BANK FOR INTERNATIONAL SETTLEMENTS

Macroprudential policy and bank risk

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Roadmap

- Motivation
- Literature review
- Empirical strategy and data
- Results
- Conclusions

Motivation

- Widely accepted definition, "*Macroprudential policies are designed to identify and mitigate risks to systemic stability, in turn reducing the cost to the economy from a disruption in financial services that underpin the workings of financial markets - such as the provision of credit, but also of insurance and payment and settlement services*" (FSB/IMF/BIS, 2009)
- Goal is systemic risk. So far literature has focused on the effects on bank lending or non performing loans (intermediate targets)

- Novelty of this paper:
  - comprehensive analysis of the effects of macroprudential tools on bank risk exploiting cross-sectional differences among countries

Use of macroprudential instruments

Type of instrument	Total measures	Frequency of use (percent)	Tightening measures	Loosening measures
	(1)	(2)	(3)	(4)
a. Capital based instruments	178	17.0	148	30
Capital requirement/Risk weights (RW)	127	12.1	108	19
Provisioning requirement (Prov)	51	4.9	40	11
b. Liquidity based instruments				
Liquidity requirements (Liq)	64	6.1	26	38
c. Asset side instruments	207	19.8	146	61
Credit growth limits (Credit)	51	4.9	31	20
Maximum debt-service-to-income ratio and other lending criteria (DSTI)	36	3.4	31	5
Limits on banks' exposure to the housing sector	11	1.1	7	4
Maximum loan-to-value ratio and loan prohibition (LTV)	109	10.4	77	32
d. Reserve requirement (RR)	558	53.3	278	280
e. Currency instruments	40	3.8	29	11
Net open position (NOP)	26	2.5	17	9
Foreign currency lending limits (FCL)	14	1.3	12	2
Total	*1047*	*100*	*627*	*420*

Notes: The table shows the number of policy actions taken by the countries in the sample. Frequency of use in column (2) indicates the share of each policy action among the total in column (1).

Challenges

- [1] The evaluation of the effectiveness of macroprudential policies, especially when more than one tool is activated
- [2] The varied nature of macroprudential objectives and instruments. There is no one-size-fits-all approach.
- [3] Most of the macroprudential policies aim at containing systemic risk that is by nature endogenous
  - Ideally the focus should be on how these policies influence a bank's contribution to systemic-wide risk

Literature review

Literature review (1)

- DTI ratios and, probably to a lesser extent, LTV ratios are relatively more effective than capital req as tools for containing asset growth
  Claessens et al (2013); Kuttner and Shim (2012)
- MPP tightening is associated with lower bank credit growth and house price inflation
  Bruno, Shim and Shin (2016), Cerutti, et al. (2015); Akinci and Olmstead-Rumsey (2015), Lim et al (2011), Arregui et al (2012)
- Lower effects in financially more developed and open economies
  Cerutti, et al. (2015)
- Evidence of leakages to the shadow banking sector and cross-border
  Cizel et al (2016), Reinhart and Sowerbutts (2015), Buch and Goldberg (2016), Aiyar et al (2014)
- Introduction of CCB had little impact on credit extension although it had some effect on mortgage pricing
  Basten and Koch (2015); Gambacorta and Drehmann (2012)

Literature review (2)

- Reserve requirements can affect broader credit conditions and played a complementary role to monetary policy
  Tovar et al (2012); Lim et al (2011)
- Risk taking channel of monetary policy: Monetary policy conditions may affect financial stability
  Borio and Zhu (2012), Adrian and Shin (2014), Altunbas et al (2014); Jimenez et al (2012)
- *Complements or substitutes?* DSGE and empirical findings support that MPP and MP are more complements than substitutes but it depends on the type of shock
  Agenor Pereira da Silva (2012); IMF (2013)
- Recent empirical evidence for Asian economies suggests that macroprudential policies tend to be more successful when they complement monetary policy by reinforcing monetary tightening rather than when they act in the opposite direction
  Bruno, Shim and Shin (2016)

Empirical strategy and data

Empirical Strategy

Baseline model adapted from Altunbas et al (2014, IJCB):

$$\Delta Risk_{i,k,t} = \alpha \Delta Risk_{i,k,t-1} + \beta \Delta EDF\_NF_{k,t} + \gamma MP_{k,t} + \psi\, MC_{k,t} + \lambda BSC_{i,k,t-1} + \delta\, MP_{k,t} * BSC_{i,k,t-1} + \theta_i + \varepsilon_{i,k,t}$$

where *i* is the bank, *k* is the country and *t* is time.

$\Delta Risk$= annual change of risk measure

$\Delta EDF\_NF = EDF$ change for the non-financial sector

MP= change in macroprudential tool (+1 tight; -1 easy)

MC= macro controls (GDP, monetary policy stance)

BCS= bank-specific characteristics (liq, cap, size, dep)

Data

- Moody's KMV / BankScope / IMF / OECD
- 1990-2012
- 3,177 banks operating in 61 countries

Endogeneity issues

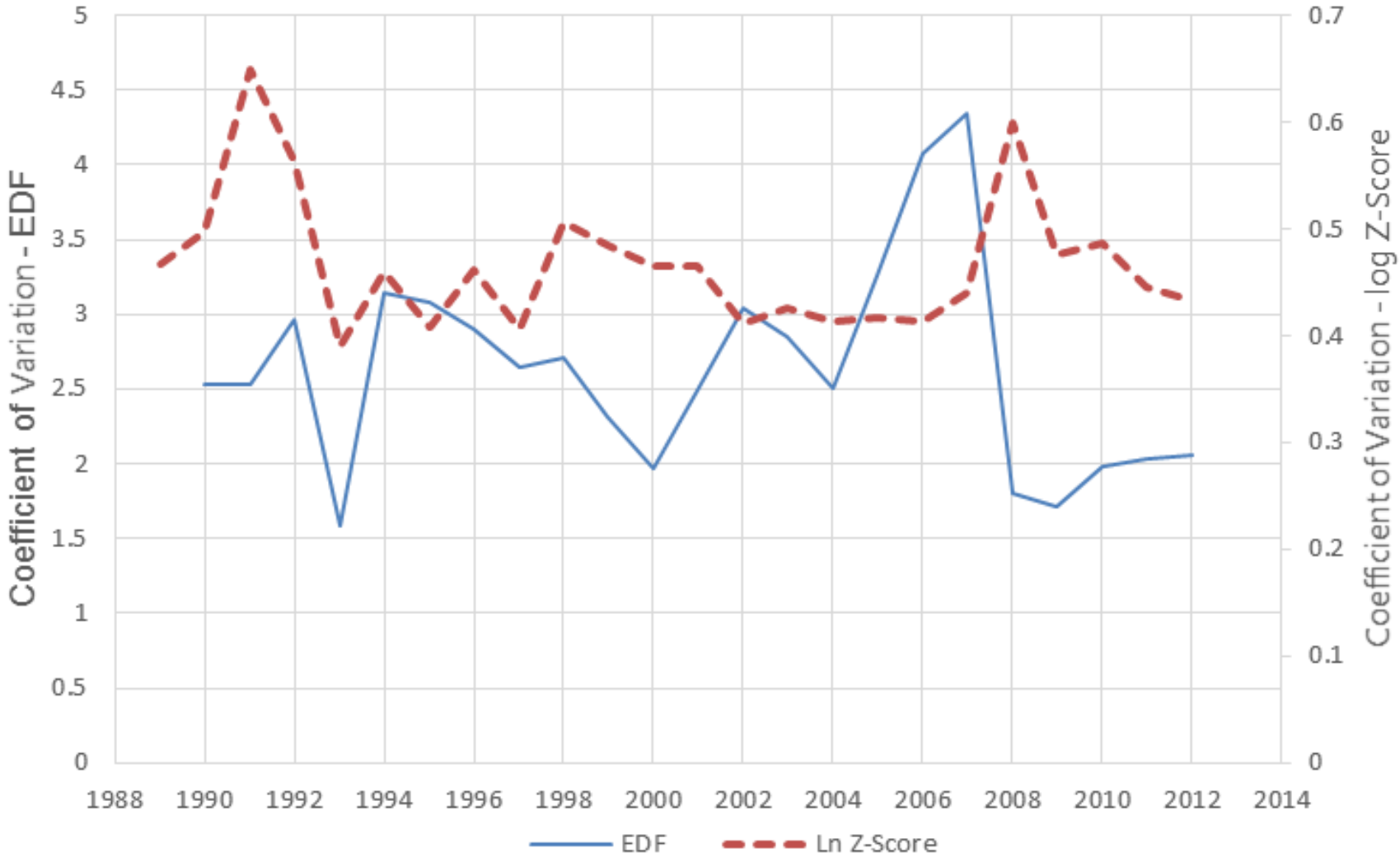
- GMM
- Bank-specific characteristics in t-1

Measurement of bank risk

1. Δ*EDF:* probability that a bank will default within one year. Computed by Moody's KMV, which builds on Merton's model to price corporate bond debt (Merton, 1974)

2. ΔZ-score: $Z=(k+ROA)/\sigma_{ROA}$, where k is equity capital as percent of assets, ROA is average after-tax return as percent on assets, and σ_{ROA} is standard deviation of the after-tax return on assets, as a proxy for return volatility

Cross-sectional dispersion of bank risk measures



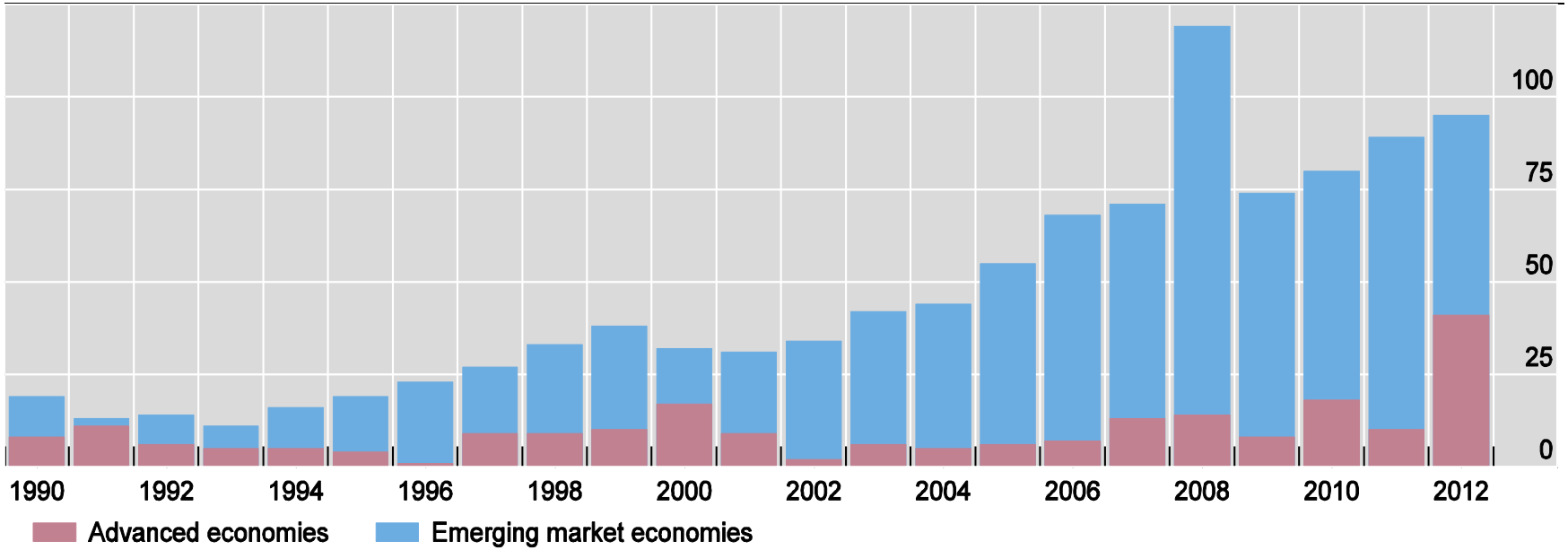
Balance sheet characteristics and bank risk profile(1)

	Lending	Size	Liquidity	Capitalization	Cost to income ratio	ROA	EDF
	(annual growth rate)	(USD mill.)	(% total assets)	(% total assets)	(%)	(%)	(%)
Full Sample							
High-risk banks	5.085	15.551	15.523	13.460	73.425	0.312	7.356
Low-risk banks	14.268	16.251	17.923	16.995	58.835	2.588	0.070
Advance Economies							
High-risk banks	2.253	15.796	14.557	12.208	74.378	0.086	8.005
Low-risk banks	14.024	16.295	17.674	15.868	59.409	2.352	0.060
Emerging Economies							
High-risk banks	13.134	14.849	18.290	17.051	70.751	0.961	5.494
Low-risk banks	17.183	15.749	20.730	29.714	52.396	5.251	0.182

Note: (1) A low-risk bank has an average ratio of the *EDF* in the first decile of the distribution by bank risk; a high-risk bank an average EDF in the last decile.

Macroprudential measures over time[(1)]

Number of macroprudential policy actions



[1] The sample covers 1,047 macroprudential policy actions adopted in 64 countries (29 advanced and 35 emerging market economies). The database has been constructed using information in Kuttner and Shim (2013) and Lim et al (2011, 2013).
Sources: IMF; BIS.

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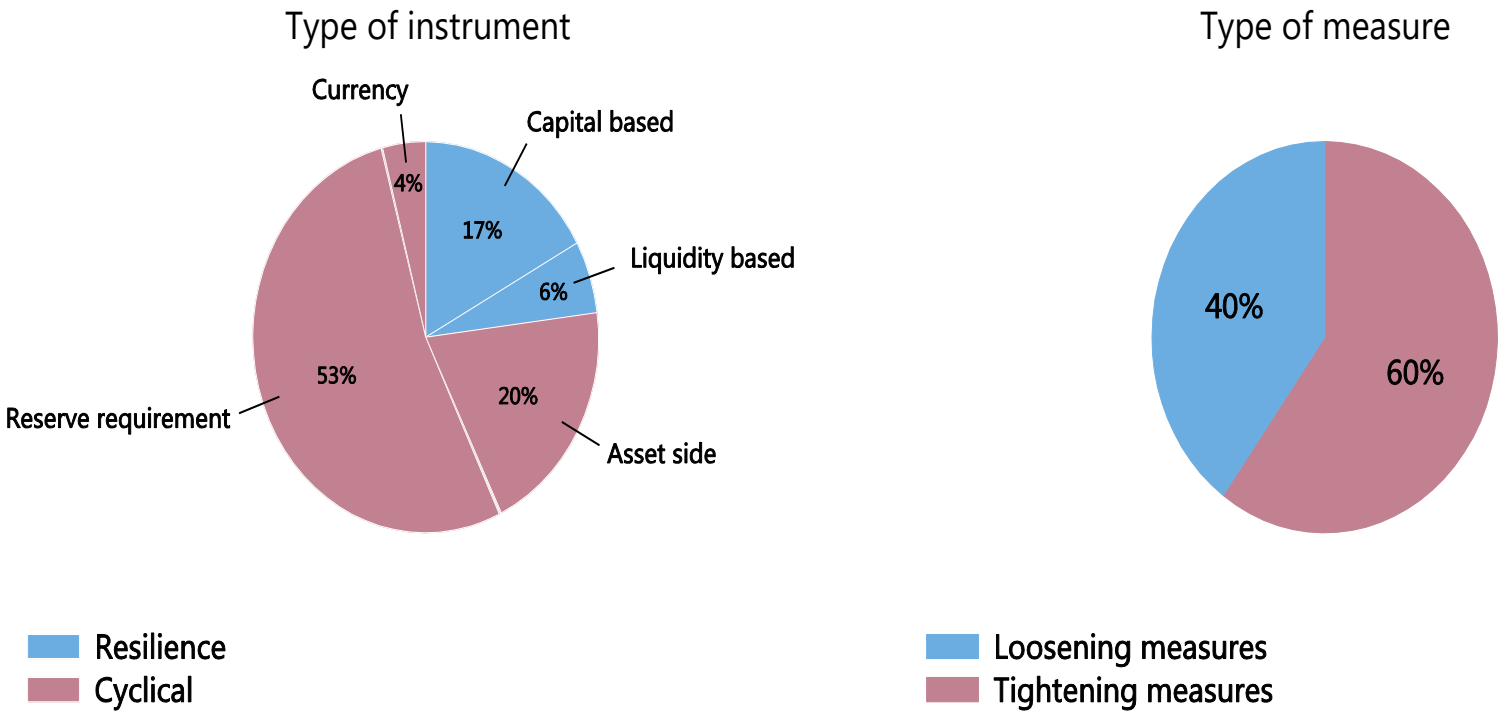
Different kinds of macroprudential policies

In percent



Note: Resilience macroprudential tools include: a) capital based instruments (countercyclical capital requirements, leverage restrictions, general or dynamic provisioning) and b) the establishment of liquidity requirements. Cyclical macroprudential tools consider: c) asset side instruments (credit growth limits, maximum debt service-to-income ratio, limits to banks' exposures to the housing sector as maximum loan to value ratio); d) changes in reserve requirements; e) currency instruments (variations in limits on foreign currency exchange mismatches and net open positions).

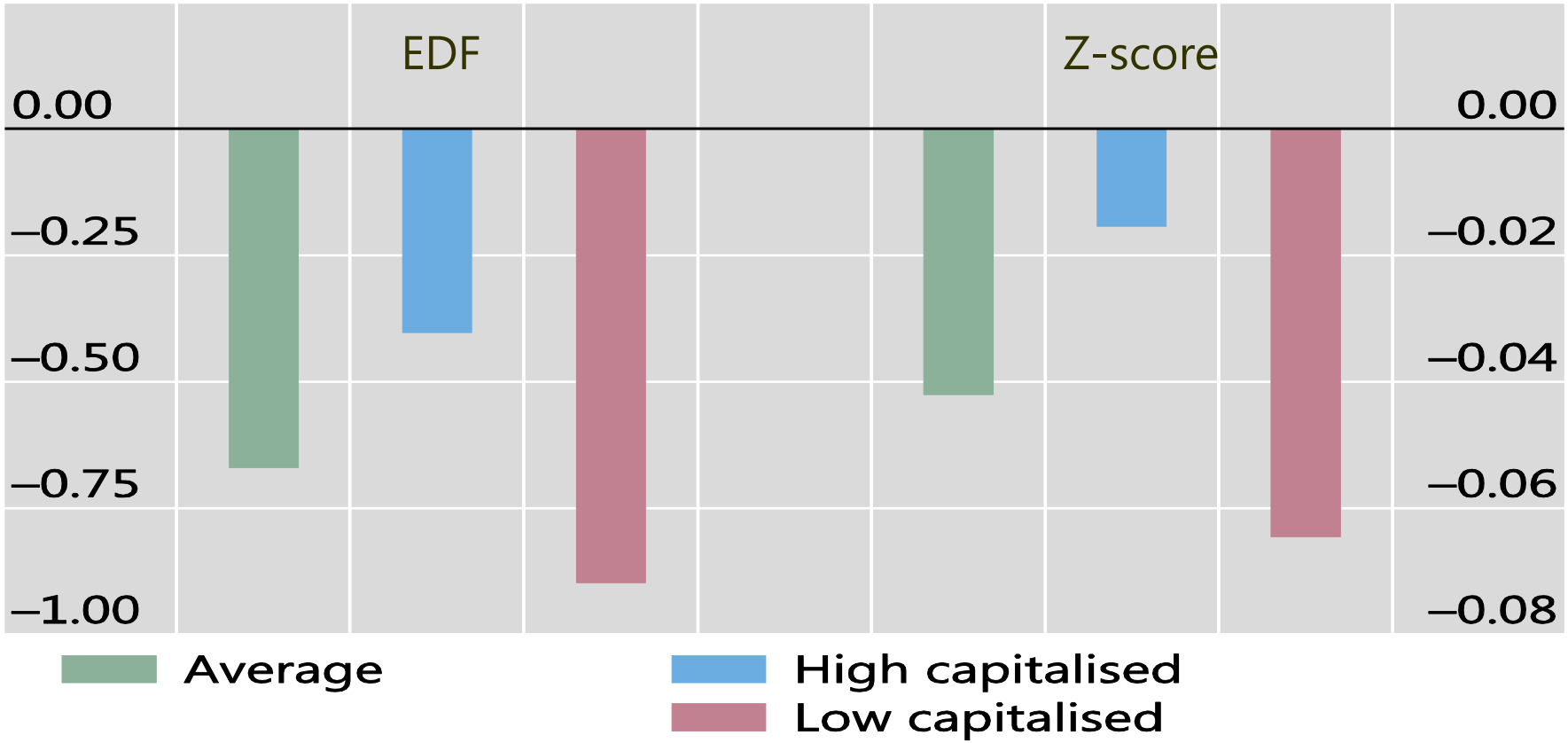
Source: IMF, BIS, authors' calculations.

Results

Baseline regression with aggregate macroprudential index

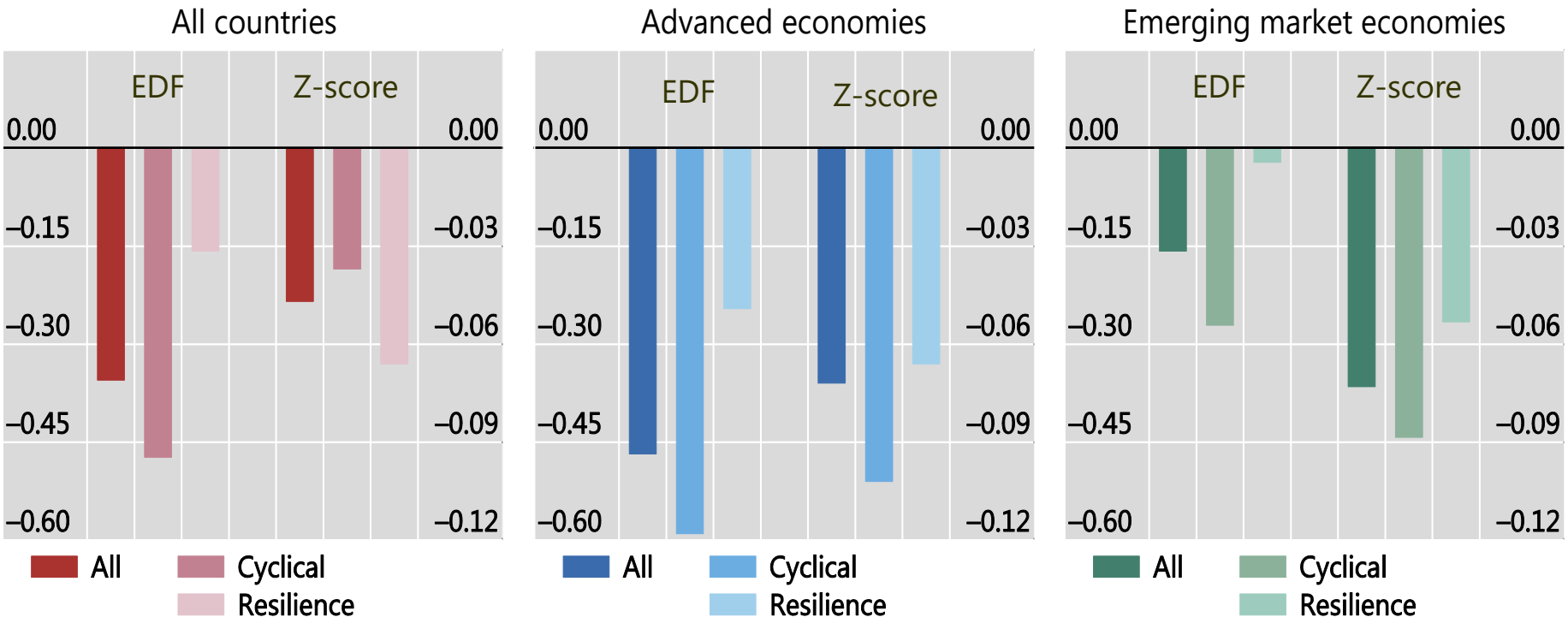
	ΔEDF						ΔZ-score					
	(I)			(II)			(III)			(IV)		
	Coeff		Std err	Coeff		Std err	Coeff		Std err	Coeff		Std err
Dependent variable$_{t-1}$	0.221	***	0.003	0.216	***	0.006	0.894	***	0.020	0.931	***	0.125
ΔEDF_NFS$_t$	0.411	***	0.067	0.395	***	0.060	0.019	***	0.005	0.018	***	0.005
DIFF$_t$	-0.012	**	0.006	-0.020	**	0.009	-0.01	**	0.005	-0.003	**	0.001
ΔGDP$_t$	-0.839		0.703	-0.533		0.671	-0.665	***	0.065	-0.423	***	0.113
SIZE$_{t-1}$	-0.01	***	0.003	-0.071	**	0.036	-0.021	***	0.003	-0.014	*	0.008
LIQ$_{t-1}$	-0.118	***	0.015	-0.090	*	0.051	-0.043	*	0.024	-0.075	**	0.036
CAP$_{t-1}$	-0.158	***	0.027	-1.027	**	0.468	-0.86	***	0.048	-0.517	**	0.244
DEP$_{t-1}$	-0.063	**	0.031	-0.627	***	0.216	-0.973	***	0.030	-0.678	***	0.240
MP_index$_t$	-0.655	***	0.066	-0.670	***	0.237	-0.007	**	0.003	-0.012	*	0.007
*MP_index$_t$*CAP $_{t-1}$*				3.189	***	0.357				0.317	***	0.032
*MP_index$_t$*SIZE $_{t-1}$*				0.491	***	0.057				0.007	*	0.004
*MP_index$_t$*LIQ $_{t-1}$*				0.201	*	0.116				-0.038		0.074
*MP_index$_t$*DEP $_{t-1}$*				0.194	*	0.117				0.247	***	0.030
Observations	20,870			20,870			20,870			20,870		
Serial correlation test	0.110			0.140			0.066			0.127		
Hansen test	0.560			0.640			0.730			0.760		

Effect of a MP tightening: well vs low capitalized banks



Note: The graph reports the effect on bank risk of a tightening in macroprudential tool. The left part indicates the effects on banks' expected default frequency (left-hand axis), the right part the effects on the Z-score (right-hand axis).
Source: Authors' calculations

Average impact: Advanced vs emerging market economies



Note: The Expected default frequency (EDF) represents the probability that a bank will default within one year. The EDF is a well-known, forward-looking indicator of risk, computed by Moody's KMV, which builds on Merton's model to price corporate bond debt (Merton, 1974). The EDF value, expressed as a percentage, is calculated by combining banks' financial statements with stock market information and Moody's proprietary default database. The Z-score is an alternative measure for risk and it can be summarized as $Z=(k+ROA)/\sigma_{ROA}$, where k is equity capital as percent of assets, ROA is average after-tax return as percent on assets, and σ_{ROA} is standard deviation of the after-tax return on assets, as a proxy for return volatility. The Z-score measures the number of standard deviations a return realization has to fall in order to deplete equity, under the assumption of normality of banks' returns. A higher Z-score corresponds to a lower upper bound of insolvency risk, a higher z-score therefore implies a lower probability of insolvency risk. To compare the signs of the coefficients in the regressions, we have therefore multiplied the Z-score by -1.

Source: Authors' calculations.

Cyclical vs Resilience macroprudential tools

	(I) Δ EDF			(II) Δ Z-score		
	Coeff		Std err	Coeff		Std err
Dependent variable$_{t-1}$	0.089	**	0.043	0.890	***	0.067
Macro controls	Yes			Yes		
Bank-specific characteristics	Yes			Yes		
MP_Cyclical index$_t$	-0.473	**	0.194	-0.037	*	0.020
MP_Resilience_index$_t$	-0.158	***	0.042	-0.066	***	0.001
*MP_Cyclical index$_t$ * CAP$_{t-1}$*	1.510	***	0.434	0.568	***	0.145
*MP_Cyclical index$_t$ * SIZE$_{t-1}$*	0.125	*	0.067	0.009	*	0.005
*MP_Cyclical index$_t$ * LIQ$_{t-1}$*	0.551	***	0.010	0.162	***	0.040
*MP_Cyclical index$_t$ * DEP$_{t-1}$*	0.545	**	0.237	0.117	*	0.069
*MP_ Resilience index$_t$ * CAP$_{t-1}$*	2.056	**	0.913	0.621	***	0.183
*MP_ Resilience index$_t$ * SIZE$_{t-1}$*	0.088	**	0.035	0.031	***	0.006
*MP_ Resilience index$_t$ * LIQ$_{t-1}$*	0.304	*	0.158	0.104	*	0.058
*MP_ Resilience index$_t$ * DEP$_{t-1}$*	1.501	**	0.737	0.101	***	0.020
Observations	20,870			20,870		
Serial correlation test[1]	0.077			0.275		
Hansen test[2]	0.358			0.180		

Asymmetric effects for tightening and easing

$$\Delta Risk_{i,k,t} = \alpha \Delta Risk_{i,k,t-1} + \beta \Delta EDF\_NF_{k,t} + \psi\, MC_{k,t} + \lambda BSC_{i,k,t-1} + \\ + \gamma MP\_easy_{k,t} + \gamma^{*} MP\_tight_{k,t} + \delta\, MP\_easy_{k,t} * BSC_{i,k,t-1} + \\ \delta^{*} MP\_tight_{k,t} * BSC_{i,k,t-1} + \theta_i + \varepsilon_{i,k,t}$$

- MPs are more effective in a tightening than in an easing
- Many interaction terms (17 out of 40 for EDF; 24 out of 40 for Z-score) are statistically significant, indicating that macroprudential policies have heterogeneous effects across banks
- Banks that are small, low capitalised and with a higher share of wholesale funding react more to changes in MP tools

Conclusions

- MP tools have a significant impact on bank risk, both those focused on dampening the cycle and those that are specifically designed to enhance banks' resilience
- MP tools are more effective in a tightening than an easing (in line with Cerutti et al. 2015; Claessens et al. 2014; Kuttner and Shim, 2013).
- The responses to changes in MP tools differ among banks, depending on their specific balance sheet characteristics

Annexes

Summary statistics of the variables (1990-2012)(1)

Variables	Number of observations	Mean	Median	Std. Dev	Min	Max	1st quartile	3rd quartile	Sources
Δ EDF	20,870	0.116	-0.003	2.094	-32.275	29.65	-0.111	0.157	Moody's KMV
Z-score	20,870	-2.685	-2.847	-1.256	-5.298	-4.605	-3.467	-2.078	Authors' calc.
Δ EDF_NFS	20,870	-0.069	-0.150	1.546	-6.448	8.236	-1.022	0.771	Moody's KMV
DIFF	20,870	-0.012	-0.009	0.025	-0.220	0.235	-0.023	0.001	IMF/WB/OECD
ΔGDP	20,870	2.760	2.720	2.967	-13.130	15.060	1.450	4.350	IMF/WB/OECD
DEP	20,870	0.000	0.067	1.180	-0.802	0.966	-0.076	0.136	BankScope
SIZE	20,870	0.000	-0.137	2.192	-16.031	7.932	-1.443	1.365	BankScope
CAP	20,870	0.000	-0.048	0.176	-0.141	0.879	-0.075	-0.015	BankScope
LIQ	20,870	0.000	-0.053	0.205	-0.267	0.783	-0.150	0.083	BankScope
Banking crisis	20,870	0.040	0	0.195	0	1	0	0	Valencia and Laeven (2012)

Note: (1) Bank specific indicators are in mean deviation form.