
GDP growth	0.0427***	0.0363**	0.0398**	0.0339**
	(0.0154)	(0.0142)	(0.0155)	(0.0143)
Inflation (CPI)	0.0365***	0.0090	0.0360***	0.0086
	(0.0116)	(0.0110)	(0.0116)	(0.0109)
Institutional Quality	2.922***	3.247***	2.854***	3.171***
	(0.7138)	(0.7253)	(0.7125)	(0.7240)
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,903	3,773	3,903	3,773
N	42,519	39,170	42,519	39,170
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4).
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

Table D.8. Impact of monetary policy on banking stability, ECB membership using ECB & Non-ECB membership metafrontier cost efficiency – FE results

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^{z}_{j,t-1}$ × Non-ECB Member	0.1518***	0.1277***	0.1889***	0.1694***
	(0.0417)	(0.0406)	(0.0423)	(0.0413)
$\text{Policy}^{z}_{j,t-1}$ × ECB Member	0.0835	0.0481	0.1006*	0.0672
	(0.0548)	(0.0536)	(0.0544)	(0.0533)
Cost efficiency × Non-ECB Member	4.430***	2.927***	4.423***	2.913***
	(0.8410)	(0.7933)	(0.8412)	(0.7937)
Cost efficiency × ECB Member	3.977***	1.026	3.972***	1.020
	(1.302)	(1.334)	(1.302)	(1.334)
Bank liquidity	0.0299***	0.0162***	0.0299***	0.0161***
	(0.0030)	(0.0022)	(0.0030)	(0.0022)
Size	-2.752***	-1.851***	-2.749***	-1.848***
	(0.1983)	(0.1782)	(0.1983)	(0.1782)
Asset structure	0.1090***	0.0579	0.1092***	0.0579
	(0.0405)	(0.0384)	(0.0405)	(0.0383)
Bank Concentration	0.0270**	0.0441***	0.0273**	0.0445***
	(0.0109)	(0.0121)	(0.0109)	(0.0121)
GDP growth	0.0426***	0.0360**	0.0398**	0.0336**
	(0.0154)	(0.0142)	(0.0155)	(0.0143)
Inflation (CPI)	0.0367***	0.0096	0.0361***	0.0092
	(0.0116)	(0.0110)	(0.0116)	(0.0109)
Institutional Quality	2.927***	3.280***	2.860***	3.204***
	(0.7146)	(0.7261)	(0.7133)	(0.7248)
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,903	3,773	3,903	3,773
N	42,519	39,170	42,519	39,170
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4).
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

E ROBUSTNESS: 3-YEAR ROLLING WINDOW STANDARD DEVIATION OF RETURNS

We provide robustness by using the 3-year rolling standard deviation of returns on average assets to calculate our banking stability measure (Z-score), as shown in Equation (9).

Table E.1. Impact of monetary policy on banking stability, using robust Z-score (3-year rolling standard deviation of ROAA) – FE results

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^{z}_{j,t-1}$	2.553***	2.465***	3.284***	3.223***
	(0.7569)	(0.7807)	(0.7682)	(0.7859)
Cost efficiency	79.92***	71.04***	79.84***	70.81***
	(9.594)	(9.727)	(9.593)	(9.722)
Bank liquidity	0.0694***	0.0545***	0.0693***	0.0542***
	(0.0259)	(0.0192)	(0.0259)	(0.0192)
Size	2.676	4.605***	2.718	4.660***
	(1.766)	(1.716)	(1.766)	(1.717)
Asset structure	-0.1310	-0.3590	-0.1279	-0.3598
	(0.2118)	(0.2327)	(0.2114)	(0.2319)
Bank Concentration	-0.2108*	-0.1189	-0.2051*	-0.1120
	(0.1246)	(0.1397)	(0.1246)	(0.1397)
GDP growth	-0.0206	0.1228	-0.0853	0.0692
	(0.2684)	(0.2422)	(0.2692)	(0.2423)
Inflation (CPI)	-0.1976	-0.2714*	-0.2077	-0.2779*
	(0.1640)	(0.1534)	(0.1642)	(0.1535)
Institutional Quality	65.32***	69.49***	64.03***	68.08***
	(8.893)	(9.079)	(8.895)	(9.081)
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,830	3,771	3,830	3,771
N	42,308	39,112	42,308	39,112
R^2	0.34	0.34	0.34	0.34

Note: Lag 1 of all predictors in Models (2) and (4).
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

Table E.2. Impact of monetary policy on banking stability, controlling for macroprudential policies (Liquidity and LFX), using robust Z-score (3-year rolling standard deviation of ROAA) – FE results

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^{z}_{j,t-1}$	2.694***	2.669***	3.435***	3.440***
	(0.7810)	(0.8044)	(0.7921)	(0.8085)
Cost efficiency	82.21***	71.10***	82.17***	70.86***
	(9.707)	(9.811)	(9.706)	(9.806)
Bank liquidity	0.0718***	0.0548***	0.0716***	0.0545***
	(0.0268)	(0.0198)	(0.0268)	(0.0198)
Size	3.086*	4.767***	3.121*	4.819***
	(1.796)	(1.740)	(1.797)	(1.741)
Asset structure	-0.0727	-0.3155	-0.0694	-0.3163
	(0.2083)	(0.2325)	(0.2078)	(0.2317)
Bank Concentration	-0.1989	-0.1095	-0.1926	-0.1020
	(0.1253)	(0.1404)	(0.1253)	(0.1404)
GDP growth	-0.1945	-0.1200	-0.2652	-0.1800
	(0.3088)	(0.2766)	(0.3092)	(0.2762)
Inflation (CPI)	0.0220	-0.0581	0.0143	-0.0617
	(0.1790)	(0.1659)	(0.1790)	(0.1658)
Institutional Quality	65.36***	69.44***	63.96***	67.93***
	(9.155)	(9.311)	(9.161)	(9.313)
Macroprudential: Liquidity	6.899***	6.784***	6.952***	6.848***
	(1.022)	(1.028)	(1.022)	(1.027)
Macroprudential: LFX	4.305**	5.532**	4.221**	5.443**
	(2.121)	(2.217)	(2.120)	(2.216)
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,743	3,685	3,743	3,685
N	41,484	38,372	41,484	38,372
R^2	0.34	0.34	0.34	0.34

Note: Lag 1 of all predictors in Models (2) and (4). LFX: Limits on FX positions.
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

Table E.3. Impact of monetary policy on banking stability, controlling for macroprudential policies (Liquidity and LTV), using robust Z-score (3-year rolling standard deviation of ROAA) – FE results

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^{z}_{j,t-1}$	2.769***	2.787***	3.539***	3.595***
	(0.7796)	(0.8053)	(0.7908)	(0.8098)
Cost efficiency	82.08***	71.25***	82.01***	70.99***
	(9.705)	(9.804)	(9.704)	(9.799)
Bank liquidity	0.0716***	0.0553***	0.0714***	0.0551***
	(0.0269)	(0.0198)	(0.0269)	(0.0198)
Size	3.116*	4.817***	3.155*	4.874***
	(1.796)	(1.740)	(1.796)	(1.741)
Asset structure	-0.0665	-0.3075	-0.0631	-0.3079
	(0.2079)	(0.2326)	(0.2074)	(0.2317)
Bank Concentration	-0.1970	-0.1087	-0.1903	-0.1006
	(0.1254)	(0.1407)	(0.1253)	(0.1406)
GDP growth	-0.2312	-0.1932	-0.3099	-0.2616
	(0.3076)	(0.2783)	(0.3080)	(0.2781)
Inflation (CPI)	-0.0426	-0.1570	-0.0540	-0.1644
	(0.1848)	(0.1747)	(0.1849)	(0.1747)
Institutional Quality	65.02***	68.73***	63.59***	67.16***
	(9.142)	(9.295)	(9.147)	(9.296)
Macroprudential: Liquidity	6.902***	6.809***	6.964***	6.883***
	(1.017)	(1.021)	(1.017)	(1.021)
Macroprudential: LTV	2.245	3.540**	2.394	3.698**
	(1.462)	(1.558)	(1.463)	(1.559)
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,743	3,685	3,743	3,685
N	41,484	38,372	41,484	38,372
R^2	0.34	0.34	0.34	0.34

Note: Lag 1 of all predictors in Models (2) and (4). LTV: Limits on Loan-to-Value Ratio
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

F MONETARY POLICY-STABILITY NEXUS: COMPETITION HETEROGENEITY

We go further to test another important market condition, banking competition, that can influence the impact of monetary policy on banking stability. We derive bank-level marginal costs and Lerner indices using a two-step stochastic metafrontier framework consisting of: i) country-specific cost frontiers that allow for heterogeneous technologies across banking systems, and ii) a stochastic metafrontier estimated on the fitted systematic component from the country frontiers. This structure enables us to benchmark market power within each country against a global best-practice technology set, thereby separating variation in inferred markups driven by local competitive conditions from variation attributable to cross-country technology gaps.

The starting point is the normalised translog cost function,

$$\ln\left(\frac{TC_{it}}{w_{1it}}\right) = g\left(\ln Y_{it},\, \ln \frac{w_{2it}}{w_{1it}},\, \ln \frac{w_{3it}}{w_{1it}}\right) + v_{it} + u_{it}, \tag{F.1}$$

where all variables are as defined earlier in subsection 4.2. The function $g(\cdot)$ is a flexible translog representation of the underlying technology. Let $\widehat{g}_{it}$ denote the fitted deterministic component of the estimated frontier.

$$\begin{aligned}\widehat{g}_{it} &= \widehat{\alpha}_0 + \widehat{\beta}_y \ln Y_{it} + \sum_{m=2}^{3} \widehat{\beta}_m \ln\left(\frac{w_{mit}}{w_{1it}}\right) \\ &+ \frac{1}{2}\widehat{\gamma}_{yy}\Big(\ln Y_{it}\Big)^2 + \sum_{m=2}^{3} \widehat{\gamma}_{ym} \ln Y_{it}\, \ln\left(\frac{w_{mit}}{w_{1it}}\right) \\ &+ \frac{1}{2}\sum_{m=2}^{3}\sum_{n=2}^{3} \widehat{\gamma}_{mn} \ln\left(\frac{w_{mit}}{w_{1it}}\right) \ln\left(\frac{w_{nit}}{w_{1it}}\right).\end{aligned} \tag{F.2}$$

Using this fitted component, the predicted total cost (in levels) is recovered as:

$$\hat{TC}_{it} = w_{1it} \exp(\widehat{g}_{it}). \tag{F.3}$$

Group-specific (country) frontiers. To allow for heterogeneity in banking technologies across countries, we estimate frontiers separately for each country $g \in \{1, \ldots, G\}$ using the same functional form as in Equation (F.1). Let $\widehat{g}_{it}^{(g)}$ denote the fitted component for country g, and $\hat{TC}_{it}^{(g)}$ is the implied predicted cost. The corresponding marginal cost is:

$$\hat{MC}_{it}^{(g)} = \frac{\hat{TC}_{it}^{(g)}}{Y_{it}}\, \widehat{\varepsilon}_{CY,it}^{(g)}, \tag{F.4}$$

and the country (group) Lerner index is:

$$\widehat{L}_{it}^{(g)} = 1 - \frac{\hat{MC}_{it}^{(g)}}{P_{it}}. \tag{F.5}$$

Metafrontier estimation. The metafrontier provides a global envelope of the country frontiers, capturing the best-practice technology available internationally. Following the stochastic metafrontier approach, we estimate the metafrontier using the fitted systematic component obtained from each country's frontier:

$$\text{pred}_{it} \equiv \widehat{g}_{it}^{(g)}.$$

Thus, the metafrontier model is:

$$\text{pred}_{it} = g^M\left(\ln Y_{it},\, \ln \tfrac{w_{2it}}{w_{1it}},\, \ln \tfrac{w_{3it}}{w_{1it}}\right) + v_{it}^M + u_{it}^M, \tag{F.6}$$

where $g^M(\cdot)$ is again specified as a translog function. Let $\widehat{g}_{it}^M$ denote the fitted metafrontier component. The implied metafrontier predicted total cost is:

$$\hat{TC}_{it}^M = w_{1it} \exp\left(\widehat{g}_{it}^M\right). \tag{F.7}$$

Marginal cost relative to the metafrontier is:

$$\hat{MC}_{it}^{M} = \frac{\hat{TC}_{it}^{M}}{Y_{it}}\,\widehat{\varepsilon}_{CY,it}^{M}, \tag{F.8}$$

and the meta-Lerner index is:

$$\widehat{L}_{it}^{M} = 1 - \frac{\hat{MC}_{it}^{M}}{P_{it}}. \tag{F.9}$$

This measure reflects market power after controlling for cross-country technological differences. Whereas $\widehat{L}_{it}^{(g)}$ captures pricing power relative to a bank's local technology, $\widehat{L}_{it}^{M}$ reflects pricing power relative to the global best-practice technology. The difference,

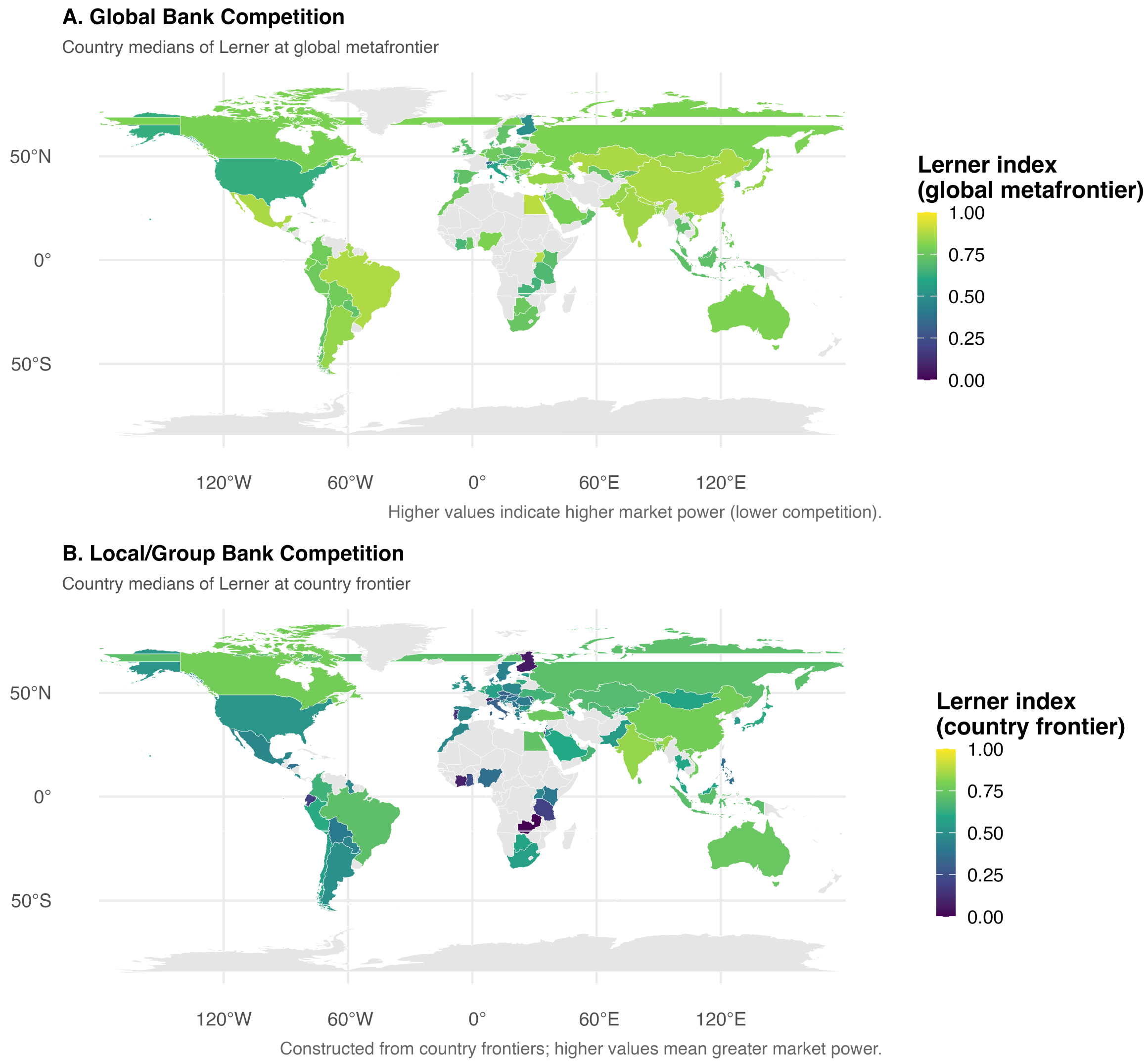
$$\widehat{L}_{it}^{(g)} - \widehat{L}_{it}^{M}, \tag{F.10}$$

therefore provides a technology-adjusted diagnostic of market power. A large positive gap suggests that apparent markups under the country benchmark may be inflated by cross-country technology differences, whereas a small gap indicates that inferred pricing power is broadly robust to benchmarking against the global best-practice technology set.

The two Lerner indices provide complementary measures of market power under distinct technological benchmarks. The country-specific Lerner index $\widehat{L}_{it}^{(g)}$ measures pricing power relative to each country's own cost technology and therefore summarises local competitive conduct conditional on the prevailing domestic production possibilities. The meta-Lerner index $\widehat{L}_{it}^{M}$, by contrast, re-evaluates the same bank against the global best-practice technology set embodied in the metafrontier and therefore nets out cross-country technological heterogeneity. Empirically, the summary statistics show $\widehat{L}_{it}^{M}$ exceeding $\widehat{L}_{it}^{(g)}$ on average, implying $\widehat{L}_{it}^{(g)} - \widehat{L}_{it}^{M} < 0$. This ordering is informative: it indicates that once marginal costs are disciplined by the global frontier (which is typically lower than domestic frontiers), implied markups are larger. Put differently, part of the "comfort" of moderate local markups reflects the fact that domestic technologies (and thus domestic cost levels) are below best practice; benchmarking to the global frontier reveals that prices are high relative to what would prevail under best-practice cost efficiency.

The patterns in Figure F.1 are characterised by a systematic wedge between the two benchmarks: for most countries in the map, the metafrontier Lerner ($\widehat{L}^{M}$) exceeds the country-frontier Lerner ($\widehat{L}^{(g)}$), implying that pricing power is larger when marginal costs are evaluated against the global best-practice technology. Interpreted through the cost-technology lens, this indicates that local marginal costs (embedded in $\widehat{L}^{(g)}$) are typically higher than the counterfactual best-practice costs used in $\widehat{L}^{M}$, so the implied markup relative to the global benchmark is mechanically larger. Regionally, several emerging and smaller banking systems exhibit particularly high $\widehat{L}^{M}$ (often alongside moderate or high $\widehat{L}^{(g)}$), consistent with the joint presence of meaningful market power and non-trivial technology gaps; in contrast, a subset of advanced systems display comparatively lower Lerner values (especially under the country benchmark), consistent with tighter competitive constraints, while still showing a positive wedge under the global benchmark. Overall, the maps jointly suggest that cross-country comparisons of competition are sensitive to technology benchmarking, and that the metafrontier-based Lerner index provides a more technology-adjusted measure of pricing power, which is especially informative in countries where cost technologies differ materially from the global best-practice frontier.

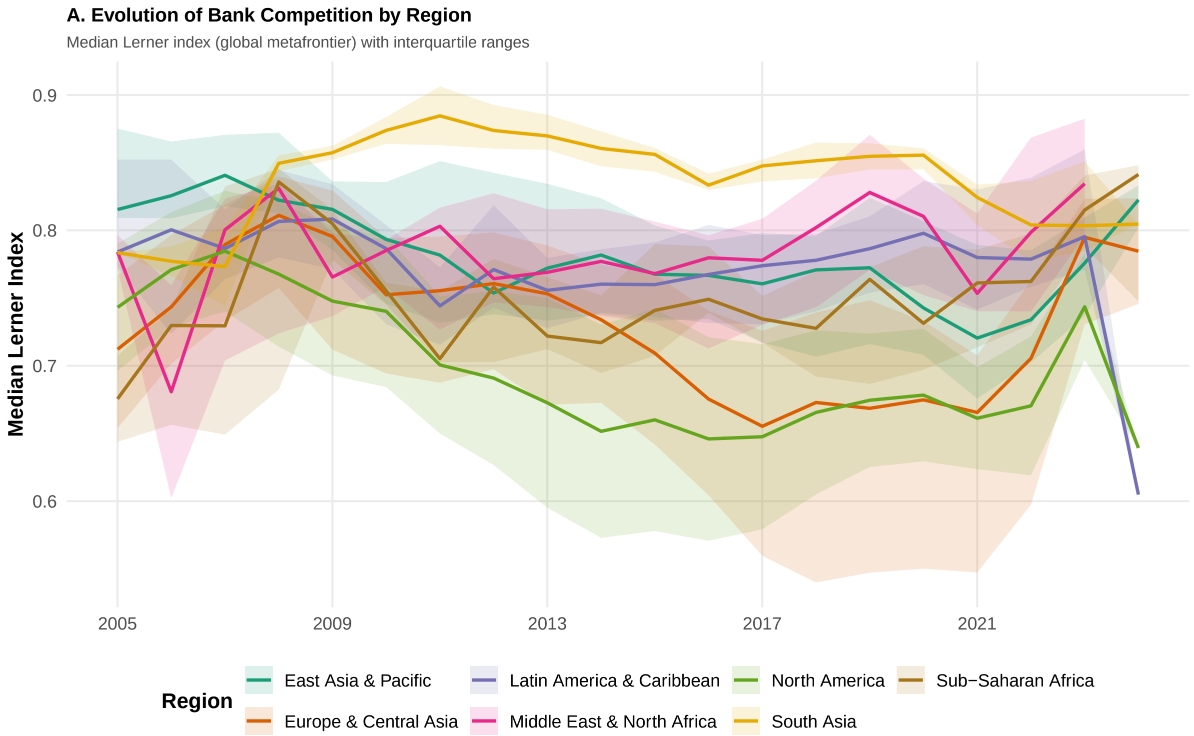
Figure F.1. Global metafrontier Lerner index



Note: Grey areas represent missing data.

The regional median meta-Lerner index, $\widehat{L}^M$, shown in Figure F.2 is uniformly high and typically exceeds the country-frontier median, indicating that benchmarking marginal costs against the global best-practice technology systematically implies higher markups than benchmarking against local technologies. The levels are especially elevated in South Asia and East Asia & Pacific (with $\widehat{L}^M$ commonly around 0.75–0.87), while Europe & Central Asia and North America tend to sit at comparatively lower (though still sizable) medians (roughly 0.65–0.79). Sub-Saharan Africa exhibits a marked upward trend in $\widehat{L}^M$ during the post-2020 period, consistent with rising implied market power under the global benchmark, or equivalently, an expansion in the technology-adjustment component embedded in the metafrontier comparison. Taken together with the cost-efficiency patterns, the Lerner evidence suggests that cross-region comparisons of competitive conduct are tightly intertwined with technology benchmarking: where typical banks are further from the global best-practice cost frontier, the implied markup relative to that frontier is mechanically larger, reinforcing the case for reporting both $\widehat{L}^{(g)}$ and $\widehat{L}^M$ to separate local competitive conditions from technology-adjusted market power.

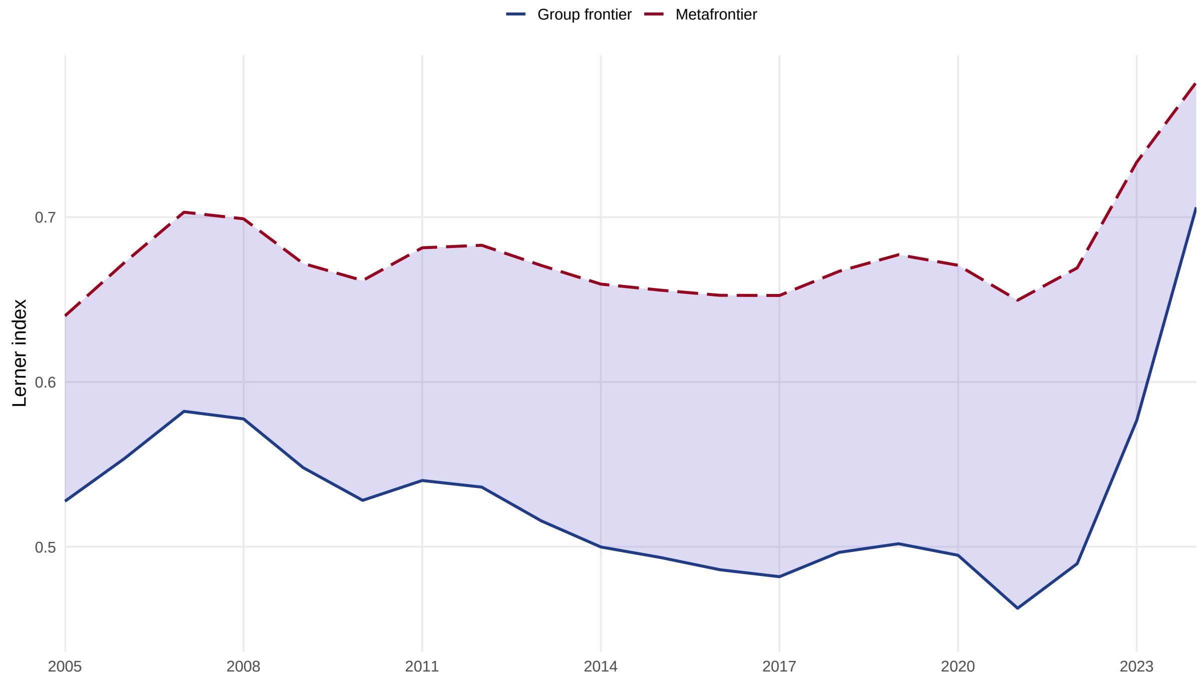
Figure F.2. Trend of median metafrontier Lerner index by region



Note: The figure reports the trend of the Lerner index following Equation (F.9).

Figure F.3 plots the average trend of both the metafrontier and country frontier Lerner index. The figure reinforces this technology interpretation. The global series $\widehat{L}_{it}^{M}$ tracks above the country series $\widehat{L}_{it}^{(g)}$ throughout, while both exhibit broadly co-moving dynamics over time. The sustained vertical gap indicates that the technology-adjustment component is persistent rather than episodic: changes in competitive conditions (or common shocks to pricing and costs) are reflected in both indices, but the level difference is driven by the counterfactual marginal cost implied by the global best-practice technology. Episodes in which the gap widens can be read as periods when technology dispersion (or the distance between domestic and best-practice frontiers) increases, magnifying the markup implied by the global benchmark; conversely, narrowing gaps observed after 2021 are consistent with convergence toward best practice, in which case $\widehat{L}_{it}^{(g)}$ and $\widehat{L}_{it}^{M}$ become more similar and inferred market power is more robust to the choice of technology benchmark.

Figure F.3. Trend of average metafrontier and country Lerner index



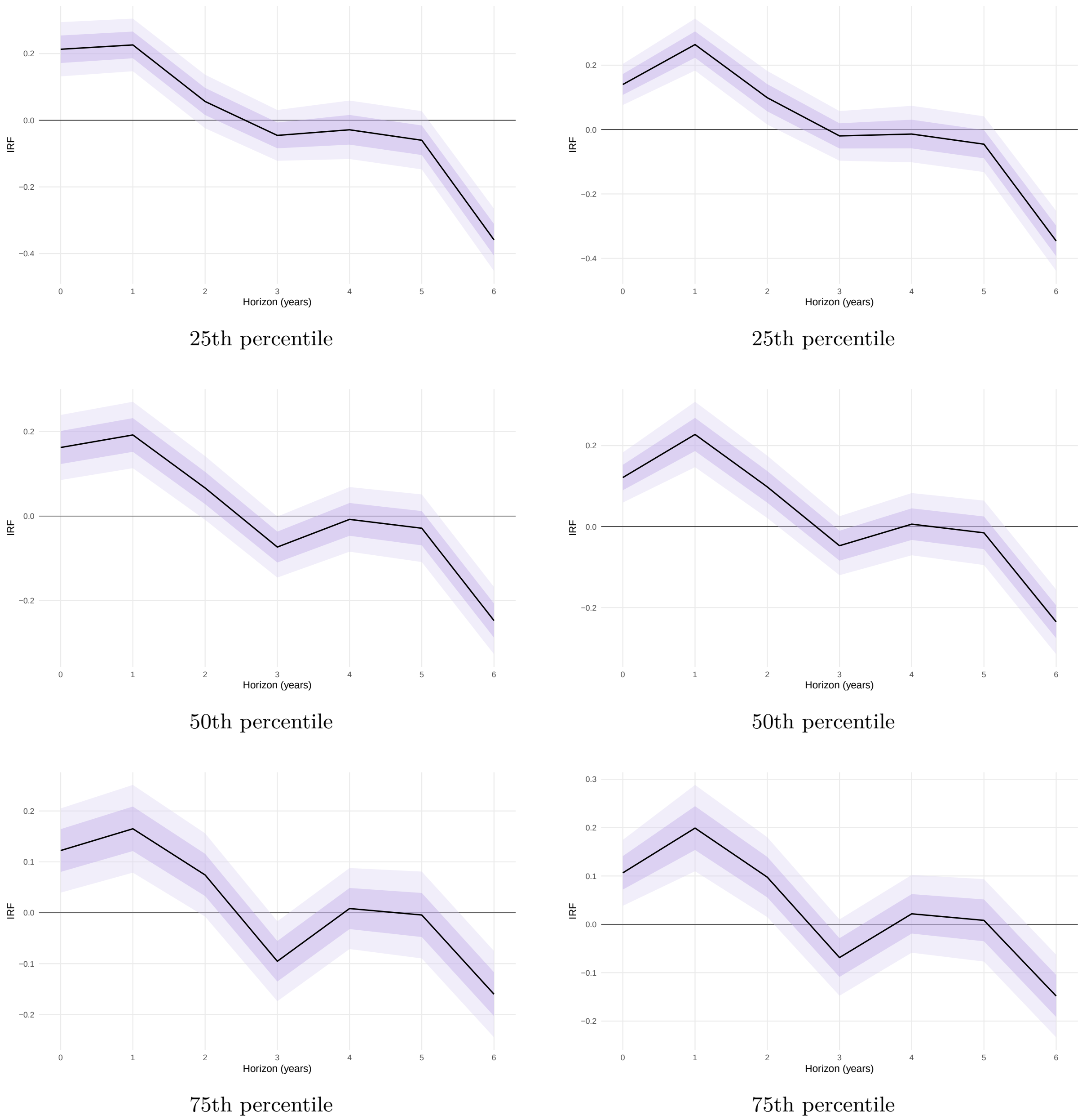
We proceed to discuss the results of the monetary policy-stability nexus, conditional on the competitive environment, which is proxied by the Lerner index derived earlier. In the local projection framework, as in Equation (15), we condition the impulse responses of bank stability to a tightening shock on the distribution of the Lerner index (25th, 50th, and 75th percentiles). The resulting IRFs in Figures F.5 and F.6 indicate that tightening raises stability on impact across all competition regimes. This finding is consistent with a risk-discipline interpretation of monetary tightening: a higher policy rate compresses the set of profitable, marginally risky lending opportunities, strengthens screening incentives, and reduces risk-taking at the extensive margin. Importantly, the on-impact stabilisation is larger for banks operating in less competitive markets (higher market power), as reflected by the higher immediate response at lower competition (25th percentile) relative to more competitive environments.

The cross-regime differences in the dynamic responses are particularly informative. While all regimes exhibit an initial improvement in stability, low-competition markets display a flatter and more persistent path, whereas the responses under high competition are more pronounced and less smooth over the horizon. A plausible interpretation is that market power enhances the intertemporal transmission of monetary shocks by providing a buffer in terms of profitability and balance-sheet management. Banks with greater pricing power can adjust loan and deposit rates more strategically, smooth margins through the cycle, and avoid sharp contractions in intermediation that may otherwise amplify borrower distress and subsequent credit losses. This seem to support the competition-fragility view [Keeley, 1990, Beck et al., 2013, Berger et al., 2017] where lower competition improves banking stability. In contrast, under intense competition, pricing is more constrained, and pass-through can be more mechanical. The resulting profit compression and more abrupt portfolio adjustments can generate greater volatility in bank performance and asset quality dynamics, producing a less smooth stability response. In this sense, competition acts as an amplifier of the propagation of policy shocks even when the impact effect is stabilising.

These results have two implications for the paper's central mechanism. First, they underscore that the stabilising effect of tightening is not confined to a particular market structure: the impact response is positive throughout the competition distribution. Second, they suggest that market power is associated with resilience in propagation: lower competition does not merely raise stability contemporaneously, but also dampens the subsequent sensitivity of stability to the tightening shock. This pattern aligns with the view that charter value and pricing power mitigate short-run profitability pressures and reduce incentives to "reach for yield" following policy changes, thereby smoothing the adjustment to stability. Taken together, the Lerner-conditioned IRFs complement the cost efficiency heterogeneity analysis by highlighting an additional structural margin, the competitive environment, that shapes the persistence and volatility of monetary policy transmission in relation to banking stability.

Figure F.4. Local projections responses of banking stability (Z-score) to monetary policy shock, conditional on bank competition

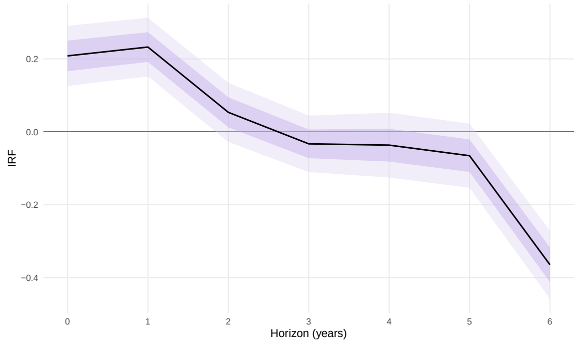
(i) One Lag of Predictors **(ii) One Lag of Z-score & Predictors**



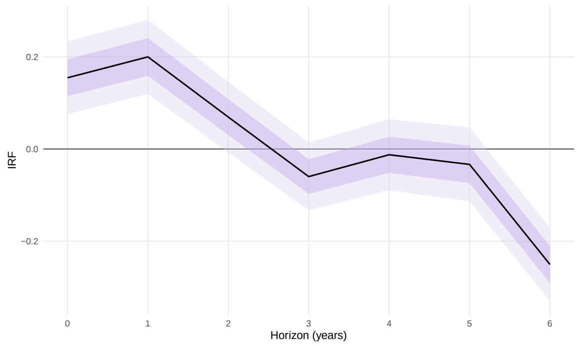
Note: The figure plots local projections responses of banking stability (Z-score) to a one-standard-deviation monetary policy shock, conditional on bank competition (evaluated at the 25th, 50th, and 75th percentiles). The lighter and darker bands represent 68% and 95% error bands, respectively. Column (i) includes 1 lag of all predictors; column (ii) includes one lag of credit growth and predictors.

Figure F.5. Local projections responses of banking stability (Z-score) to monetary policy shock, conditional on bank competition, controlling for macroprudential policies (Liquidity and LFX)

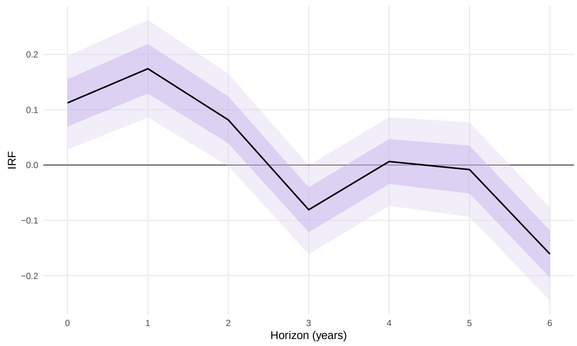
(i) One Lag of Predictors



25th percentile

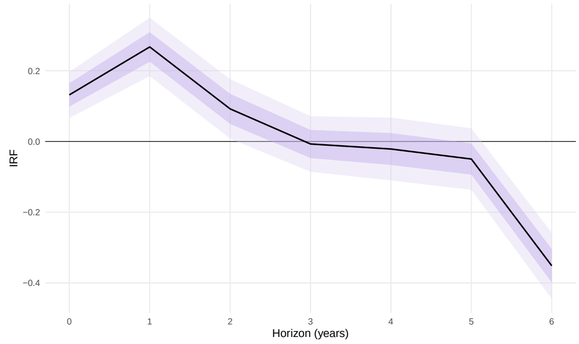


50th percentile

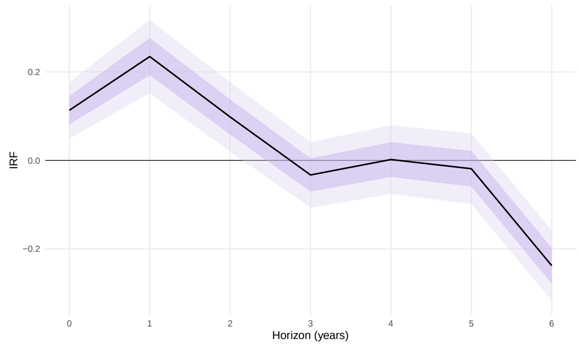


75th percentile

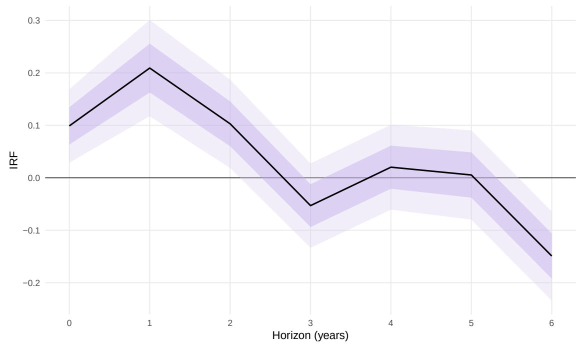
(ii) One Lag of Z-score & Predictors



25th percentile



50th percentile

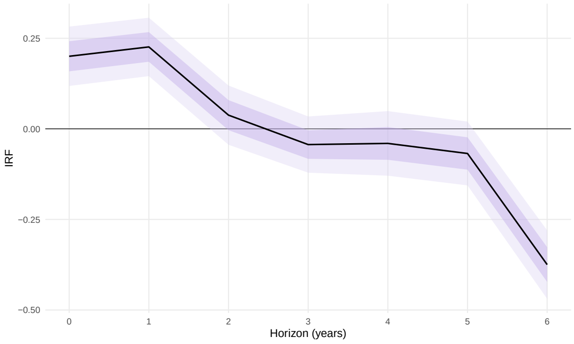


75th percentile

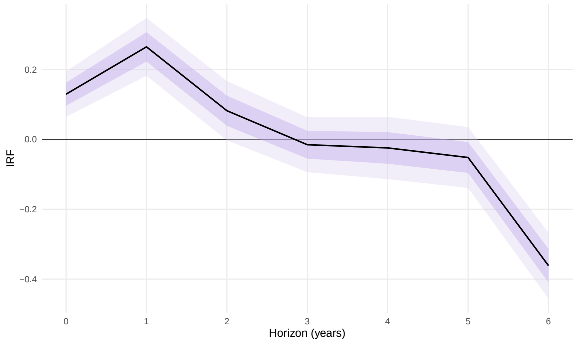
Note: The figure plots local projections responses of banking stability (Z-score) to a one-standard-deviation monetary policy shock, conditional on bank competition (evaluated at the 25th, 50th, and 75th percentiles), controlling for macroprudential policies (Liquidity and LFX). The lighter and darker bands represent 68% and 95% error bands, respectively. Column (i) includes 1 lag of all predictors; column (ii) includes one lag of Z-score and predictors.

Figure F.6. Local projections responses of banking stability (Z-score) to monetary policy shock, conditional on bank competition, controlling for macroprudential policies (Liquidity and LTV)

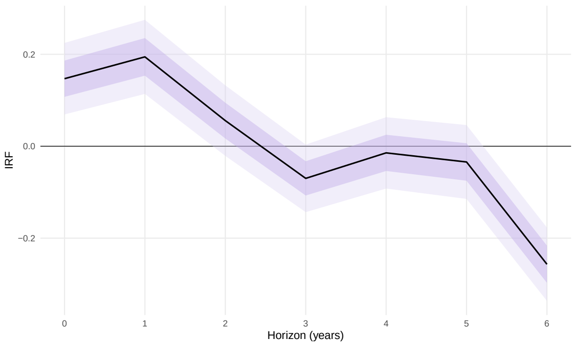
(i) One Lag of Predictors | **(ii) One Lag of Z-score & Predictors**



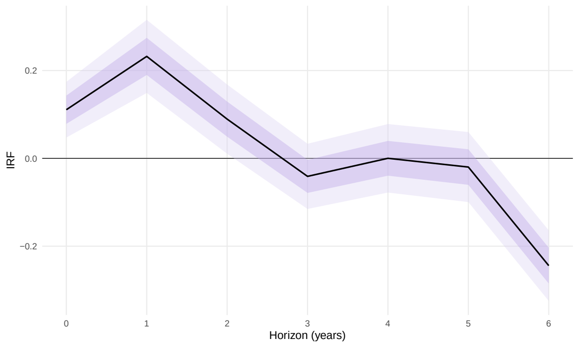
25th percentile



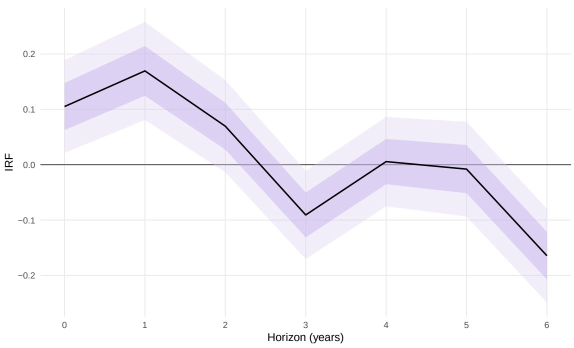
25th percentile



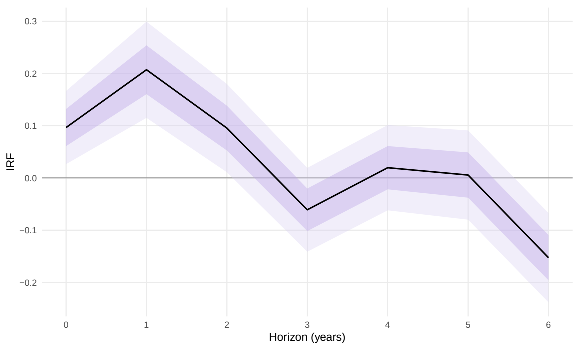
50th percentile



50th percentile



75th percentile



75th percentile

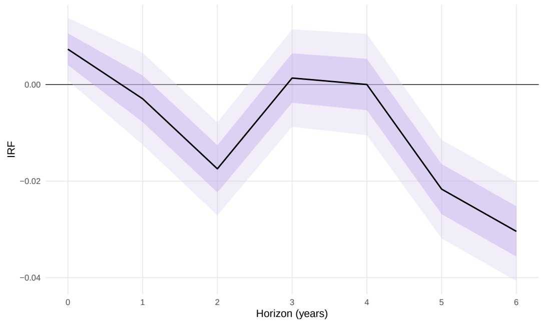
Note: The figure plots local projections responses of banking stability (Z-score) to a one-standard-deviation monetary policy shock, conditional on bank competition (evaluated at the 25th, 50th, and 75th percentiles), controlling for macroprudential policies (Liquidity and LTV). The lighter and darker bands represent 68% and 95% error bands, respectively. Column (i) includes 1 lag of all predictors; column (ii) includes one lag of Z-score and predictors.

G RESULTS OF COMPLEMENTARY CREDIT GROWTH CHANNEL

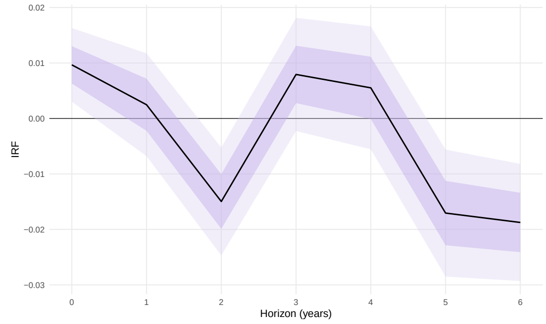
Figure G.1. Local projections responses of credit growth to monetary policy shock

(i) One Lag of Predictors

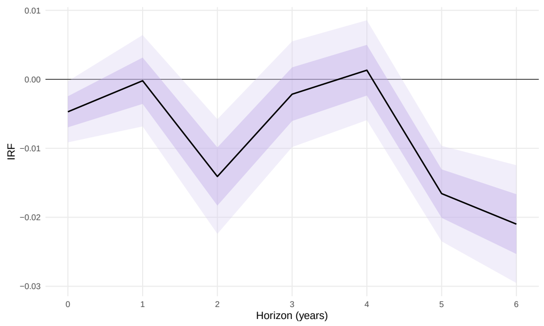
(ii) One Lag of Credit Growth & Predictors



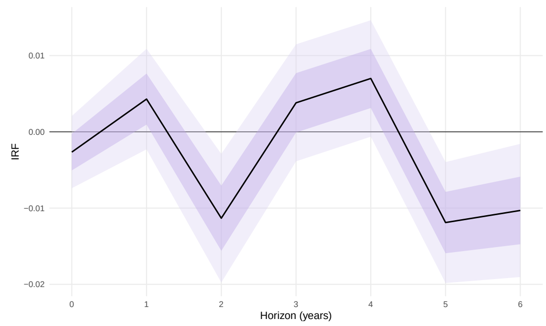
25th percentile



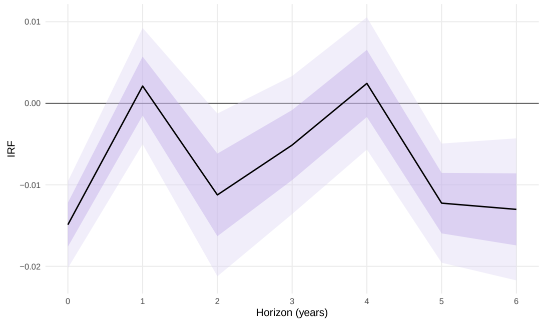
25th percentile



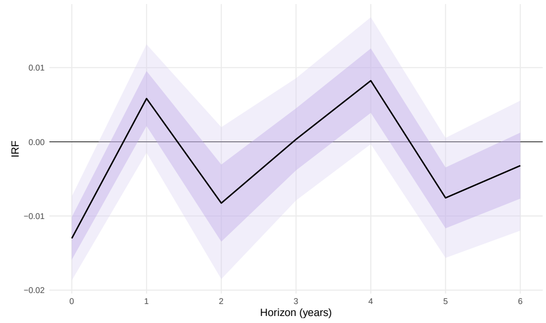
50th percentile



50th percentile



75th percentile

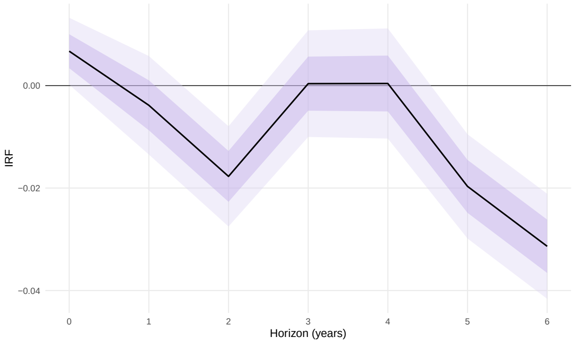


75th percentile

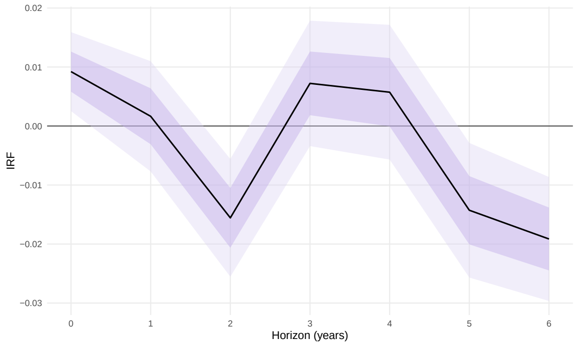
Note: The figure plots local projections responses of credit growth to a one-standard-deviation monetary policy shock, conditional on bank cost efficiency (evaluated at the 25th, 50th, and 75th percentiles). The lighter and darker bands represent 68% and 95% error bands, respectively. Column (i) includes 1 lag of all predictors; column (ii) includes one lag of credit growth and predictors.

Figure G.2. Local projections responses of credit growth to monetary policy shock, controlling for macroprudential policies (Liquidity and LFX)

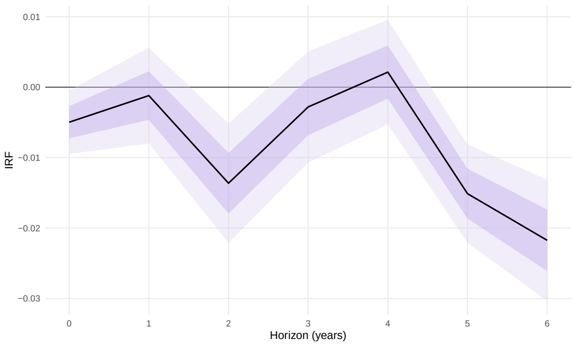
(i) One Lag of Predictors | **(ii) One Lag of Credit Growth & Predictors**



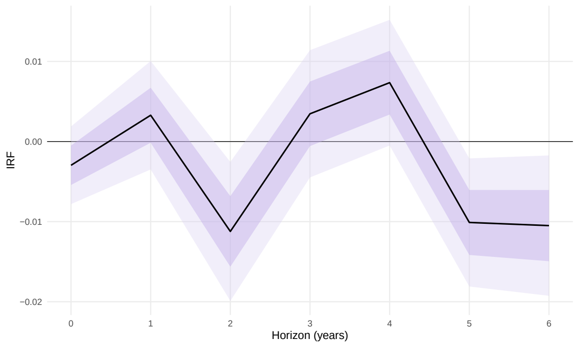
25th percentile



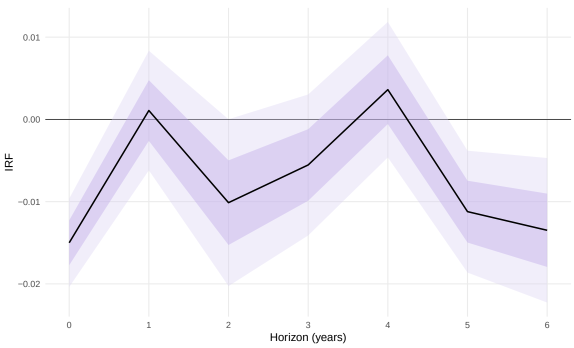
25th percentile



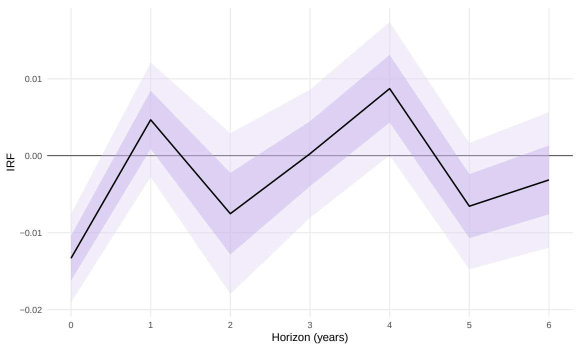
50th percentile



50th percentile



75th percentile

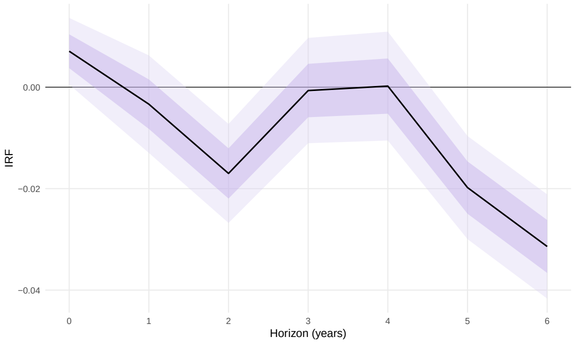


75th percentile

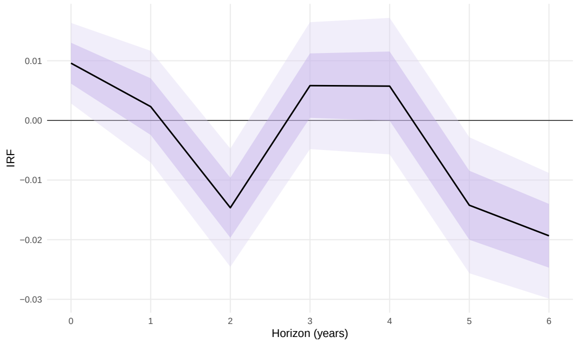
Note: The figure plots local projections responses of credit growth to a one-standard-deviation monetary policy shock, conditional on bank cost efficiency (evaluated at the 25th, 50th, and 75th percentiles), controlling for macroprudential policies (Liquidity and LFX). The lighter and darker bands represent 68% and 95% error bands, respectively. Column (i) includes 1 lag of all predictors; column (ii) includes one lag of credit growth and predictors.

Figure G.3. Local projections responses of credit growth to mnetary policy shock, controlling for macroprudential policies (Liquidity and LTV)

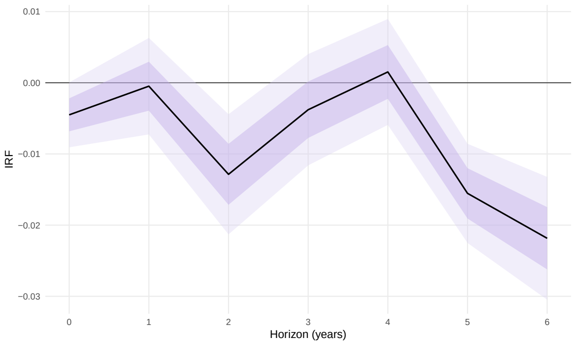
(i) One Lag of Predictors | **(ii) One Lag of Credit Growth & Predictors**



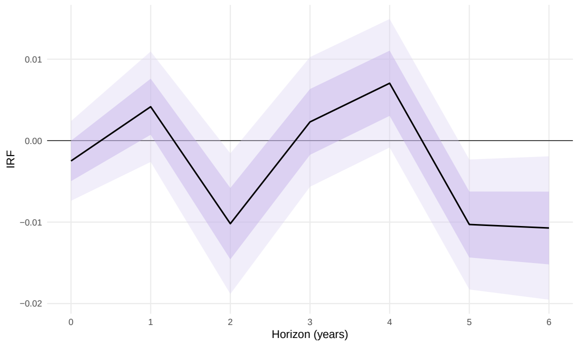
25th percentile



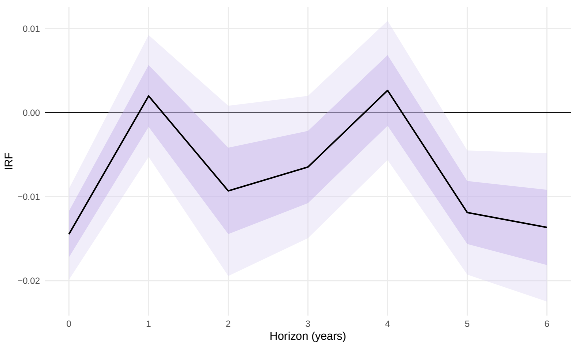
25th percentile



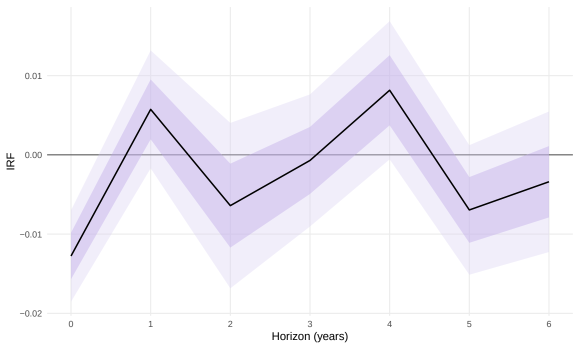
50th percentile



50th percentile



75th percentile



75th percentile

Note: The figure plots local projections responses of credit growth to a one-standard-deviation monetary policy shock, conditional on bank cost efficiency (evaluated at the 25th, 50th, and 75th percentiles), controlling for macroprudential policies (Liquidity and LTV). The lighter and darker bands represent 68% and 95% error bands, respectively. Column (i) includes 1 lag of all predictors; column (ii) includes one lag of credit growth and predictors.

H CHANNEL ANALYSIS: PORTFOLIO REBALANCING

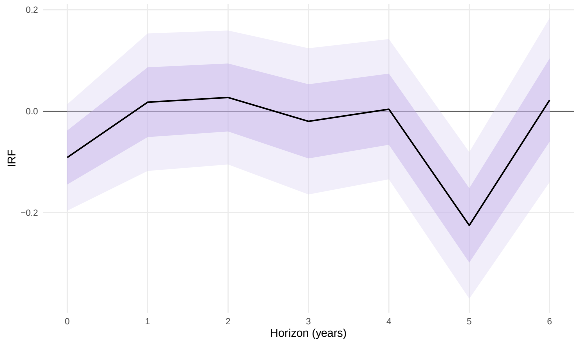
We next examine a portfolio rebalancing margin through which banks respond to tighter monetary conditions by adjusting the composition of their balance sheets. In this exercise, portfolio rebalancing is proxied by the loans-to-assets ratio, Loans/Assets, which captures shifts in the relative weight of lending within total assets. Unlike credit growth, Loans/Assets is a composition object and can move due to changes in the numerator (loans), the denominator (total assets), or both. We estimate LPs analogous to the credit-growth specifications, using Loans/Assets as the dependent variable and interacting the monetary policy shock with lagged cost efficiency. Figures F1-F3 report the corresponding impulse responses across efficiency percentiles.

The results indicate that monetary tightening reduces Loans/Assets on impact, consistent with banks reallocating away from loan exposures and/or expanding non-loan/liquid positions as funding costs rise and risk constraints tighten. The impact response is heterogeneous by cost efficiency: the decline in Loans/Assets is larger for high-efficiency banks (p75), while the response for low-efficiency banks (p25) is flatter and, in some specifications, close to zero at short horizons. This pattern suggests that cost-efficient banks rebalance more actively and rapidly when policy tightens, consistent with greater operational flexibility, lower adjustment costs, and more effective balance-sheet management.

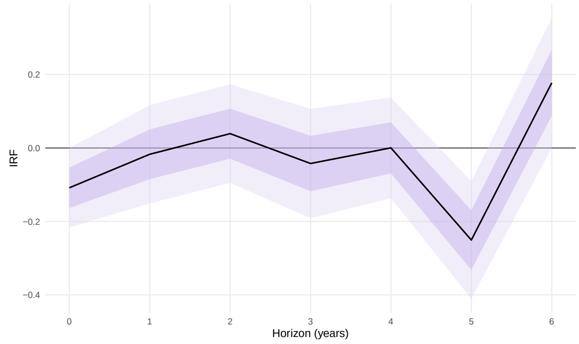
The dynamic profiles reinforce this interpretation. High-efficiency banks exhibit a more pronounced rebalancing trajectory over subsequent horizons, indicating an earlier and more decisive shift in portfolio composition when monetary conditions tighten. Low-efficiency banks, by contrast, display a smoother and muted adjustment path—consistent with limited capacity to reallocate assets quickly, higher internal frictions, and slower updating of portfolio targets. Taken together, these findings support the broader theme of the paper: cost efficiency is associated not only with higher stability outcomes, but also with the shape of balance-sheet adjustment to monetary tightening—more front-loaded and active among efficient banks, and more inertial among less efficient banks.

Figure H.1. Local projections responses of loan share (Loans/Assets) to monetary policy shock, conditional on bank cost efficiency

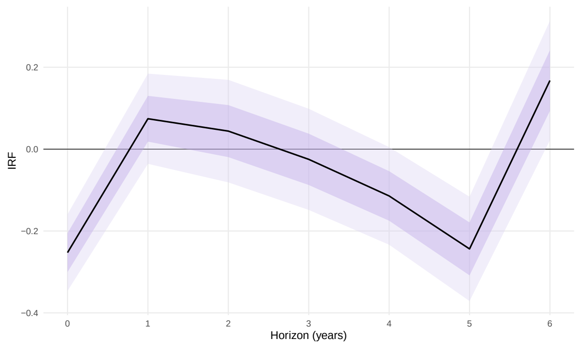
(i) One Lag of Predictors	(ii) One Lag of Loan share & Predictors



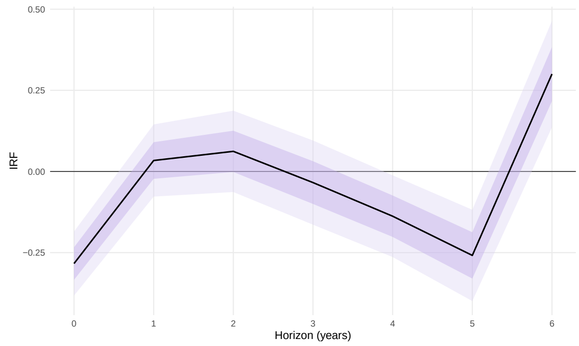
25th percentile



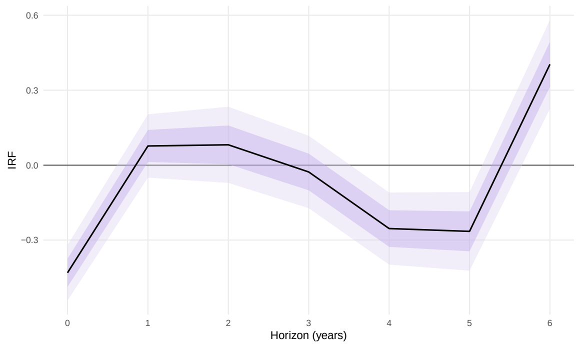
25th percentile



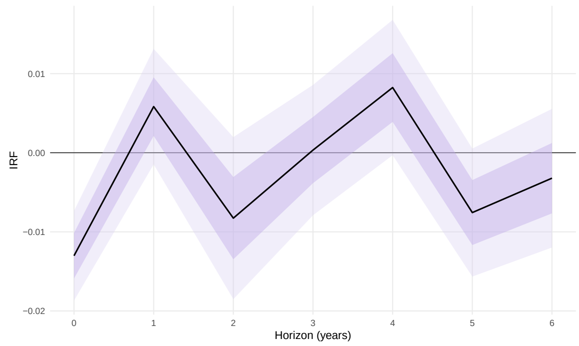
50th percentile



50th percentile



75th percentile



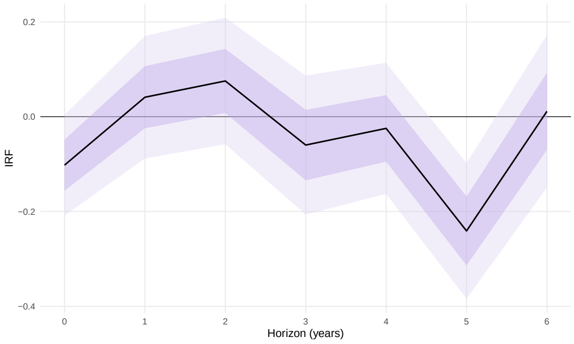
75th percentile

Note: The figure plots local projections responses of loan share (Loans/Assets) to a one-standard-deviation monetary policy shock, conditional on bank cost efficiency (evaluated at the 25th, 50th, and 75th percentiles). The lighter and darker bands represent 68% and 95% error bands, respectively. Column (i) includes 1 lag of all predictors; column (ii) includes one lag of loan share and predictors.

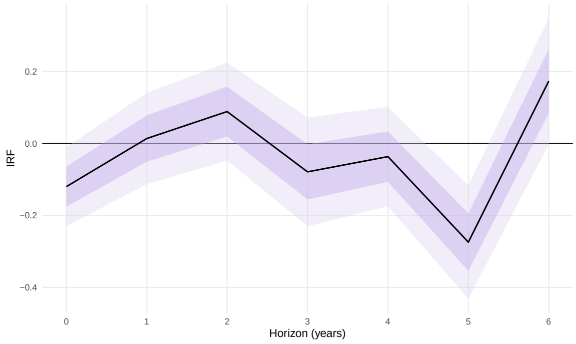
Figure H.2. Local projections responses of ploan share (Loans/Assets) to monetary policy shock, conditional on bank cost efficiency, controlling for macroprudential policies (Liquidity and LFX)

(i) One Lag of Predictors

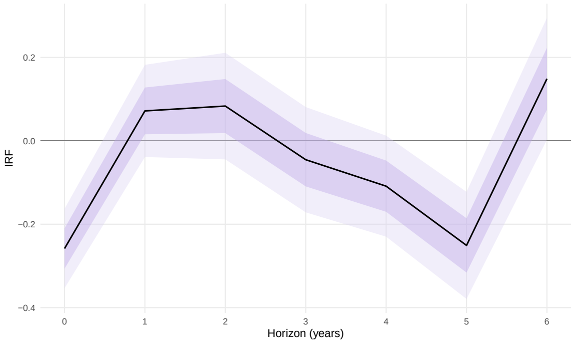
(ii) One Lag of loan share & Predictors



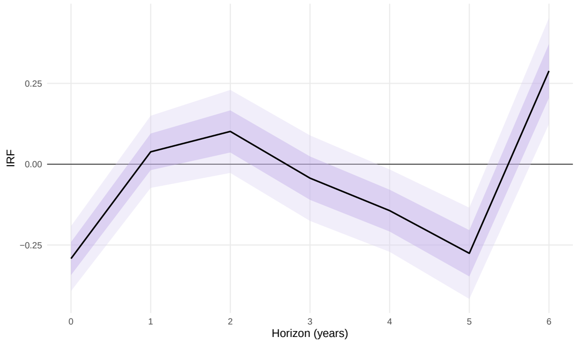
25th percentile



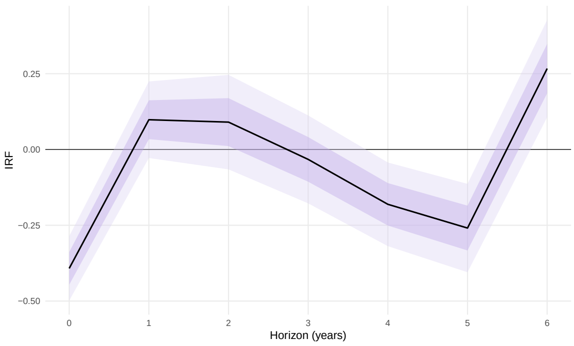
25th percentile



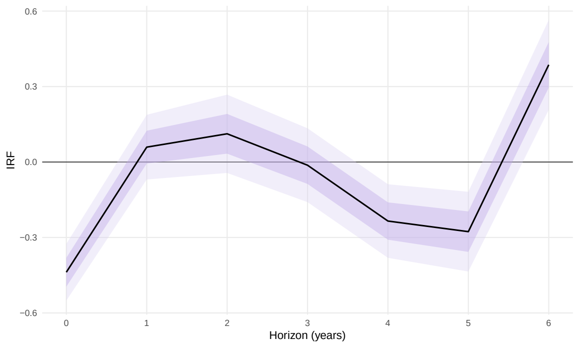
50th percentile



50th percentile



75th percentile

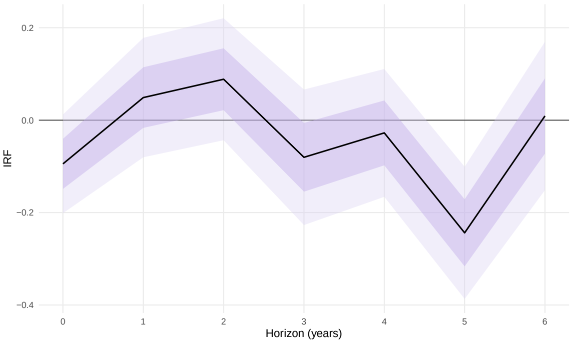


75th percentile

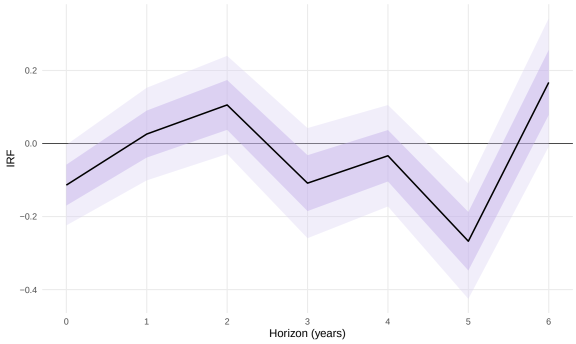
Note: The figure plots local projections responses of loan share (Loans/Assets) to a one-standard-deviation monetary policy shock, conditional on bank cost efficiency (evaluated at the 25th, 50th, and 75th percentiles), controlling for macroprudential policies (Liquidity and LFX). The lighter and darker bands represent 68% and 95% error bands, respectively. Column (i) includes 1 lag of all predictors; column (ii) includes one lag of loan share and predictors.

Figure H.3. Local projections responses of loan share (Loans/Assets) to monetary policy shock, conditional on bank cost efficiency, controlling for macroprudential policies (Liquidity and LTV)

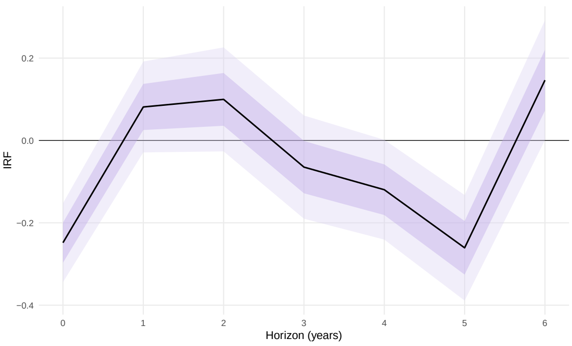
(i) One Lag of Predictors | **(ii) One Lag of loan spread & Predictors**



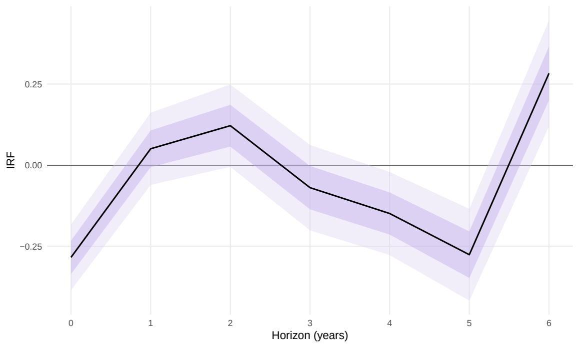
25th percentile



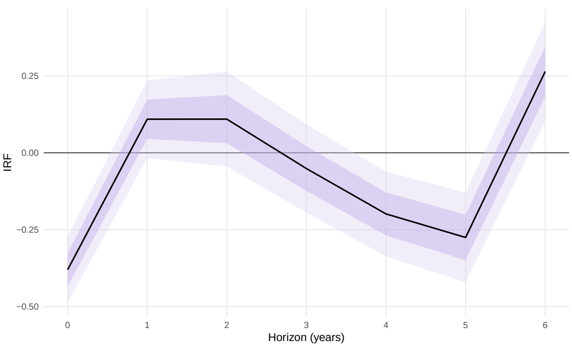
25th percentile



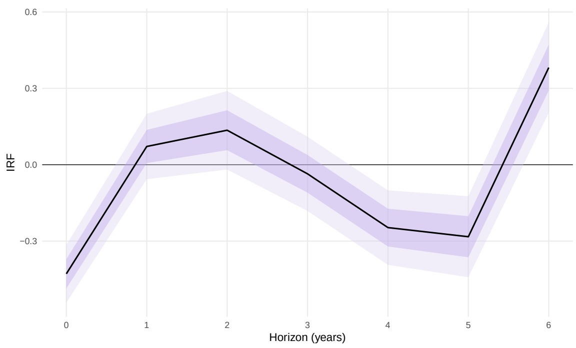
50th percentile



50th percentile



75th percentile



75th percentile

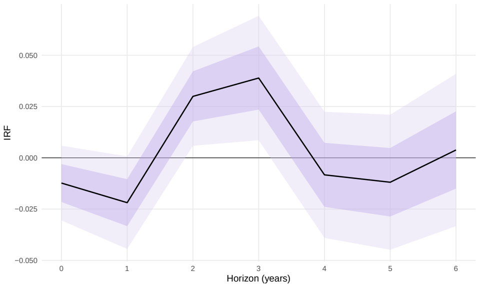
Note: The figure plots local projections responses of loan share (Loans/Assets) to a one-standard-deviation monetary policy shock, conditional on bank cost efficiency (evaluated at the 25th, 50th, and 75th percentiles), controlling for macroprudential policies (Liquidity and LTV). The lighter and darker bands represent 68% and 95% error bands, respectively. Column (i) includes 1 lag of all predictors; column (ii) includes one lag of loan share and predictors.

I RESULTS OF ROBUSTNESS USING NPL AS A MEASURE OF STABILITY

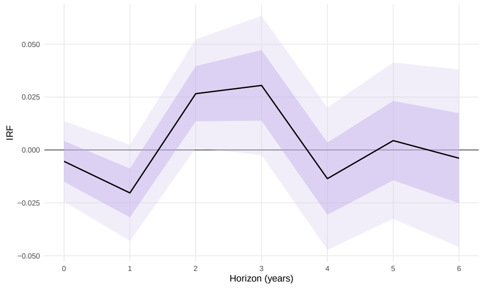
Figure I.1. Local projections responses of NPL growth to monetary policy shock

(i) One Lag of Predictors

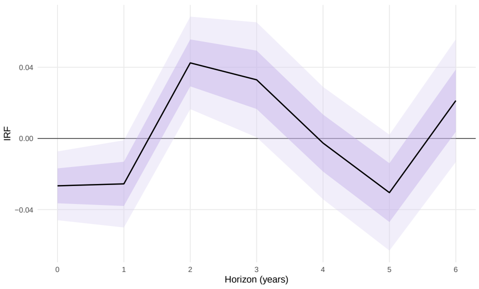
(ii) One Lag of NPL Growth & Predictors



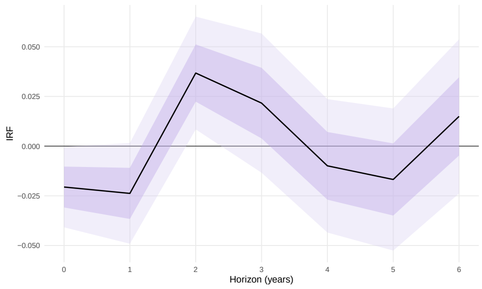
25th percentile



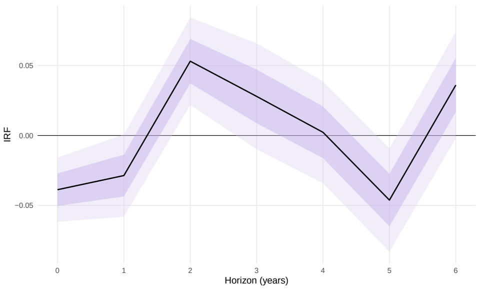
25th percentile



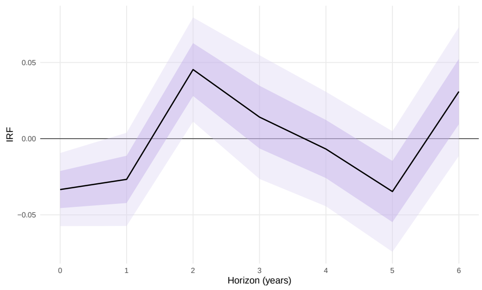
50th percentile



50th percentile



75th percentile



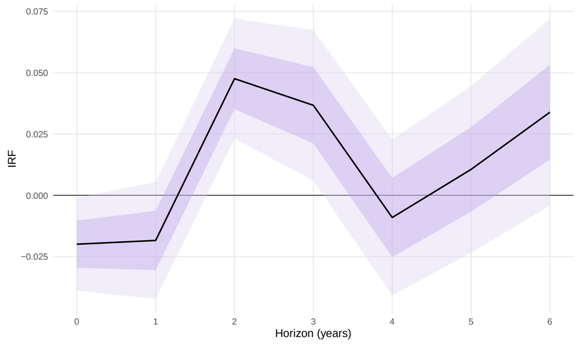
75th percentile

Note: The figure plots local projections responses of NPL growth to a one-standard-deviation monetary policy shock, conditional on bank cost efficiency (evaluated at the 25th, 50th, and 75th percentiles). The lighter and darker bands represent 68% and 95% error bands, respectively. Column (i) includes 1 lag of all predictors; column (ii) includes one lag of credit growth and predictors.

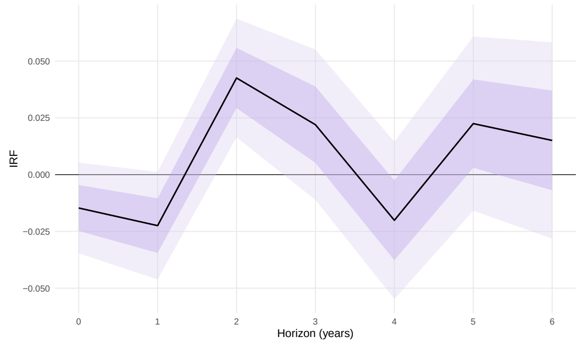
Figure I.2. Local projections responses of NPL ratio growth to monetary policy shock

(i) One Lag of Predictors

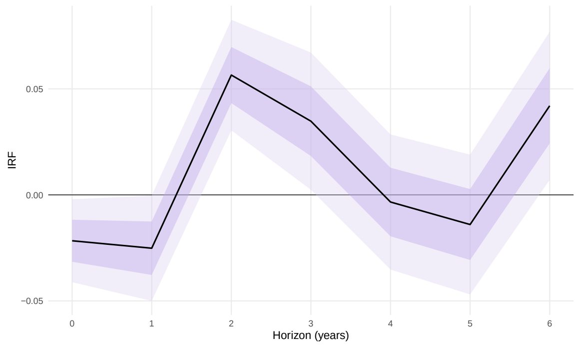
(ii) One Lag of NPL ratio Growth & Predictors



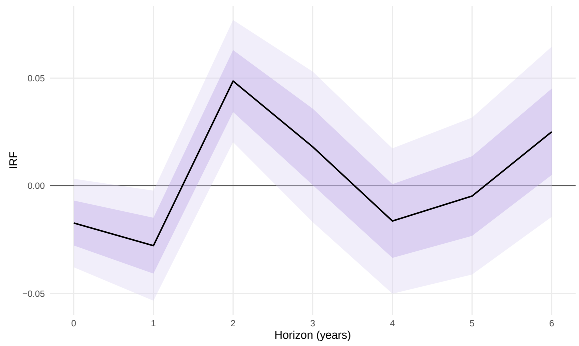
25th percentile



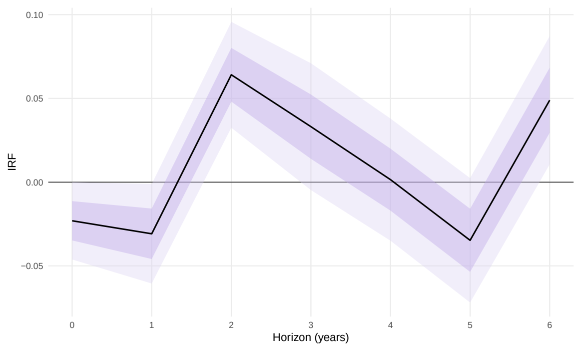
25th percentile



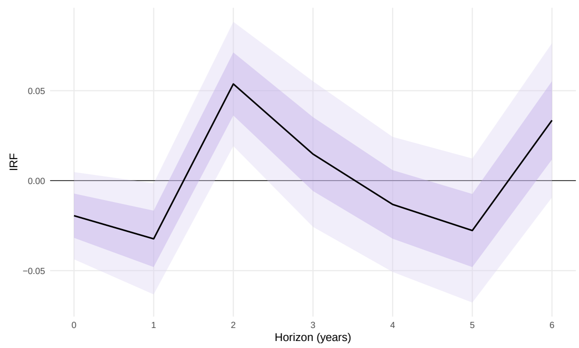
50th percentile



50th percentile



75th percentile



75th percentile

Note: The figure plots local projections responses of NPL ratio growth to a one-standard-deviation monetary policy shock, conditional on bank cost efficiency (evaluated at the 25th, 50th, and 75th percentiles). The lighter and darker bands represent 68% and 95% error bands, respectively. Column (i) includes 1 lag of all predictors; column (ii) includes one lag of credit growth and predictors.

J RESULTS OF TWO-STAGE LEAST SQUARES (2SLS) ESTIMATES

The results of the 2SLS discussions in the main paper are presented here in Tables J.1 to J.3.

Table J.1. Impact of monetary policy on banking stability – 2SLS

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^{z}_{j,t-1}$	5.45*	7.25**	4.00*	5.33**
	(2.92)	(3.22)	(2.11)	(2.31)
Cost efficiency	5.00***	2.61***	4.65***	2.28***
	(0.937)	(0.876)	(0.862)	(0.860)
Bank liquidity	0.031***	0.017***	0.031***	0.016***
	(0.003)	(0.003)	(0.003)	(0.003)
Size	-2.60***	-1.61***	-2.62***	-1.63***
	(0.213)	(0.219)	(0.209)	(0.209)
Asset structure	0.121***	0.059*	0.120***	0.056
	(0.039)	(0.036)	(0.039)	(0.035)
Bank Concentration	0.047***	0.082***	0.045***	0.077***
	(0.017)	(0.023)	(0.016)	(0.021)
GDP growth	-0.301	-0.362*	-0.224	-0.270*
	(0.195)	(0.186)	(0.152)	(0.141)
Inflation (CPI)	-0.010	-0.023	-0.0009	-0.019
	(0.031)	(0.024)	(0.025)	(0.020)
Institutional Quality	-2.96	-5.22	-1.85	-3.74
	(3.50)	(4.07)	(2.88)	(3.33)
First Stage Regression				
CBI → $\text{Policy}^{z}_{j,t-1}$	-0.778***	-0.738***	-1.060***	-1.002***
	(0.123)	(0.120)	(0.139)	(0.138)
F-stats (1st stage)	38.530	29.620	67.634	51.619
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,883	3,755	3,883	3,755
N	42,287	38,948	42,287	38,948
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4).
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

Table J.2. Impact of monetary policy on banking stability, controlling for macroprudential policies (Liquidity and LFX) – 2SLS

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^{z}_{j,t-1}$	5.78**	7.63**	4.18**	5.54**
	(2.93)	(3.21)	(2.08)	(2.26)
Cost efficiency	5.14***	2.63***	4.74***	2.27***
	(0.986)	(0.889)	(0.890)	(0.864)
Bank liquidity	0.031***	0.017***	0.031***	0.017***
	(0.003)	(0.003)	(0.003)	(0.003)
Size	-2.65***	-1.66***	-2.66***	-1.67***
	(0.212)	(0.212)	(0.209)	(0.204)
Asset structure	0.127***	0.062*	0.124***	0.058
	(0.040)	(0.037)	(0.040)	(0.036)
Bank Concentration	0.047***	0.084***	0.045***	0.078***
	(0.018)	(0.024)	(0.017)	(0.021)
GDP growth	-0.376*	-0.443**	-0.271	-0.318**
	(0.224)	(0.215)	(0.168)	(0.158)
Inflation (CPI)	-0.008	-0.011	0.001	-0.009
	(0.027)	(0.022)	(0.022)	(0.018)
Institutional Quality	-3.89	-6.12	-2.59	-4.39
	(3.67)	(4.17)	(2.97)	(3.37)
Macroprudential: Liquidity	0.093	0.239	0.033	0.145
	(0.161)	(0.204)	(0.129)	(0.161)
Macroprudential: LFX	0.485***	0.546***	0.298**	0.296**
	(0.175)	(0.203)	(0.127)	(0.144)
First Stage Regression				
CBI → $\text{Policy}^{z}_{j,t-1}$	-0.782***	-0.747***	-1.081***	-1.029***
	(0.123)	(0.121)	(0.141)	(0.140)
F-stats (1st stage)	39.856	31.180	72.166	55.937
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,796	3,669	3,796	3,669
N	41,458	38,204	41,458	38,204
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4).LFX: Limits on FX.
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

Table J.3. Impact of monetary policy on banking stability, controlling for macroprudential policies (Liquidity and LTV) – 2SLS

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$\text{Policy}^{z}_{j,t-1}$	5.74*	7.62**	4.17**	5.55**
	(2.97)	(3.25)	(2.12)	(2.30)
Cost efficiency	5.07***	2.60***	4.69***	2.24**
	(0.961)	(0.892)	(0.878)	(0.873)
Bank liquidity	0.031***	0.017***	0.031***	0.017***
	(0.003)	(0.003)	(0.003)	(0.003)
Size	-2.64***	-1.65***	-2.65***	-1.66***
	(0.215)	(0.216)	(0.211)	(0.207)
Asset structure	0.127***	0.064*	0.125***	0.060*
	(0.041)	(0.037)	(0.041)	(0.036)
Bank Concentration	0.048***	0.085***	0.045***	0.079***
	(0.018)	(0.025)	(0.017)	(0.022)
GDP growth	-0.385	-0.463**	-0.279	-0.336**
	(0.239)	(0.230)	(0.181)	(0.171)
Inflation (CPI)	-0.022	-0.033	-0.009	-0.026
	(0.036)	(0.028)	(0.028)	(0.023)
Institutional Quality	-3.85	-6.14	-2.57	-4.43
	(3.70)	(4.23)	(3.01)	(3.42)
Macroprudential: Liquidity	0.101	0.255	0.041	0.160
	(0.174)	(0.218)	(0.141)	(0.173)
Macroprudential: LTV	0.569	0.845*	0.402	0.638*
	(0.436)	(0.474)	(0.345)	(0.373)
First Stage Regression				
CBI → $\text{Policy}^{z}_{j,t-1}$	-0.769***	-0.737***	-1.058***	-1.011***
	(0.120)	(0.118)	(0.136)	(0.136)
F-stats (1st stage)	38.813	30.526	69.731	54.405
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,796	3,669	3,796	3,669
N	41,458	38,204	41,458	38,204
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4).LTV: Limits on Loan-to-Value Ratio
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

K RESULTS OF NON-LINEARITY IN POLICY STANCE

The results that correspond to the discussion of non-linearity robustness tests are presented in Tables K.1 to K.3.

Table K.1. Impact of monetary policy on banking stability—testing non-linear effect

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$Policy^{z}_{j,t-1}$	0.0990**	0.0728**	0.1227***	0.1002***
	(0.0392)	(0.0366)	(0.0397)	(0.0376)
$Policy^{z}_{j,t-1}$ sq.	-0.0764***	-0.0776***	-0.0812***	-0.0823***
	(0.0226)	(0.0209)	(0.0225)	(0.0215)
Cost efficiency	4.253***	2.582***	4.281***	2.593***
	(0.8216)	(0.7872)	(0.8219)	(0.7871)
Bank liquidity	0.0297***	0.0160***	0.0297***	0.0161***
	(0.0030)	(0.0022)	(0.0030)	(0.0022)
Size	-2.771***	-1.871***	-2.768***	-1.867***
	(0.1978)	(0.1780)	(0.1980)	(0.1781)
Asset structure (%)	0.1090***	0.0575	0.1091***	0.0574
	(0.0402)	(0.0378)	(0.0402)	(0.0378)
Bank Concentration	0.0265**	0.0430***	0.0273**	0.0441***
	(0.0109)	(0.0121)	(0.0109)	(0.0121)
GDP growth	0.0459***	0.0388***	0.0442***	0.0371***
	(0.0153)	(0.0142)	(0.0153)	(0.0143)
Inflation (CPI)	0.0363***	0.0093	0.0358***	0.0089
	(0.0116)	(0.0109)	(0.0116)	(0.0109)
Institutional Quality	2.673***	2.987***	2.568***	2.871***
	(0.7169)	(0.7326)	(0.7161)	(0.7320)
Threshold ($Policy^{z}_{j,t-1}$)	0.6478	0.4693	0.7561	0.6085
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,903	3,773	3,903	3,773
N	42,519	39,170	42,519	39,170
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4).
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

Table K.2. Impact of monetary policy on banking stability controlling for macroprudential policies (Liquidity and LFX) —testing non-linear effect

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$Policy^{z}_{j,t-1}$	0.0991**	0.0650*	0.1243***	0.0916**
	(0.0402)	(0.0374)	(0.0407)	(0.0385)
$Policy^{z}_{j,t-1}$ sq.	-0.0744***	-0.0761***	-0.0792***	-0.0813***
	(0.0230)	(0.0213)	(0.0229)	(0.0219)
Cost efficiency	4.196***	2.516***	4.225***	2.527***
	(0.8302)	(0.7944)	(0.8305)	(0.7943)
Bank liquidity	0.0299***	0.0163***	0.0299***	0.0164***
	(0.0030)	(0.0023)	(0.0030)	(0.0023)
Size	-2.784***	-1.878***	-2.781***	-1.875***
	(0.2014)	(0.1805)	(0.2015)	(0.1806)
Asset structure (%)	0.1123***	0.0591	0.1124***	0.0589
	(0.0414)	(0.0388)	(0.0414)	(0.0387)
Bank Concentration	0.0244**	0.0407***	0.0252**	0.0418***
	(0.0110)	(0.0122)	(0.0110)	(0.0122)
GDP growth	0.0460***	0.0480***	0.0439**	0.0460***
	(0.0170)	(0.0154)	(0.0171)	(0.0155)
Inflation (CPI)	0.0315**	0.0050	0.0312**	0.0048
	(0.0126)	(0.0119)	(0.0126)	(0.0119)
Institutional Quality	2.427***	2.868***	2.319***	2.752***
	(0.7379)	(0.7550)	(0.7368)	(0.7542)
Macroprudential: Liquidity	-0.1731***	-0.1928***	-0.1697***	-0.1891***
	(0.0453)	(0.0446)	(0.0453)	(0.0446)
Macroprudential: LFX	0.2913***	0.2970***	0.2888***	0.2953***
	(0.1086)	(0.1085)	(0.1086)	(0.1084)
Threshold ($Policy^{z}_{j,t-1}$)	0.6658	0.4271	0.7851	0.5635
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,816	3,687	3,816	3,687
N	41,690	38,426	41,690	38,426
R^2	0.95	0.96	0.95	0.96

Note: Lag 1 of all predictors in Models (2) and (4). LFX: Limits on FX positions. Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

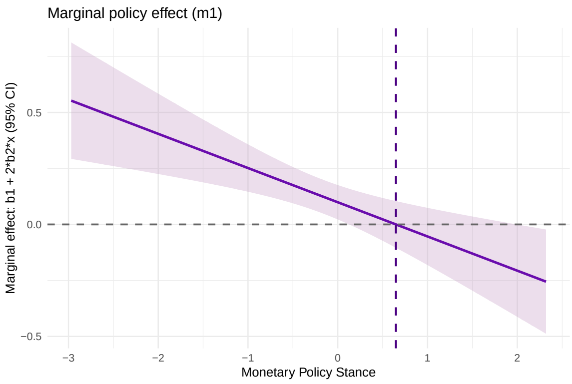
Table K.3. Impact of monetary policy on banking stability controlling for macroprudential policies (Liquidity and LTV) —testing non-linear effect

Policy variable:	Hybrid		Official	
Model:	(1)	(2)	(3)	(4)
$Policy^{z}_{j,t-1}$	0.0877**	0.0540	0.1142***	0.0819**
	(0.0403)	(0.0372)	(0.0407)	(0.0383)
$Policy^{z}_{j,t-1}$ sq.	-0.0733***	-0.0757***	-0.0780***	-0.0807***
	(0.0230)	(0.0212)	(0.0228)	(0.0219)
Cost efficiency	4.257***	2.566***	4.285***	2.577***
	(0.8305)	(0.7943)	(0.8308)	(0.7943)
Bank liquidity	0.0299***	0.0163***	0.0300***	0.0163***
	(0.0030)	(0.0023)	(0.0030)	(0.0023)
Size	-2.789***	-1.885***	-2.786***	-1.882***
	(0.2012)	(0.1804)	(0.2014)	(0.1806)
Asset structure (%)	0.1124***	0.0584	0.1125***	0.0583
	(0.0414)	(0.0386)	(0.0414)	(0.0385)
Bank Concentration	0.0239**	0.0402***	0.0248**	0.0413***
	(0.0110)	(0.0122)	(0.0110)	(0.0122)
GDP growth	0.0571***	0.0585***	0.0548***	0.0562***
	(0.0167)	(0.0151)	(0.0167)	(0.0152)
Inflation (CPI)	0.0370***	0.0105	0.0364***	0.0102
	(0.0125)	(0.0118)	(0.0125)	(0.0118)
Institutional Quality	2.410***	2.851***	2.303***	2.736***
	(0.7361)	(0.7535)	(0.7352)	(0.7530)
Macroprudential: Liquidity	-0.1872***	-0.2063***	-0.1836***	-0.2023***
	(0.0448)	(0.0443)	(0.0448)	(0.0443)
Macroprudential: LTV	-0.2494***	-0.2469***	-0.2428***	-0.2396***
	(0.0920)	(0.0851)	(0.0920)	(0.0850)
Threshold ($Policy^{z}_{j,t-1}$)	0.5986	0.3562	0.7321	0.5070
Fixed-effects				
Bank	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
No. of Banks	3,816	3,687	3,816	3,687
N	41,690	38,426	41,690	38,426
R^2	0.95	0.96	0.95	0.96

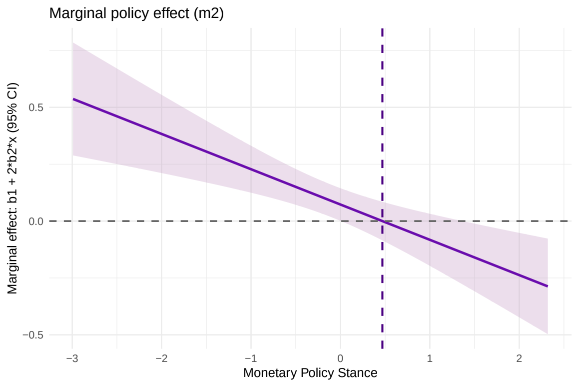
Note: Lag 1 of all predictors in Models (2) and (4). LTV: Limits on Loan-to-Value Ratio
Clustered (bank level) standard errors in parentheses.
****p<0.01, **p<0.05, *p<0.1.*

Figure K.1. Marginal effect of monetary policy stance ($Policy^{z}_{j,t-1}$) with quadratic term on banking stability based on Table K.1

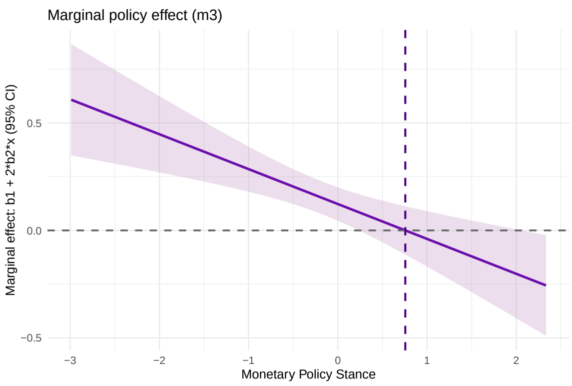
(i) No Lag of predictors | **(ii) One Lag of all Predictors**



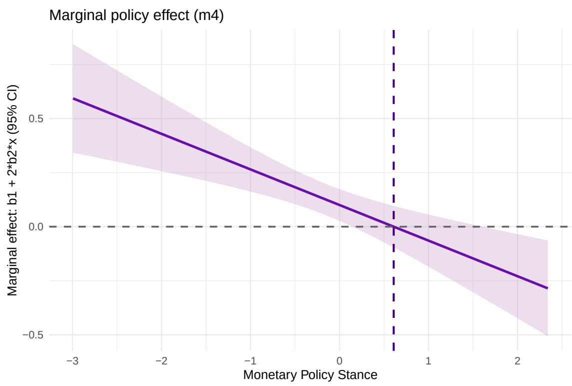
Policy, Hybrid



Policy, Hybrid



Policy, Official

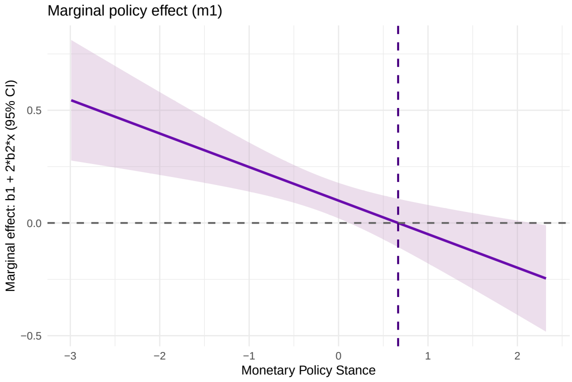


Policy, Official

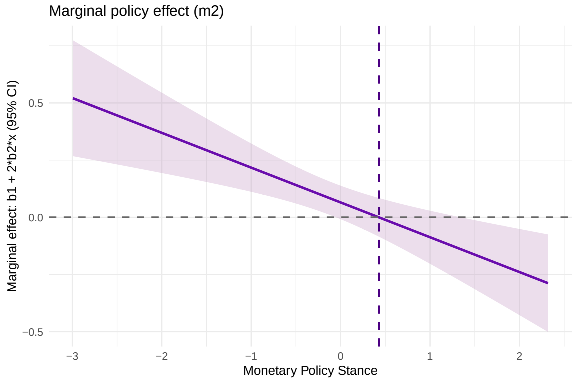
Note: Column (i) No lag of other predictors; column (ii) includes of all predictors.

Figure K.2. Marginal effect of monetary policy stance ($Policy^{z}_{j,t-1}$) with quadratic term on banking stability, controlling for macroprudential policies (Liquidity and LFX) based on Table K.2

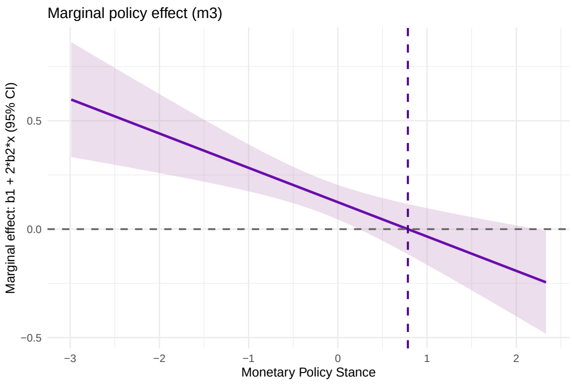
(i) No Lag of predictors | **(ii) One Lag of all Predictors**



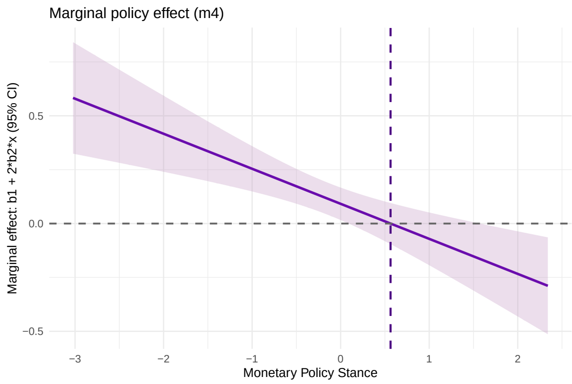
Policy, Hybrid



Policy, Hybrid



Policy, Official

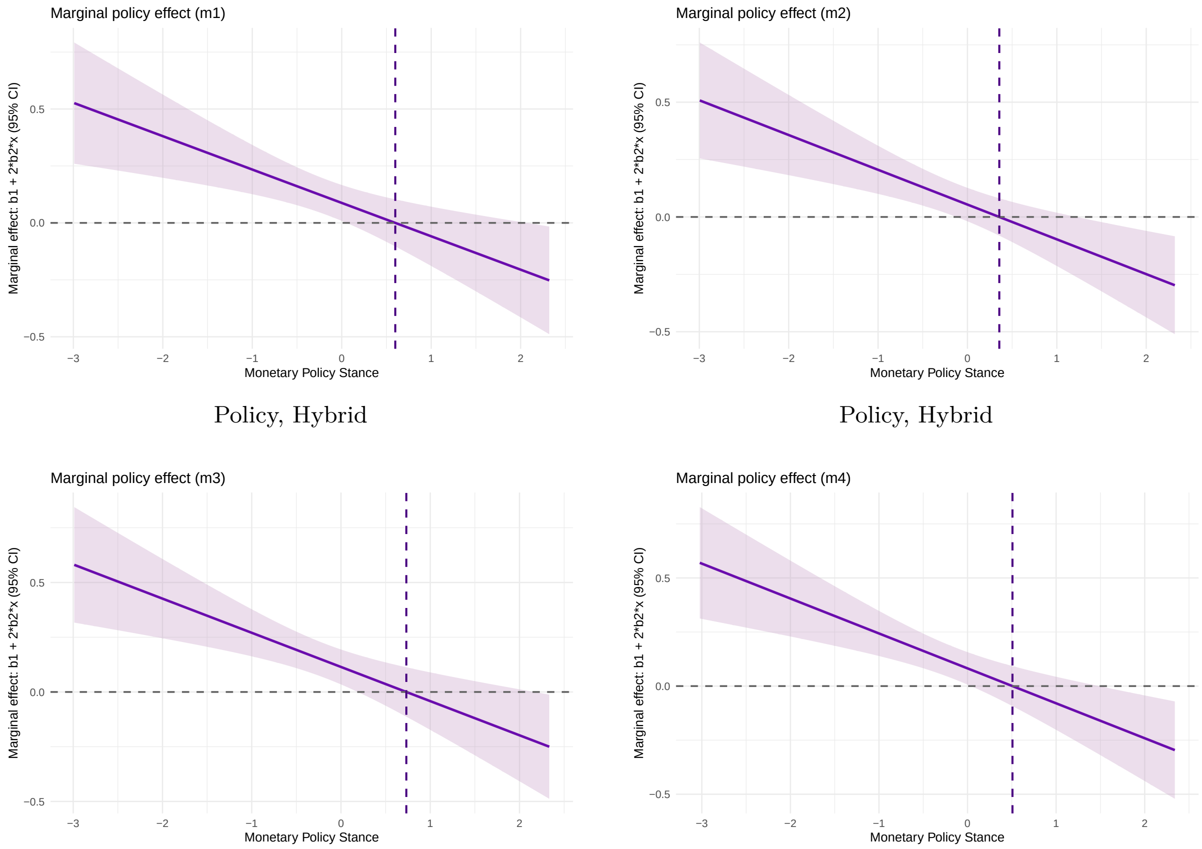


Policy, Official

Note: Column (i) No lag of other predictors; column (ii) includes of all predictors.

Figure K.3. Marginal effect of monetary policy stance ($Policy^{z}_{j,t-1}$) with quadratic term on banking stability, controlling for macroprudential policies (Liquidity and LTV) based on Table K.3

(i) No Lag of predictors **(ii) One Lag of all Predictors**



Policy, Hybrid | Policy, Hybrid

Policy, Official | Policy, Official

Note: Column (i) No lag of other predictors; column (ii) includes of all predictors.

L DSGE MODEL DERIVATIONS

The remainder of this appendix collects the derivations, proofs, and structural details underlying the DSGE model of monetary policy, bank cost efficiency, and financial stability.

L.1 Household Problem: Euler Equation and Deposit Demand

Lagrangian. The household maximises (19) subject to (20). Letting $\Lambda_t \equiv \beta^t C_t^{-\sigma}/P_t$ denote the marginal utility of nominal wealth, the FOCs are:

Consumption Euler.

$$C_t^{-\sigma} = \beta\,\mathbb{E}_t\Big[C_{t+1}^{-\sigma}(R_t^D/\Pi_{t+1})\Big],$$

where $\Pi_{t+1} \equiv P_{t+1}/P_t$ and R_t^D is the gross return on the deposit composite. Log-linearising around a zero-inflation steady state with $\bar{R}^D = 1/\beta$:

$$-\sigma\hat{C}_t = -\sigma\mathbb{E}_t[\hat{C}_{t+1}] + \hat{R}_t - \mathbb{E}_t[\hat{\pi}_{t+1}].$$

Using goods-market clearing $C_t = Y_t$ and the output-gap definition $\hat{x}_t \equiv \hat{Y}_t - \hat{Y}_t^n$ (where natural output is constant in our specification):

$$\hat{x}_t = \mathbb{E}_t[\hat{x}_{t+1}] - \frac{1}{\sigma}\Big(\hat{R}_t - \mathbb{E}_t[\hat{\pi}_{t+1}]\Big), \tag{23}$$

which is the IS curve used in the model.

Labour supply.

$$\frac{W_t}{P_t} = C_t^{\sigma} N_t^{\varphi}.$$

This pins down the real wage and, combined with the firms' labour demand, determines equilibrium employment. In the linearised system with flexible-price output as the benchmark, the labour supply condition is absorbed into the NKPC slope parameter κ (see Appendix L.2).

Deposit demand. The household allocates deposits across the three bank types to minimise the cost of acquiring a given level of the CES aggregate (21). The cost-minimisation problem is:

$$\min_{\{D_{k,t}\}} \sum_k R_{k,t}^D D_{k,t} \quad \text{s.t.} \quad \left(\sum_k \omega_k^{1/\eta_D} D_{k,t}^{(\eta_D-1)/\eta_D}\right)^{\eta_D/(\eta_D-1)} \geq D_t.$$

The FOC for $D_{k,t}$ (equating the marginal cost per unit of aggregate to the Lagrange multiplier R_t^D) gives:

$$R_{k,t}^D = R_t^D \cdot \omega_k^{1/\eta_D} \left(\frac{D_{k,t}}{D_t}\right)^{-1/\eta_D} \cdot \frac{D_t^{1/\eta_D}}{D_t^{1/\eta_D}}.$$

Solving for $D_{k,t}$:

$$D_{k,t} = \omega_k \left(\frac{R_{k,t}^D}{R_t^D}\right)^{-\eta_D} D_t.$$

For the general case with bank-specific elasticity $\eta_{D,k}$ (reflecting differential ease of access associated with cost efficiency), this becomes equation (22):

$$D_{k,t} = \omega_k \, (R_{k,t}^D / R_t^D)^{\eta_{D,k}} \, D_t.$$

The aggregate deposit rate is the CES price index $R_t^D = \left(\sum_k \omega_k (R_{k,t}^D)^{1-\eta_D}\right)^{1/(1-\eta_D)}$.

L.2 Calvo NKPC Derivation

A fraction $1-\alpha$ of intermediate firms reset their price each period to maximise

$$\mathbb{E}_t \sum_{j=0}^{\infty} \alpha^j \Lambda_{t,t+j} \Big[P_t^* Y_{t+j|t} - \Psi(Y_{t+j|t})\Big],$$

where P_t^* is the reset price, $Y_{t+j|t} = (P_t^*/P_{t+j})^{-\varepsilon} Y_{t+j}$ is the demand faced by a firm that last reset at t, and $\Psi(\cdot)$ is the cost function. The FOC is

$$\mathbb{E}_t \sum_{j=0}^{\infty} \alpha^j \Lambda_{t,t+j} Y_{t+j|t} \Big[P_t^* - \mathcal{M} \cdot \Psi'(Y_{t+j|t})\Big] = 0, \qquad \mathcal{M} \equiv \frac{\varepsilon}{\varepsilon - 1}.$$

Linearising around a zero-inflation steady state, using $\hat{p}_t^* \equiv \ln(P_t^*/P_t)$ and $mc_t \equiv \ln(\Psi'(Y_t)/(\overline{MC}))$, and aggregating via the Calvo price index $P_t = [\alpha P_{t-1}^{1-\varepsilon} + (1-\alpha)(P_t^*)^{1-\varepsilon}]^{1/(1-\varepsilon)}$ yields

$$\pi_t = \beta\,\mathbb{E}_t[\pi_{t+1}] + \kappa\, x_t, \qquad \kappa \equiv \frac{(1-\alpha)(1-\alpha\beta)}{\alpha}(\sigma+\varphi),$$

where σ is the inverse IES and φ the inverse Frisch elasticity (the real marginal-cost elasticity $mc_t = (\sigma+\varphi)x_t$ uses the production-function and household-supply conditions).

L.3 CSV Default Linearisation

Threshold-crossing rule. Following Bernanke et al. [1996], idiosyncratic entrepreneurial productivity ω_i is drawn from a lognormal distribution $\omega \sim \text{LN}(-\sigma_\omega^2/2,\, \sigma_\omega^2)$ so that $\mathbb{E}[\omega] = 1$. A borrower defaults whenever realised cash flow falls short of the contractual repayment:

$$\omega_i\, R_t^k\, Q_{t-1}K_{t-1} \;<\; R_{k,t-1}^L\, B_{k,t-1}.$$

This defines the default threshold

$$\bar{\omega}_{k,t} \;=\; \frac{R_{k,t-1}^L\, B_{k,t-1}}{R_t^k\, Q_{t-1}K_{t-1}},$$

and the default probability is $p_{k,t} = F(\bar{\omega}_{k,t}) = \Phi\Big((\ln\bar{\omega}_{k,t} + \sigma_\omega^2/2)/\sigma_\omega\Big)$, where Φ is the standard normal CDF.

Monitoring and volatility. Bank monitoring shifts the tail of the idiosyncratic distribution: $\sigma_{\omega,k}(m) \equiv \sigma_\omega \exp(-\zeta_k m_{k,t})$, where ζ_k rises in θ_k (cost-efficient banks have a more effective monitoring technology). For a given threshold $\bar{\omega}$, the default probability is decreasing in $m_{k,t}$ because the tighter distribution has less mass below $\bar{\omega}$.

Linearisation. Taking a first-order Taylor expansion of $p_{k,t} = F(\bar{\omega}_{k,t}; \sigma_{\omega,k})$ around the steady state $(\bar{\omega}, \bar{\sigma}_\omega)$:

$$\hat{p}_{k,t} \;\approx\; \underbrace{\frac{f(\bar{\omega})\,\bar{\omega}}{F(\bar{\omega})}}_{\equiv\,\pi_d}\; \hat{\bar{\omega}}_{k,t} \;-\; \underbrace{\frac{f(\bar{\omega})\,\bar{\omega}\,\sigma_\omega\,\zeta_k}{F(\bar{\omega})}\cdot(\text{scale})}_{\equiv\,\chi_k}\; \hat{m}_{k,t}.$$

The first term is the *CSV elasticity*: π_d is the elasticity of the default probability with respect to the threshold, evaluated at steady state using the lognormal hazard $f(\bar{\omega})/F(\bar{\omega})$. The second term captures the monitoring-induced volatility compression. The composite χ_k satisfies $\chi_k = \pi_d \cdot \zeta_k \cdot \bar{\omega} \cdot \sigma_\omega \cdot \phi(\Phi^{-1}(F(\bar{\omega})))/f(\bar{\omega})$, where ϕ is the standard normal PDF; we calibrate χ_k directly.

Distress as a threshold proxy. We approximate the log-deviation of the threshold $\hat{\bar{\omega}}_{k,t}$ by the smoothed debt-service ratio $\hat{d}_t$ defined in equation (34). This is justified because $\bar{\omega} \propto R^L B/(R^k QK)$, which in log-deviations is $\hat{R}_t^L + \hat{b}_t - \hat{y}_t$ (the same object that enters the distress equation). Substituting:

$$\hat{p}_{k,t} \;=\; \pi_d\, \hat{d}_t \;-\; \chi_k\, \hat{m}_{k,t}, \tag{30}$$

as stated in the main text.

L.4 Static-Rotemberg Approximation

Dynamic problem. Bank k chooses $R^L_{k,t}$ to minimise the discounted sum of target-deviation and adjustment costs:

$$\min_{\{R^L_{k,s}\}_{s\geq t}} \mathbb{E}_t \sum_{s=t}^{\infty} \beta^{s-t} \Big[\tfrac{1}{2}(R^L_{k,s} - R^{L*}_{k,s})^2 + \tfrac{1}{2}\phi_{L,k}(R^L_{k,s} - R^L_{k,s-1})^2 \Big].$$

The FOC is

$$(R^L_{k,t} - R^{L*}_{k,t}) + \phi_{L,k}(R^L_{k,t} - R^L_{k,t-1}) - \beta\phi_{L,k}\mathbb{E}_t[R^L_{k,t+1} - R^L_{k,t}] = 0.$$

This is a second-order stochastic difference equation in $R^L_{k,t}$.

Static limit. At annual frequency the discount factor $\beta \approx 0.96$ and the rate of mean-reversion of the desired rate are both close to one, making the forward term $\beta\phi_{L,k}\mathbb{E}_t[R^L_{k,t+1} - R^L_{k,t}]$ small relative to the contemporaneous terms (it is $O(\beta\phi_{L,k}(1-\rho_R))$ where ρ_R is the persistence of the policy rate process). Setting the forward term to zero:

$$(R^L_{k,t} - R^{L*}_{k,t}) + \phi_{L,k}(R^L_{k,t} - R^L_{k,t-1}) = 0.$$

Solving for $R^L_{k,t}$:

$$R^L_{k,t} = \frac{\phi_{L,k}}{1+\phi_{L,k}} R^L_{k,t-1} + \frac{1}{1+\phi_{L,k}} R^{L*}_{k,t} \;\equiv\; \rho_{L,k}\, R^L_{k,t-1} + (1-\rho_{L,k})\, R^{L*}_{k,t},$$

with $\rho_{L,k} \equiv \phi_{L,k}/(1+\phi_{L,k})$. An identical argument applies to $R^D_{k,t}$ (with $\phi_{D,k}$ replacing $\phi_{L,k}$, giving $\rho_{D,k}$) and to the lending equation (with γ_L giving ρ_l).

Quantitative validation. For the calibrated $\phi_{L,k} \in \{0.43, 0.54, 0.67\}$ (corresponding to $\rho_{L,k} \in \{0.30, 0.35, 0.40\}$) and $\beta = 0.99$, the omitted forward term is at most $\beta\phi_{L,k}(1-\rho_R) \approx 0.99 \times 0.67 \times 0.20 = 0.13$, compared to $(1+\phi_{L,k}) = 1.67$. The approximation error is therefore at most 8% of the dominant term.

L.5 Proofs of Analytical Results

Proof of Lemma 1. *Immediate from equation (49): $\hat{m}_{k,0} = \rho_m \cdot 0 + \nu_k \hat{\varepsilon}^R_0$, with $\hat{\varepsilon}^R_0 = \sigma_R e^R_0 = \sigma_R > 0$ and $\nu_k > 0$ for all k.* □

Proof of Proposition 1. *From equation (56), $\hat{z}_{k,0} = w_{NIM}\hat{\mu}_{k,0} - w_{loss}\lambda_{LGD}\hat{p}_{k,0} - w_{cost}c_{m,k}\hat{m}_{k,0} + w_{CAR}\widehat{car}_{k,0} + w_{vol,k}\hat{m}_{k,0}$. At $h=0$, $\hat{e}_{k,0} \approx 0$ (equity is a state variable with $\hat{e}_{k,-1} = 0$) and $\hat{l}_{k,0}$ is small (governed by the partial-adjustment parameter ρ_l), so $\widehat{car}_{k,0} \approx 0$. With $w_{cost} = 0$ in the baseline calibration, the cost channel vanishes. Substituting $\hat{p}_{k,0} = \pi_d \hat{d}_0 - \chi_k \hat{m}_{k,0}$ from (30) and $\hat{m}_{k,0} = \nu_k\sigma_R$ from Lemma 1,*

$$\begin{aligned}\hat{z}_{k,0} &\approx w_{NIM}\hat{\mu}_{k,0} - w_{loss}\lambda_{LGD}(\pi_d\hat{d}_0 - \chi_k\nu_k\sigma_R) + w_{vol,k}\nu_k\sigma_R \\ &= \underbrace{(w_{vol,k} + w_{loss}\lambda_{LGD}\chi_k)\nu_k\sigma_R}_{>0 \text{ (stabilising)}} - \underbrace{w_{loss}\lambda_{LGD}\pi_d\hat{d}_0}_{\text{(destabilising if } d_0>0)} + \underbrace{w_{NIM}\hat{\mu}_{k,0}}_{\text{(typically } <0)}.\end{aligned}$$

The stabilising term is increasing in ν_k, χ_k, and $w_{vol,k}$, all of which rise in the cost-efficiency parameter θ_k under Assumption 1. The distress component $\pi_d\hat{d}_0$ is common across types (it depends on the aggregate loan rate and borrower debt, not on θ_k). The NIM component $\hat{\mu}_{k,0}$

is type-specific because banks have different deposit markdowns $\beta^*_{D,k}$ *and loan-rate stickiness* $\rho_{L,k}$. *Higher-efficiency banks have larger* $\beta^*_{D,k}$ *(less deposit market power), so their deposit rate rises more on impact, producing a more negative* $\hat{\mu}_{k,0}$. *However, this makes the destabilising term* $-w_{NIM}\hat{\mu}_{k,0}$ less *negative (smaller in absolute value) for higher-efficiency types. Combining both effects: the left-hand side of* (58) *is strictly increasing in* θ_k *while the right-hand side is non-increasing. Thus if the condition binds for* $k = 25$, *it holds strictly for* $k \in \{50, 75\}$. □

Proof of Proposition 2. *The monitoring response decays geometrically:* $\hat{m}_{k,h} \sim \rho_m^h \nu_k \sigma_R$ *as* $h \to \infty$, *so* $\hat{m}_{k,h} \to 0$. *The stabilising channels—volatility reduction* ($w_{vol,k}\hat{m}_{k,h}$) *and monitoring-induced default reduction* ($w_{loss}\lambda_{LGD}\chi_k\hat{m}_{k,h}$)*—therefore fade to zero at rate* ρ_m.

Meanwhile, the distress state satisfies $\hat{d}_h \approx \rho_d^h \hat{d}_0 + \sum_{j=0}^{h-1} \rho_d^{h-1-j}(1-\rho_d)(\hat{R}^L_j + \hat{b}_j - \hat{y}_j)$. *Since* $\rho_d > \rho_m$, *the distress state decays more slowly than monitoring and remains elevated at horizons where monitoring has already returned to near zero.*

At horizon h *where* $\hat{m}_{k,h} \approx 0$: *(i) the default probability is* $\hat{p}_{k,h} \approx \pi_d \hat{d}_h > 0$ *(monitoring cannot offset distress); (ii) equity has eroded through cumulative ROA losses, so* $\hat{e}_{k,h} < 0$ *and* $\widehat{car}_{k,h} < 0$; *(iii) with* $\omega_e > 0$, *the financial accelerator pushes loan rates higher, deepening distress further. The Z-score becomes*

$$\hat{z}_{k,h} \approx \underbrace{w_{NIM}\hat{\mu}_{k,h}}_{small} - \underbrace{w_{loss}\lambda_{LGD}\pi_d\hat{d}_h}_{>0} + \underbrace{w_{CAR}\widehat{car}_{k,h}}_{<0} + \underbrace{w_{vol,k}\hat{m}_{k,h}}_{\approx 0} < 0.$$

For the ordering $H^*_{25} \le H^*_{50} \le H^*_{75}$: *the stabilising term at any horizon is* $(w_{vol,k} + w_{loss}\lambda_{LGD}\chi_k)\hat{m}_{k,h}$, *which is proportional to* ν_k. *Since* $\nu_{25} < \nu_{50} < \nu_{75}$, *the stabilising term for* $k = 25$ *is the smallest and is overwhelmed by the destabilising channels earliest.* □

Proof of Proposition 3. *Under* $\Theta_{25} = \Theta_{50} = \Theta_{75}$, *the bank-level equations are symmetric: for any two types* k, k', *the monitoring equation* (49) *gives* $\hat{m}_{k,t} = \hat{m}_{k',t}$ *(same* ν *and* ρ_m*), the default equation* (30) *gives* $\hat{p}_{k,t} = \hat{p}_{k',t}$ *(same* χ *and common* $\hat{d}_t$*), and so on through the loan-pricing* (42)*, deposit-pricing* (45)*, ROA* (55)*, equity* (54)*, lending* (47)*, and Z-score* (56) *equations. The linearised system has a unique stable solution (by the BK conditions), and this solution must respect the symmetry. Therefore* $\hat{z}_{25,h} = \hat{z}_{50,h} = \hat{z}_{75,h}$ *for all* h. □

Proof of Proposition 4. *With* $\nu_k = 0$, *equation* (49) *gives* $\hat{m}_{k,h} = 0$ *for all* h *and all* k. *The volatility-reduction channel (v) in* (56) *vanishes:* $w_{vol,k}\hat{m}_{k,0} = 0$. *The default equation* (30) *reduces to* $\hat{p}_{k,0} = \pi_d\hat{d}_0$ *(pure distress, no monitoring offset). The monitoring-cost channel (iii) and the monitoring-induced default reduction both vanish. The impact Z-score simplifies to*

$$\hat{z}_{k,0} \approx w_{NIM}\hat{\mu}_{k,0} - w_{loss}\lambda_{LGD}\pi_d\hat{d}_0 + w_{CAR}\widehat{car}_{k,0}.$$

At $h = 0$, $\widehat{car}_{k,0} \approx 0$ *as before. Under the stated condition* $w_{loss}\lambda_{LGD}\pi_d\hat{d}_0 > w_{NIM}\hat{\mu}_{k,0}$ *(the loss-tail channel dominates the NIM channel),* $\hat{z}_{k,0} < 0$. *Impact stabilisation is therefore entirely a structural consequence of the active risk-management channel* ($\nu_k > 0$). □

Proof of Lemma 2. *Consider two economies identical in all parameters except* ω_e: *economy A with* $\omega_e > 0$ *and economy B with* $\omega_e = 0$. *At* $h = 0$, *the impact responses are similar (the capital ratio* $\widehat{car}_{k,0} \approx 0$, *so* $-\omega_e\widehat{car}_{k,0} \approx 0$*). At* $h = 1$, *equity has fallen* ($\hat{e}_{k,1} < 0$) *through ROA losses, so* $\widehat{car}_{k,1} < 0$. *In economy A, the loan-pricing equation* (41) *adds* $-\omega_e\widehat{car}_{k,1} > 0$ *to the desired loan rate, while in economy B this term is absent. The higher loan rate in A feeds into the distress equation* (34) *(through* $\hat{R}^L_t$*), raising* $\hat{d}_{t+1}$, *which increases default* (30)*, reduces ROA* (55)*, and further erodes equity* (54)*. This positive-feedback loop—absent in economy B—strictly amplifies* *the cumulative decline in $\hat{e}_{k,h}$, $\widehat{car}_{k,h}$, and $\hat{z}_{k,h}$ for all $h \geq 1$. The medium-horizon Z-score trough* $\min_h \hat{z}_{k,h}$ *is therefore strictly deeper in economy A.* □

L.6 Bank First-Order Conditions: Derivation

This section derives all five FOCs of the bank's problem stated in Section 6.3. The bank of type k solves

$$V_{k,t} = \max_{\{R^L_{k,s}, R^D_{k,s}, L_{k,s}, m_{k,s}, \text{Div}_{k,s}\}} \mathbb{E}_t \sum_{j=0}^{\infty} \Lambda_{t,t+j} \, \text{Div}_{k,t+j},$$

subject to the constraints (i)–(vii) in (39). Dividends are residual: $\text{Div}_{k,t} = \Pi^B_{k,t} L_{k,t-1} - (E_{k,t} - (1-\delta_e)E_{k,t-1})$, where $\Pi^B_{k,t}$ is per-loan profit (36).

Dividend FOC. Differentiating with respect to $\text{Div}_{k,t}$ and using the equity constraint $E_{k,t} \geq \bar{\kappa} L_{k,t}$ with multiplier $\xi_{k,t}$:

$$\Lambda_{t,t} + \xi_{k,t} \cdot \frac{\partial E_{k,t}}{\partial \text{Div}_{k,t}} = 0 \implies \xi_{k,t} = \Lambda_{t,t} = 1,$$

since higher dividends reduce equity one-for-one ($\partial E_{k,t}/\partial \text{Div}_{k,t} = -1$). This pins down $\bar{\xi}_k = 1$ when the capital constraint is binding in steady state. When the constraint is slack, $\bar{\xi}_k = 0$ by complementary slackness; in the linearised system we treat the constraint as binding at the margin, so that $\hat{\xi}_{k,t}$ varies with the capital gap $\widehat{car}_{k,t}$, giving rise to the ω_e term in the loan-pricing FOC below.

Loan-pricing FOC. Differentiating with respect to $R^L_{k,t}$:

$$\mathbb{E}_t \Lambda_{t,t+1} \frac{\partial \Pi^B_{k,t+1}}{\partial R^L_{k,t}} L_{k,t} + \frac{\partial L_{k,t}}{\partial R^L_{k,t}} \Big[\mathbb{E}_t \Lambda_{t,t+1} \Pi^B_{k,t+1} - \xi_{k,t} \bar{\kappa} \Big] - \phi_{L,k}(R^L_{k,t} - R^L_{k,t-1}) = 0.$$

From CES loan demand $L_{k,t} = (R^L_{k,t}/R^L_t)^{-\epsilon_L} L_t$, $\partial L_{k,t}/\partial R^L_{k,t} = -\epsilon_L L_{k,t}/R^L_{k,t}$. The per-loan profit derivative is $\partial \Pi^B_{k,t+1}/\partial R^L_{k,t} = (1 - \lambda_{LGD}\bar{p}_k)$. Evaluating at steady state and rearranging:

$$\bar{R}^L_k (1 - \lambda_{LGD} \bar{p}_k) = \frac{\epsilon_L}{\epsilon_L - 1} \Big[(1-\bar{\kappa})\bar{R}^D_k + \bar{\kappa}\bar{R}^E + \bar{c}^m_k + \bar{\xi}_k \bar{\kappa} \Big],$$

Linearising, the desired rate $R^{L*}_{k,t}$ deviates from steady state as:

$$\hat{R}^{L*}_{k,t} = \hat{R}_t + \underbrace{\frac{\epsilon_L}{\epsilon_L - 1} \lambda_{LGD}}_{\omega_p} \hat{p}_{k,t} + \underbrace{\frac{\bar{c}^m_k}{\bar{R}^L_k(1 - \lambda_{LGD}\bar{p}_k)}}_{\omega_m} \hat{m}_{k,t} - \underbrace{\frac{\bar{\xi}_k \bar{\kappa}}{\bar{R}^L_k(1 - \lambda_{LGD}\bar{p}_k)}}_{\omega_e} \widehat{car}_{k,t}. \tag{L.1}$$

where $\overline{MR} \equiv \bar{R}^L_k(1 - \lambda_{LGD}\bar{p}_k)$ is the steady-state marginal revenue per loan. In the implemented model, the ω_e term loads on the *deviation* of bank k's capital ratio from the cross-sectional average, $\widehat{car}_{k,t} - \widehat{car}_{\text{avg},t}$ (where $\widehat{car}_{\text{avg},t} \equiv \frac{1}{3}\sum_j \widehat{car}_{j,t}$). This deviation-based formulation ensures that under homogeneous efficiency—when all types have identical parameters and hence $\widehat{car}_{k,t} = \widehat{car}_{\text{avg},t}$—the ω_e term vanishes identically and the zero-gap result (Proposition 3) holds without any additional parameter restrictions. Under heterogeneity, a bank whose capital ratio is below the sector average faces a higher shadow cost and charges a higher loan rate. The Rotemberg partial-adjustment law (42) then gives $\hat{R}^L_{k,t} = \rho_{L,k}\hat{R}^L_{k,t-1} + (1-\rho_{L,k})\hat{R}^{L*}_{k,t}$.

Deposit-pricing FOC (Drechsler). From the household's CES deposit aggregator (21), the deposit supply to bank k is $D_{k,t} = \omega_k (R^D_{k,t}/R^D_t)^{\eta_{D,k}} D_t$. The bank chooses $R^D_{k,t}$ facing this supply curve plus the equity constraint, with adjustment cost $(\phi_{D,k}/2)(R^D_{k,t} - R^D_{k,t-1})^2$. The FOC is:

$$-L_{k,t} \cdot (1 - \bar{\kappa}) + \eta_{D,k} \frac{D_{k,t}}{R^D_{k,t}} \Big[\mathbb{E}_t \Lambda_{t,t+1} \Pi^B_{k,t+1} - \xi_{k,t} \bar{\kappa} \Big] - \phi_{D,k} (R^D_{k,t} - R^D_{k,t-1}) = 0.$$

At steady state with $D_k = (1 - \bar{\kappa}) L_k$ (from the balance sheet):

$$\bar{R}^{D*}_k = \frac{\eta_{D,k}}{\eta_{D,k} + 1} \bar{R} \;\equiv\; \beta^*_{D,k} \bar{R}.$$

The markdown $\beta^*_{D,k} < 1$ reflects deposit market power: banks with larger $\eta_{D,k}$ (more elastic depositors, typically associated with higher efficiency θ_k) have a smaller markdown. Linearising and applying the Rotemberg partial-adjustment:

$$\hat{R}^D_{k,t} = \rho_{D,k} \hat{R}^D_{k,t-1} + (1 - \rho_{D,k}) \beta^*_{D,k} \hat{R}_t.$$

Lending FOC. Differentiating with respect to $L_{k,t}$:

$$\mathbb{E}_t [\Lambda_{t,t+1} \Pi^B_{k,t+1}] - \xi_{k,t} \bar{\kappa} - \gamma_L (L_{k,t} - L_{k,t-1}) = 0.$$

Linearising $\mathbb{E}_t[\Lambda_{t,t+1}\Pi^B_{k,t+1}]$ around steady state, substituting the ROA expression (55), and using the capital-constraint slackness condition $\hat{\xi}_{k,t} \bar{\kappa} \approx a_e^{-1} (\hat{l}_{k,t} - a_e \hat{e}_{k,t})$:

$$\hat{l}_{k,t} = \rho_l \hat{l}_{k,t-1} + (1 - \rho_l) [a_e \hat{e}_{k,t} - a_{r,k} \hat{R}^L_{k,t} + a_y \hat{y}_t - a_{m,k} \hat{m}_{k,t}], \tag{L.2}$$

where the composite coefficients are:

$\rho_l = \gamma_L / (1 + \gamma_L)$	(portfolio adjustment ratio),
$a_e \approx 1/\bar{\kappa}$	(equity semi-elasticity; $= 1/\bar{\kappa}$ when constraint binds tightly),
$a_{r,k} = \epsilon_L \cdot \bar{R}^L_k \bar{L}_k / (\bar{\Pi}^B \bar{L})$	(CES loan-demand elasticity $\times$ steady-state share),
$a_y = \bar{Y} \cdot \partial \bar{L} / \partial \bar{Y} / \bar{L}$	(output elasticity of loan demand),
$a_{m,k} = (\partial \bar{c}^m_k / \partial \bar{m}_k) \cdot \bar{L}_k / (\bar{\Pi}^B \bar{L})$	(monitoring→credit-standards loading).

In the calibration, a_e and a_y are treated as common; $a_{r,k}$ and $a_{m,k}$ are type-specific (estimated in the MD exercise).

Risk-management (monitoring) FOC. Differentiating with respect to $m_{k,t}$, using $\partial p_{k,t} / \partial m_{k,t} = -\chi_k / (1 + \zeta_k)$ from the CSV algebra (Appendix L.3), and incorporating the risk-taking channel (the marginal benefit of monitoring rises with the monetary shock because the bank's exposure to the risky asset increases):

$$\lambda_{LGD} \chi_k (1 + \eta \varepsilon^R_t) \bar{R}^L_k \bar{L}_k - \frac{\kappa_m}{\theta_k} m_{k,t} - \frac{\varphi_m}{\theta_k} (m_{k,t} - m_{k,t-1}) = 0,$$

where $\eta > 0$ is the risk-taking elasticity—the percentage increase in the marginal return to monitoring per unit of the policy surprise. Linearising:

$$\hat{m}_{k,t} = \rho_m \hat{m}_{k,t-1} + \nu_k \hat{\varepsilon}_t^R,$$
$$\rho_m \equiv \varphi_m / (\kappa_m + \varphi_m),$$
$$\nu_k \equiv \lambda_{LGD} \eta \theta_k \chi_k \bar{R}_k^L \bar{L}_k / [(\kappa_m + \varphi_m)\bar{m}_k].$$

Cost efficiency enters through θ_k (lower monitoring costs), χ_k (more effective monitoring technology), and $\bar{m}_k$ (higher steady-state monitoring). All three raise ν_k, delivering the efficiency ordering in Assumption 1.

L.7 Z-Score Decomposition: Weights and Accounting

Empirical Z-score definition. The empirical Z-score is $Z_{k,t} \equiv (\text{ROA}_{k,t} + \text{CAR}_{k,t})/\sigma(\text{ROA}_{k,t})$, where $\sigma(\text{ROA})$ is the rolling standard deviation of ROA.

Steady-state decomposition. In steady state, $\bar{Z}_k = (\overline{\text{ROA}}_k + \bar{\kappa})/\bar{\sigma}_k$. The per-unit ROA is $\overline{\text{ROA}}_k = \bar{R}_k^L(1 - \lambda_{LGD}\bar{p}_k) - (1 - \bar{\kappa})\bar{R}_k^D - \bar{c}_k^m \bar{m}_k$. Define the steady-state ROA shares:

$$s_{\text{NIM}} \equiv \bar{\mu}_k / \overline{\text{ROA}}_k, \qquad s_{\text{loss}} \equiv \lambda_{LGD} \bar{p}_k \bar{R}_k^L / \overline{\text{ROA}}_k, \qquad s_{\text{cost}} \equiv \bar{c}_k^m \bar{m}_k / \overline{\text{ROA}}_k.$$

First-order expansion. Taking a first-order Taylor expansion of $Z_{k,t}$ around the steady state and using $\hat{Z}_{k,t} \equiv (Z_{k,t} - \bar{Z}_k)/\bar{Z}_k$:

$$\hat{Z}_{k,t} = \frac{1}{\bar{\sigma}_k}\left[\frac{\partial \text{ROA}_k}{\partial \mu_k}\hat{\mu}_{k,t} + \frac{\partial \text{ROA}_k}{\partial p_k}\hat{p}_{k,t} + \frac{\partial \text{ROA}_k}{\partial m_k}\hat{m}_{k,t} + \frac{\partial \text{CAR}_k}{\partial (e_k - l_k)}\widehat{car}_{k,t}\right] - \frac{\bar{Z}_k}{\bar{\sigma}_k}\frac{\partial \sigma_k}{\partial m_k}\hat{m}_{k,t}.$$

Evaluating the partial derivatives:

$$\frac{\partial \text{ROA}_k}{\partial \mu_k} = 1 \implies w_{\text{NIM}} = 1/\bar{\sigma}_k,$$
$$\frac{\partial \text{ROA}_k}{\partial p_k} = -\lambda_{LGD} \implies w_{\text{loss}} = \lambda_{LGD}/\bar{\sigma}_k,$$
$$\frac{\partial \text{ROA}_k}{\partial m_k} = -c_{m,k} \implies w_{\text{cost}} = c_{m,k}/\bar{\sigma}_k,$$
$$\frac{\partial \text{CAR}_k}{\partial (e_k - l_k)} = 1 \implies w_{\text{CAR}} = 1/\bar{\sigma}_k.$$

For the volatility channel, $\sigma_{\omega,k}(m) = \sigma_\omega \exp(-\zeta_k m_{k,t})$ implies $\partial \sigma_k / \partial m_k = -\zeta_k \bar{\sigma}_k$ (to first order), so:

$$w_{\text{vol},k} = \bar{Z}_k \cdot \zeta_k \equiv \bar{Z}_k \cdot \zeta_{\sigma,k}.$$

The volatility-channel weight is type-specific because ζ_k (monitoring-to-volatility elasticity) rises in cost efficiency.

Calibration mapping. In the empirical data, the Z-score averages around $\bar{Z} \approx$ 20–30 and the ROA standard deviation is $\bar{\sigma} \approx$ 0.01–0.02. The weight $w_{\text{NIM}} = 1/\bar{\sigma}$ would then be 50–100. We re-scale the weights to match the observed relative contributions of each channel in the LP IRFs (flow margin contributes about 15% of the impact Z-score response, losses about 80%, capital about 5%), giving the calibrated values $w_{\text{NIM}} = 0.15$, $w_{\text{loss}} = 1.80$, $w_{\text{CAR}} = 0.10$. The re-scaling is equivalent to normalising $\bar{\sigma}$ to absorb the data aggregation and smoothing effects inherent in the annual-frequency empirical Z-score.

L.8 Equity Accumulation Derivation

The nonlinear equity law of motion is

$$E_{k,t} = (1-\delta_e)E_{k,t-1} + (1-\delta_{div})\Pi^B_{k,t}L_{k,t-1} - \mathrm{Div}_{k,t},$$

where δ_e is the equity erosion rate (depreciation of retained earnings), δ_{div} is the dividend-payout ratio, $\Pi^B_{k,t}$ is per-loan profit (36), and dividends are set to keep the equity ratio near the capital requirement (the Div FOC in Appendix L.6).

In steady state, $\bar{E}_k = \bar{\kappa}\bar{L}_k$ (binding capital constraint), $\overline{\mathrm{Div}}_k = (1-\delta_{div})\bar{\Pi}^B\bar{L}_k - \delta_e\bar{E}_k$, and the accumulation is zero. Log-linearising around steady state and substituting $\hat{\mathrm{Div}}_{k,t}$ from the Div FOC:

$$\begin{aligned}\hat{e}_{k,t} &= (1-\delta_e)\hat{e}_{k,t-1} + \frac{(1-\delta_{div})\bar{\Pi}^B}{\bar{\kappa}}\hat{\mathrm{roa}}_{k,t}\\ &\equiv \rho_e\hat{e}_{k,t-1} + \phi_e\hat{\mathrm{roa}}_{k,t},\end{aligned}$$

with $\rho_e = 1-\delta_e$ and $\phi_e = (1-\delta_{div})\bar{\Pi}^B/\bar{\kappa}$. The rescaling by $1/\bar{\kappa}$ arises because equity is a fraction $\bar{\kappa}$ of lending, so small changes in ROA are amplified in percentage terms relative to the equity base.

L.9 NPL Dynamics: Markov Hazard Derivation

Nonlinear Markov model. Each loan in bank k's portfolio transitions between two states: Performing (P) and Non-Performing (NPL). The hazard rates are:

$$\begin{aligned}\text{P} \to \text{NPL}: \quad & h^{PN}_t = \pi_{PN}\exp(\delta_{PN}\hat{d}_t) && \text{(distress raises inflow)},\\ \text{NPL} \to \text{Resolved}: \quad & h^{NP}_{k,t} = \pi_{NP,k}\exp(\delta_{NP}\hat{m}_{k,t}) && \text{(monitoring speeds resolution)}.\end{aligned}$$

The base hazards π_{PN} and $\pi_{NP,k}$ are steady-state values; δ_{PN} and δ_{NP} are the semi-elasticities of the hazards to distress and monitoring, respectively.

Steady-state NPL stock. In steady state, inflows equal outflows: $\pi_{PN}(\bar{L}_k - \overline{NPL}_k) = \pi_{NP,k}\overline{NPL}_k$. Solving:

$$\overline{NPL}_k = \frac{\pi_{PN}}{\pi_{PN}+\pi_{NP,k}}\bar{L}_k.$$

High-efficiency banks have larger $\pi_{NP,k}$ (faster NPL resolution), hence lower steady-state NPL ratios.

Linearisation. The NPL stock evolves as $NPL_{k,t} = (1-h^{NP}_{k,t})NPL_{k,t-1} + h^{PN}_t(L_{k,t-1} - NPL_{k,t-1})$. Taking a first-order expansion around steady state and expressing in log-deviations:

$$\begin{aligned}\widehat{npl}_{k,t} = &\underbrace{\left[1-\pi_{NP,k} - \pi_{PN}(\bar{L}_k/\overline{NPL}_k - 1)\right]}_{\rho_{npl,k}}\widehat{npl}_{k,t-1}\\ &+ (1-\rho_{npl,k})\left[\underbrace{\frac{\delta_{PN}\pi_{PN}}{\pi_{PN}+\pi_{NP,k}}}_{\iota_d}\hat{d}_t - \underbrace{\frac{\delta_{NP}\pi_{NP,k}}{\pi_{PN}+\pi_{NP,k}}}_{\iota_{m,k}}\hat{m}_{k,t}\right].\end{aligned}$$

The inflow loading ι_d is common across types (distress is aggregate); the resolution loading $\iota_{m,k}$ is type-specific because $\pi_{NP,k}$ varies with efficiency.

L.10 Borrower Debt-Rollover Problem

Nonlinear problem. The representative borrower chooses new borrowing NB_t to maximise the discounted expected net worth

$$\max_{NB_t} \mathbb{E}_t \sum_{j=0}^{\infty} \beta_B^j \Big[\omega_{i,t+j} R^k_{t+j} Q_{t+j-1} K_{t+j-1} - R^L_{t+j-1} B_{t+j-1} + NB_{t+j}\Big],$$

subject to the budget constraint $B_t = (1-\delta_b)B_{t-1} + NB_t$ and a borrowing limit tied to expected income. The FOC equates the marginal cost of an additional unit of debt (the expected future repayment R^L_t) to the marginal benefit (current consumption smoothing plus the return on investment funded by the borrowing).

Linearisation. At the optimum, new borrowing responds positively to income and negatively to the loan rate. Linearising around steady state:

$$\hat{b}_t = (1-\delta_b)\hat{b}_{t-1} + \delta_b(\eta_y \hat{y}_t - \eta_R \hat{R}^L_t),$$

where η_y and η_R are the income and rate semi-elasticities of the borrower's debt-Euler condition. At the baseline calibration ($\eta_y = \eta_R = 1$) these are normalised to unity, implying a unit-elastic response of new borrowing to both income and the cost of funds.

Distress equation. Borrower distress is a smoothed debt-service ratio:

$$\hat{d}_t = \rho_d \hat{d}_{t-1} + (1-\rho_d)(\hat{R}^L_t + \hat{b}_t - \hat{y}_t) - \phi_{\Delta\ell}\bar{\ell}_{t-1},$$

where $\hat{R}^L_t + \hat{b}_t - \hat{y}_t$ is the log-deviation of the debt-service ratio and ρ_d controls the smoothing (a higher ρ_d means distress accumulates more slowly but is more persistent).

The credit-crunch term $\phi_{\Delta\ell}\bar{\ell}_{t-1}$ is a disciplined reduced-form proxy for the effect of aggregate credit availability on borrower refinancing. A fully microfounded version would model the borrower's refinancing decision explicitly: when banks contract lending, some borrowers cannot roll over maturing debt and must service it from current income, raising the effective debt-service burden. The lagged (not contemporaneous) specification avoids simultaneity while capturing the one-period propagation delay between bank balance-sheet decisions and borrower distress.

L.11 Financial Accelerator: Feedback-Loop Algebra

This section formalises the amplification mechanism created by the capital-constraint feedback parameter $\omega_e > 0$.

The feedback loop. Consider the chain of effects following a monetary tightening at $h = 0$:

(i) **NIM compression**: $\hat{R}^L_{k,0}$ rises less than $\hat{R}^D_{k,0}$ (the deposit-franchise cushion only partially absorbs the funding-cost increase), so $\hat{\mu}_{k,0} < 0$.

(ii) **ROA decline**: $\widehat{\text{roa}}_{k,1} = \hat{R}^L_{k,1} - \lambda_{LGD}\hat{p}_{k,1} - (1-\bar{\kappa})\hat{R}^D_{k,1} - c_{m,k}\hat{m}_{k,1} < 0$ (NIM compression and rising default costs).

(iii) **Equity erosion**: $\hat{e}_{k,1} = \rho_e \hat{e}_{k,0} + \phi_e \widehat{\text{roa}}_{k,1} < 0$ (since $\widehat{\text{roa}}_{k,1} < 0$ and $\hat{e}_{k,0} \approx 0$).

(iv) **Capital ratio falls**: $\widehat{car}_{k,1} = \hat{e}_{k,1} - \hat{l}_{k,1} < 0$ (equity fell; lending may also contract, but equity falls faster for small ϕ_e).

(v) **Loan rate rises further**: From (L.1), $\hat{R}^{L*}_{k,2}$ includes $-\omega_e \widehat{car}_{k,1} > 0$.

(vi) **Distress deepens**: The higher loan rate feeds into (34), raising $\hat{d}_{t+1}$.

(vii) **Default rises**: $\hat{p}_{k,t+1} = \pi_d \hat{d}_{t+1} - \chi_k \hat{m}_{k,t+1}$, with $\hat{d}_{t+1}$ elevated and $\hat{m}_{k,t+1}$ decaying.

(viii) **Return to (ii)**: Higher default reduces ROA further, restarting the loop.

Amplification multiplier (approximate). To see the magnitude, consider a simplified static version where the equity-lending-capital-rate feedback operates within one period. Write the steady-state-deviation capital ratio as $\widehat{car} = \hat{e} - \hat{l}$, with $\hat{e} = \phi_e \text{rôa}$ and $\hat{l} \approx -a_{r,k}(1-\rho_{L,k})\omega_e \widehat{car}$ (lending contracts in response to the higher rate). Substituting:

$$\widehat{car} = \phi_e[\hat{R}^L - \lambda_{LGD}\hat{p} - (1-\bar{\kappa})\hat{R}^D - c_m \hat{m}] + a_{r,k}(1-\rho_{L,k})\omega_e \widehat{car}.$$

Collecting terms in $\widehat{car}$:

$$\widehat{car} \cdot [1 - a_{r,k}(1-\rho_{L,k})\omega_e] = \phi_e[\cdots].$$

The amplification multiplier is

$$\mathcal{A} \equiv \frac{1}{1 - a_{r,k}(1-\rho_{L,k})\omega_e}.$$

For the calibrated values $a_{r,k} \approx 0.25$, $(1-\rho_{L,k}) \approx 0.65$, $\omega_e \approx 0.47$: $\mathcal{A} \approx 1/(1-0.076) \approx 1.08$. The financial accelerator amplifies the capital-ratio decline by roughly 8% per period—modest in any single period but cumulative over the medium horizon ($\mathcal{A}^5 \approx 1.47$ after five periods), which accounts for the deeper Z-score trough in the estimated model.

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