On bank maturity transformation and the effects of regulatory limits: an empirical analysis

Pierluigi Bologna

Bank of Italy

Post crisis financial regulation.
Experiences from the two sides of the Atlantic.

The Federal Reserve Bank of New York,
New York, November 30, 2018

Disclaimer: The views expressed should not be attributed to the Bank of Italy.

Outline

Motivation

- Maturity transformation is inherently linked to the liquidity creation function performed by banks
- BUT creates a maturity mismatch (MM) that exposes banks to interest rate risk and to funding risk
- Excessive MM can threaten bank and financial system stability in case of liquidity shocks (Hellwig 2009)
- Need to oversight MM both at bank and banking system level (Goldstein and Turner 2004)
- At bank level: introduction of the NSFR (BCBS 2011)
- At banking system level: macroprudential policy (ECB 2014, ESRB 2014, IMF 2014)

- Lack of empirical evidence on:
  - the role of MT for bank profitability
  - the effects of prudential regulations limiting MT

This work

- Studies the relationship between maturity transformation and net interest margin
- Investigates the effect of a regulatory change that removed a cap on maturity mismatch
- Innovates the literature in two ways:
  1. Uses a new measure of maturity transformation
     - based on a full account of the contractual maturity of both assets and liabilities (most of the literature approximates MT with rates differentials, LTD, etc)
     - allows to differentiate between the two risk-dimensions of maturity mismatch: i.e. interest rate and funding risk
     - conceptually similar to the NSFR
  2. Studies the effects of...
     - a regulatory loosening of...
     - a prudential regulation on maturity transformation
     - The literature so far focused on the effects of tightening and on short-term liquidity related tools à la LCR (Banerjee and Mio (2017), Dujim and Wierts (2016), De Haan and van den End (2013))

Main findings

- Positive relationship between maturity transformation and net interest margin
- Loosening of a regulatory limit on MT
  - Affects banks' - balance sheet composition - risk exposure
  - Uncertain effects on profitability

Data

Bank level data from the Italian banks' prudential reports for the period 1999H1 to 2008H1:

$\approx$ 650 banks every period
$\geq$ 80 per cent of banking system assets
$\approx$ 12900 obs every period

Sample description

Definition of maturity transformation

Ratio of weighted assets to weighted liabilities and capital

- Weights depend on the assets' and liabilities' effective residual *contractual* maturity
- Weights are given by the regulation on bank maturity transformation in place in Italy until end-2005

Asset and Liability weightings

Maturity (in years)	Assets	Liabilities
> 5	1	1
$1.5 - 5$	0.5	0.5
< 1.5	0	0.25
Interbank only if > 0.25		0.25

Other bank-level variables: credit risk, interest rate risk, risk aversion, bank size, net interest margin, commission income, roe, operational costs

Modelling the effects of regulatory change 1/4

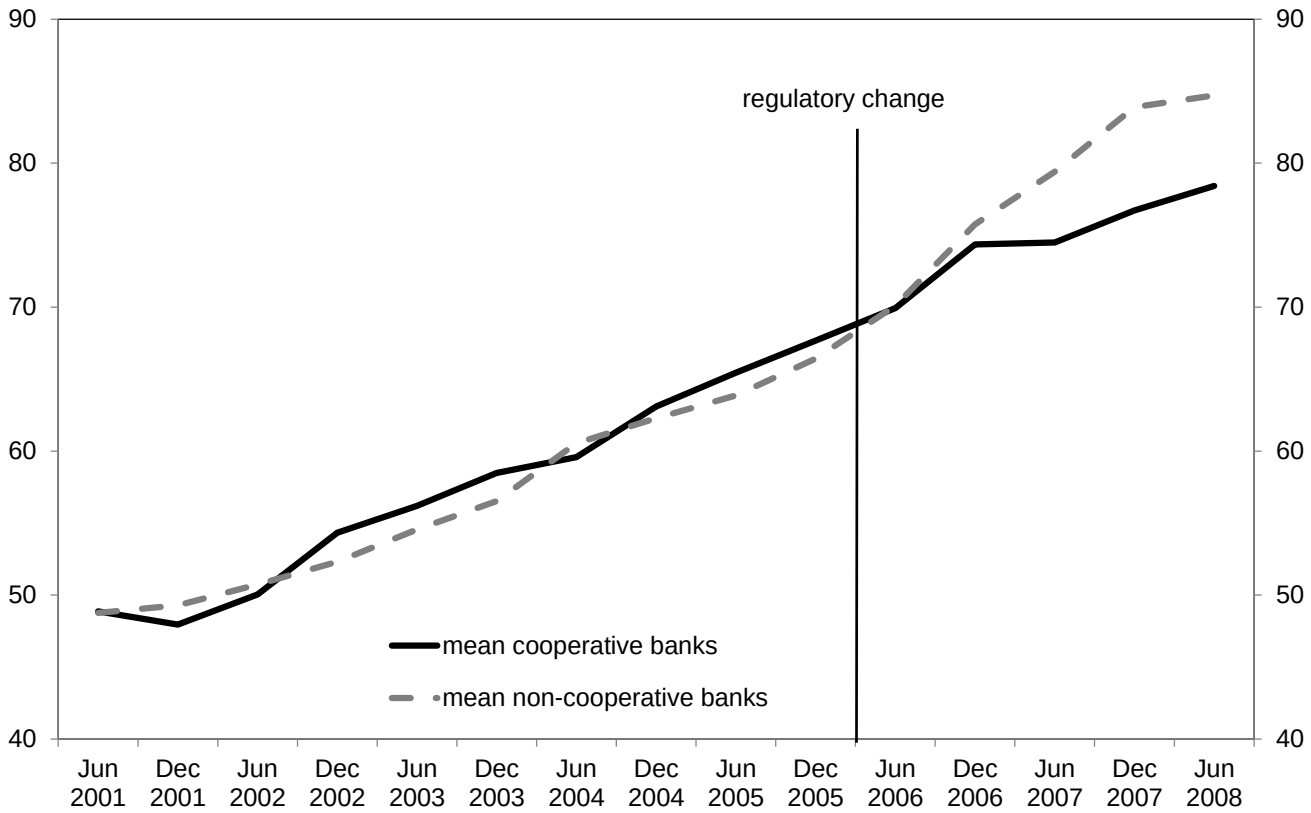
- Regulatory limit on MT in force between 1993 and 2005 and repealed as of June 2006: an exogenous policy decision
- Regulation applied to all banks: no exogenous treatment and control groups

Identification

- Banks divided on the basis of their legal status: cooperative vs non-cooperative banks
- Hp: cooperatives de facto not constrained by the regulation
  - mutual nature, subject to legal constraints that limit scope for growth and diversification (e.g. credit to be granted mainly to shareholders, 70 per cent of profits to be retained, limited the geographical area of competence, shareholders resident in the same area, etc)

Modelling the effects of regulatory change 2/4

Average maturity transformation by bank type 1.pdf



Modelling the effects of regulatory change 3/4

Average MT growth rate

- Before regulatory change:
  - Cooperative banks 3.5
  - Non-cooperative banks 3.3
- After regulatory change:
  - Cooperative banks 3.0
  - Non-cooperative banks 5.0

Bank legal status instrument for treatment (constrained, i.e. non-cooperative banks) and control (unconstrained, i.e. cooperative banks) groups

Modelling the effects of regulatory change 4/4

Effect of maturity transformation regulation on net interest margin, balance sheet and risk

$$Y_{i,t} = \alpha + \beta_1 pol_t + \beta_2 con_i + \beta_3 pol_t con_i + \beta_4 size_{i,t} + \sum_{j=1}^{n} \beta_j X_{j,t} + \epsilon_{i,t}$$

pol is a dummy = 1 after the regulatory change (as of 2006H1)
con is a dummy = 1 for the treated non-cooperative banks

Estimation with fixed effects and robust clustered standard errors
Estimation period: 2001H1 - 2008H1

Results - Net interest margin and maturity transformation

VARIABLES	FE	FE	System GMM
Nim_t-1		-0.038	0.077
		(0.066)	(0.168)
Nim_t-2		0.111***	0.215***
		(0.033)	(0.048)
Maturity transformation	0.003***	0.003***	0.005***
	(0.001)	(0.001)	(0.002)
Interest rate risk	-0.001	-0.001	0.002
	(0.001)	(0.001)	(0.004)
Credit risk	0.002**	0.003***	0.004***
	(0.001)	(0.001)	(0.001)
Risk aversion	0.001	0.005***	0.001
	(0.001)	(0.001)	(0.002)
Operational costs	0.324***	0.483***	-0.065
	(0.063)	(0.089)	(0.126)
...	...	...	...
Constant	2.165***	0.853**	0.000
	(0.354)	(0.368)	(0.000)
R^2	0.235	0.353	
Bank and Time FE	YES	YES	

- MT and credit risk significant with the expected sign
- Operational costs significant with the expected sign only with FE

Results - Effects of regulatory change on balance sheet composition by maturity and asset type

VARIABLES	LT assets	Mortgages	LT liabilities
Policy	-0.052**	0.018	0.094***
	(0.026)	(0.027)	(0.022)
Policy*constrained	0.001	0.021***	-0.005***
	(0.003)	(0.004)	(0.002)
Size	0.001	-0.004	0.007**
	(0.006)	(0.010)	(0.003)
HH index	0.114***	0.073***	-0.067***
	(0.020)	(0.022)	(0.016)
Constant	-0.129	0.174	-0.000
	(0.108)	(0.175)	(0.063)
Observations	10058	9921	10058
R^2	0.662	0.608	0.030
Bank and time FE	YES	YES	YES

- Significant recomposition of assets and liabilities after the policy change
- On the asset side, mortgage lending higher for constrained banks
- On the liability side, constrained banks increased LT liaiblities

Results - Effects of regulatory change on balance sheet composition by interest rate

VARIABLES	LT assets - fixed rate	LT liabilities - fixed rate
Policy	-86.436***	-237.466***
	(8.325)	(73.928)
Policy*constrained	3.985***	4.008
	(1.045)	(4.161)
Size	-3.007	-15.768**
	(2.555)	(6.948)
HH index	57.962***	171.263***
	(6.514)	(55.572)
Constant	-22.755	83.326
	(45.905)	(163.193)
Observations	9425	3203
R^2	0.152	0.038
Bank and Time FE	YES	YES

- Recomposition of LT assets for constrained banks, with higher share of assets at fixed-rate
- No effect on LT liabilities

Results - Effects of regulatory change on risk exposure

VARIABLES	Credit risk - average RW	Credit risk - NPLs	IR risk	Risk aversion
Policy	35.177***	-2.606***	-28.911***	-6.915
	(13.524)	(0.628)	(5.935)	(7.650)
Policy*constrained	-3.056***	0.099	2.517***	1.074*
	(0.774)	(0.099)	(0.948)	(0.571)
Size	-2.122	-0.350	-0.523	-13.418***
	(1.437)	(0.226)	(0.674)	(2.374)
HH index	-20.250**	1.809***	23.177***	6.856
	(10.151)	(0.499)	(4.508)	(6.162)
Constant	143.587***	6.188	-28.262**	261.973***
	(33.192)	(4.081)	(13.756)	(43.909)
Observations	10058	9768	10058	10058
R^2	0.116	0.014	0.071	0.150
Bank and time FE	YES	YES	YES	YES

- Change in risk exposure for the constrained banks: credit risk ↓ interest rate risk ↑ risk aversion ↑
- Results consistent with recomposition of A&L by maturity and IR:
  - Credit risk ↓ and risk aversion ↑ coherent with ↑ mortgages (carry lower RW than other asset classes)
  - ↑ IR risk consistent with ↑ in fixed-rate LT assets, relative to the fixed-rate LT liablities, which ceteris paribus entails a higher duration gap

Results - Effects of regulatory change on net interest margin

VARIABLES	Net interest margin	Interest income	Interest expense
Policy	0.279	-0.996***	-0.475*
	(0.183)	(0.371)	(0.284)
Policy*constrained	-0.015	-0.008	-0.000
	(0.015)	(0.023)	(0.015)
Y_t-1	0.012	-0.055	0.144***
	(0.068)	(0.060)	(0.052)
Y_t-2	0.124***	0.088***	0.165***
	(0.030)	(0.030)	(0.033)
Maturity transformation	0.002***	0.003***	0.001
	(0.000)	(0.001)	(0.001)
Interest rate risk	0.001	-0.002	-0.002**
	(0.001)	(0.002)	(0.001)
Credit risk	0.003***	0.003***	-0.000
	(0.001)	(0.001)	(0.000)
Risk aversion	0.004***	0.003***	-0.001
	(0.001)	(0.001)	(0.001)
Operational costs	0.464***	0.554***	0.113
	(0.090)	(0.167)	(0.100)
R^2	0.311	0.466	0.528
Bank and Time FE	YES	YES	YES

- Contrary to expectation and despite the increase in average MT, no effect on NIM and on both its components
- Result possibly due to increased competitive pressure

Results - Effects of regulatory change on commission income

VARIABLES	Commission income	Commission income credit	Commission income asset management
Policy	1.700***	0.216***	1.740***
	(0.273)	(0.014)	(0.279)
Policy*constrained	-0.034*	-0.024***	0.036**
	(0.018)	(0.004)	(0.018)
Y_t-1	-0.134*	0.193***	-0.163**
	(0.070)	(0.019)	(0.077)
Y_t-2	0.537***	0.458***	0.529***
	(0.046)	(0.021)	(0.054)
Operational costs	0.530**	0.018***	0.479**
	(0.211)	(0.006)	(0.214)
Size	0.028	-0.008	0.065
	(0.091)	(0.006)	(0.092)
HH index	-1.914***	-0.268***	-1.716***
	(0.266)	(0.015)	(0.277)
R^2	0.656	0.776	0.543
Bank and Time FE	YES	YES	YES

- Decrease in credit related commission income - consistent with the finding on NIM
- Increase in asset management commission income - indicative of possible cross-selling

Results - Effects of regulatory change on ROE

VARIABLES	ROE	ROE
Policy	119.487***	110.872***
	(6.754)	(8.283)
Policy*constrained	0.749**	0.465*
	(0.331)	(0.275)
ROE_t-1		0.105***
		(0.036)
ROE_t-2		0.222***
		(0.036)
Maturity transformation	-0.002	-0.001
	(0.009)	(0.009)
Interest rate risk	0.025	0.030
	(0.040)	(0.035)
Credit risk	0.021	0.004
	(0.013)	(0.012)
Risk aversion	0.060**	0.032
	(0.026)	(0.025)
Operational costs	-2.658***	-2.759***
	(0.813)	(0.898)
Size	0.566	-0.442
	(0.786)	(0.668)
HHI	-114.652***	-106.632***
	(6.419)	(7.908)
R^2	0.197	0.258
Bank and Time FE FE	YES	YES

- Positive sign of the interaction term suggests positive effect on ROE, but only marginally significant

Conclusions

Propose a new measure of maturity transformation, proxy for structural funding risk

Study the loosening of a regulatory limit on MT and find that it:

- Impacts banks' balance sheet composition by
  - increasing mortgage lending
  - reducing long-term liabilities
  - increasing the share of long-term assets at fixed rate
- Impacts risk exposure by increasing irr and decreasing credit risk
- Uncertain effects on profitability
  - no effect on NIM and negative effect on credit-related commission income
  - positive effect in other commission income, suggesting possible cross-selling

Main policy implication

- Use of NSFR for macroprudential policy: need for ex ante assessment of the financial and (real?) (un)intended

Thank you

Sample description

	Date																		
	1999H1	1999H2	2000H1	2000H2	2001H1	2001H2	2002H1	2002H2	2003H1	2003H2	2004H1	2004H2	2005H1	2005H2	2006H1	2006H2	2007H1	2007H2	2008H1
n. of banks																			
total	696	705	712	723	718	704	701	682	675	667	658	660	662	661	659	655	653	652	651
of which:																			
parent/consolidating banks	64	59	59	60	60	59	59	63	65	65	65	65	67	68	68	67	66	62	62
subsidiaries	93	104	119	122	124	120	125	117	114	115	113	117	117	115	115	113	113	114	120
individual banks	539	542	534	541	534	525	517	502	496	487	480	478	478	478	476	475	474	476	469
memo:																			
of which cooperative banks	472	473	473	472	463	444	439	427	420	415	412	407	406	404	402	402	402	401	398
asset size (percentage)																			
share ot total banking system	77.4	79.6	81.0	81.1	80.3	86.5	87.0	82.8	83.0	83.7	82.0	82.5	81.3	81.6	81.5	80.0	73.7	80.3	80.2
share of GDP	105.5	107.8	112.7	114.0	112.3	120.0	120.8	120.4	120.8	123.1	121.0	123.2	127.1	129.9	132.5	137.2	137.7	150.1	156.5

This table describes the sample, by semester, in terms of share of total banking system assets and share of GDP, as well as its composition by consolidation status (i.e. individual/solo banks, parent/consolidating banks, and subsidiaries of banking groups – and by institutional status (i.e. cooperative and commercial banks).

Back

Main bank-specific variables: descriptive statistics

	Obs	Mean	Std. Dev.	Median	Min	Max
Total assets (1)	12,894	2,591	12,689	236	3	402,460
Long-term assets	12,894	0.13	0.07	0.12	0.00	0.64
Mortgage loans	12,740	0.28	0.12	0.28	0.00	0.93
Maturity trasformation	12,833	59.10	23.68	58.31	0.25	281.48
Interest rate risk	12,894	4.79	7.09	3.43	-49.43	134.02
Credit risk	12,894	67.51	18.30	66.91	6.32	238.51
Risk aversion	12,894	11.98	15.99	8.58	-20.47	521.29
Net interest margin	12,892	1.56	0.49	1.57	-5.32	8.58
Operational costs	12,812	1.45	0.52	1.41	0.00	9.92

(1) Millions of euro.

Back