BANKING BUSINESS MODELS MONITOR

EUROPE

Performance, Risk, Response to Regulation and Resolution: 2005-2017

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1. INTRODUCTION

In a changing regulatory context and evolving market structures, bank business models (BBM) analysis emerged as a policy tool to better understand the nature of risk attached to banks and the relative contribution of each identified business model to systemic risk throughout the economic cycle.

This new Monitor edition for Europe provides an updated identification of BBM for 3,287 banking groups and subsidiaries in the European Economic Area (EEA) and Switzerland, accounting for 25,402 bank-year observations and using Ayadi (2019) definition, methodology and financial stability framework.

The financial assessment includes the links with ownership, the migration of business models, the assessment of performance and risks, and how different business models respond to regulation and resolution.

Some novelties are introduced in this edition of the BBM Monitor. In particular, the non-performing loans ratio is added as additional proxy of the bank credit portfolio quality; the SRISK is inserted as proxy of systemic risk of the European banking system; and the Minimum Requirement for own funds and Eligible Liabilities (MREL) is measured as requested by regulators, whose objective is to ensure the proper functioning of the bail-in mechanism, increasing a bank's capacity to absorb losses.

The findings provide new evidence about the role of different business models and ownership structures in European banking, in terms of financial performance & operational efficiency, contribution to the real economy, contribution to systemic risk and impact on financial (in)stability. It is clear that the shareholder value banks, which are more focussed on investment and wholesale business, are more oriented towards financial performance, whilst tending to accelerate the accumulation of risk at a system level and being less resilient to extreme stress conditions. In turn, retail-oriented banks, which are more stakeholder-oriented institutions, are more likely to contribute to the real economy, whilst maintaining equivalent levels of financial performance and contributing less to the accumulation of risk at a system level as well as being more resilient to extreme stress conditions.

2. DIVERSITY IN THE BANKING SECTOR ECOSYSTEM

Ten years on from the financial crisis, the global banking system is still addressing a set of legacy issues, as well as facing new and diverse challenges. Legacy issues play an important role in the European banking landscape, with many large players still grappling with non-performing loans, low capitalisation and stagnant profitability.

Despite some positive trends, weak economic growth has compounded the problems that banks face in many countries. In 2018, the average European bank only generated a return on equity of 6 per cent, with banks in some Southern European countries posting significant losses. The cost of capital has remained high, which hampers banks' ability to raise new equity. Some of Europe's largest banks are facing a litany of problems, from failing IT infrastructure to regulatory fines and sanctions. Significantly, European banks are no longer amongst the top global players and have lost customers and market segment to US competitors, as well as to emerging players from Asia.

On the regulatory side, European banks have been faced with additional challenges compared with their international counterparties, including the creation of the Banking Union and of the SSM as a single supervisor. The new regulatory framework, however, is far from complete and it is likely to impose further costs on banks going forward.

The next challenge for European banks comes from technology: obsolete IT infrastructure and the need to invest heavily in new systems is also weighing heavily on bank balance sheets. To survive the digital transformation, European banks will need to rethink strategies and business models.

Against this backdrop, the 2018 Bank Business Models Monitor presents an insightful analysis of the European banking landscape. The detailed analysis, carried out by Professor Rym Ayadi and her team since 2010, provides an updated identification of bank business models for a very large and representative sample of banks and banking groups in the European Economic Area (EEA) and Switzerland.

The evaluation includes the analysis of changes in business models and how different business models respond to new regulation and resolution regimes. The findings provide fresh evidence of the role of different business models, in terms of performance, efficiency and contribution to

the real economy. New to this edition of the Monitor is the analysis of each business model's contribution to systemic risk and impact on financial stability.

On the basis of a cluster analysis, the authors confirm the co-existence of five business models. Most European banks adopt a retail-oriented business model, with various degrees of diversification. Specialist wholesale and investment banking models are, instead, less popular in terms of numbers, but large in terms of size. The analysis also reveals that different business models co-exist amongst banks with different ownership structures.

When looking at migrations the authors find that, in general, bank business models are stable. There are, however, a number of banks which change their business model, which is in line with the profound changes in the banking industry. One concern relates to the concentration of banks in a particular business model, as the diversity of the financial ecosystem is one of the key drivers of financial stability. The authors report a shift towards a diversified retail banking model and away from wholesale and investment banking models. The latter are, on average, more profitable but also riskier in terms of their individual contribution to systemic risk. In addition, wholesale and investment banks also seem less resilient to shocks. In this context, migrations towards more retailed oriented business models seem to be a positive development in the European banking industry: retail-oriented banks are less risky from a systemic point of view, are better capitalised and have a more stable financial performance. In addition, they provide a positive contribution to the real economy.

Whilst these changes are welcome news for policy makers, attention should be paid to long-standing issues, such as the culture (of risk), the governance and particularly to diversity, not only amongst business models but also amongst senior bank managers and boards of directors.

The ability to manage change is extremely positive in the context of current macro-economic scenarios and emerging geo-political shifts in Europe, which will require banks to remain agile.

In summary, banks have been re-assessing and changing their strategies and business models to deal with legacy problems, low profitability and governance failures. The findings of the 2018 Monitor are essential reading for those wishing to develop a deeper understanding of the dynamics of the different components of the diverse European banking sector and its resilience to future changes.

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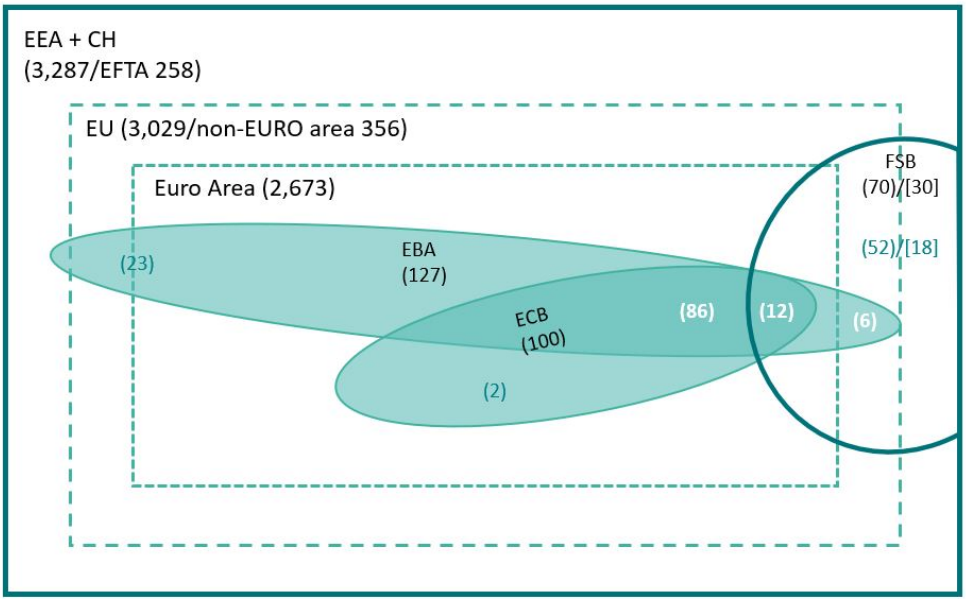
3. BUSINESS MODELS IDENTIFICATION

The sample under study in this Monitor is comprised of 3,287 banking groups and subsidiaries in the European Economic Area (EEA) and Switzerland (CH)[1], see also Figure 3.1.

Banks are spread unequally across the 32 countries in the EEA and Switzerland. More specifically, we include 2,672 Eurozone banks, 372 EU (non-Eurozone) banks and 258 banks from the four EFTA countries (Switzerland, Iceland, Norway, and Liechtenstein). See also Appendix II.

Figure 3.1 Number of banks selected, by supervisor and area



Note: The analysis Focussed on consolidated banking groups, however, some non-EEA banks have several subsidiaries in the EEA that are directly owned by the parent company or non-EEA subsidiaries. The number of observations in the assessment are indicated in between brackets "(..)", whilst the number of distinct banking groups is shown between the special brackets "[..]". The EBA banks are the banks that have been subject to 2018 EU-wide stress test; the ECB banks are the banks subject to ECB banking supervision updated at 2018; and the FSB banks are the G-SIBs and the subsidiaries on non-EEA and CH G-SIBs.

[1] The sample includes the EEA+CH banking groups and banking subsidiaries of institutions from outside this region.

Source: Authors

The banks included in the study together account for more than €60 trillion at the end of 2017, which represents more than 95% of the banking assets in the EEA. The sample includes 25,402 bank-year observations and data for all instruments required to adhere to the business models framework, as defined in Ayadi (2019)[2].

The database used for this exercise was gathered from private and public data sources by collecting accounting, market and other qualitative data, which has been carefully reviewed and harmonised by the team in a comprehensive datasheet for the business models analysis.

The database covers the period from 2005 to 2017. The balance sheet and profit and loss statement data was retrieved from SNL for more than 3,287 banks, for which there has only been comprehensive coverage from 2010 onward. The market data was obtained from Bloomberg, Markit and FactSet.

The data collection exercise spanned over sixty variables (see Appendix I for a complete list). Whenever possible, preference was given to variables with the highest coverage ratio.

Indicators on bank activities, financial position, international activities, ownership, financial performance, risk factors, as well as regulatory indicators and supervisory measures, were constructed from this subset.

The final set of indicators used in identifying and assessing the business models is shown in Table 3.1.

The activities and funding indicators cover almost the entire balance sheet and are considered as instruments for the clustering analysis, as defined in Ayadi (2019).

Hence, loans to banks, loans to customers and trading assets, on average, cover 94% of the assets side of bank balance sheets. In turn, an average of 96% of the liabilities side is covered through debt to banks, deposits, debt liabilities, derivatives and tangible common equity. Cash, intangible assets and non-common equity are excluded from the clustering.

Indicators of financial performance include income statement indicators (i.e. cost-to-income ratio (CIR), net interest, commission and fees, trading, and other earnings), balance sheet indicators (i.e. growth of

[2] This methodology builds on previous editions of the Bank Business Model Monitor (Ayadi et al, 2011; Ayadi et al, 2012; Ayadi & De Groen, 2014; Ayadi et al, 2016; and, Ayadi et al, 2017).

customer loans) and mixed ratios of the income statement and balance sheet (RoA and RoE).

For ownership structures, the coverage is complete (100%). The data coverage for indicators of financial activities, financial performance and international activities is almost complete, except for debt liabilities (90%), the coverage ranging between 95% and 100%. The situation is more contrasted for risk and regulatory indicators, the coverage ranging between 0.9% and 99%. In particular, some risk and regulatory indicators cover less than 5% of the entries. Whilst one can argue that, in many cases, they are not applicable as they affect only a small number of observations (e.g. only a small group of primarily systemic banks were subject to stress tests and received State aid), the indicators are still relevant, since they cover the large majority of banking assets. Moreover, the coverage of market indicators was reduced in comparison to the previous Monitor, since these indicators are not available for many of the primarily smaller banks that are not dependent upon market funding.

Table 3.1 Description of indicators used in the 2019 Monitor

Variable	Coverage	Mean	Std. dev.	Min.	Max.
BALANCE SHEET INDICATORS					
Loans to banks (% of assets)	99%	0.118	0.138	0	1.000
Customer loans (% of assets)	85%	0.569	0.204	0	0.995
Trading assets (% of assets)	97%	0.264	0.163	0	1.000
Bank liabilities (% of assets)	99%	0.124	0.132	0	1.220
Customer deposits (% of assets)	97%	0.649	0.226	0	7.753
Debt liabilities (% of assets)	90%	0.120	0.171	0	3.333
Derivative exposure (% of assets)	100%	0.007	0.035	0	0.758
Tang. comm. eq. (% tang. assets)	99%	0.100	0.094	-2.333	1.000
OWNERSHIP					
Shareholder-value (dummy var.)	100%	0.258	0.437	0	1
Commercial (dummy var.)	100%	0.245	0.430	0	1
Nationalised (dummy var.)	100%	0.012	0.110	0	1
Stakeholder-value (dummy var.	100%	0.741	0.437	0	1
Cooperative (dummy var.)	100%	0.498	0.500	0	1
Savings (dummy var.)	100%	0.217	0.412	0	1
Public (dummy var.)	100%	0.026	0.159	0	1
Listed on stock exchange (dummy var.)	100%	0.091	0.287	0	1
PERFORMANCE					
Return on assets (RoA)	99%	0.005	0.055	-4.454	2.120
Return on equity (RoE)	99%	0.047	0.954	-104.545	53.040
Cost-to-income ratio (CIR)	99%	0.749	3.499	-223.016	350.782
Net interest income (% of total income)	99%	0.673	1.492	-18.788	226.188
Trading income	97%	0.031	1.521	-227.313	24.478

Variable	Coverage	Mean	Std. dev.	Min.	Max.
(% of total income)					
Commission & fee income (% of total income)	99%	0.227	0.297	-31.151	11.562
Other income (% of total income)	95%	0.067	0.418	-22.680	46.040
Customer loan growth (% change)	80%	5.531	413.734	-1.000	41,154.900
RISKINESS					
Z-score (no. of std. dev. from default)	99%	69.79	98.380	-12.145	1,786.205
Loan loss provisions (% of gross customer loans)	97%	0.005	0.107	-5.000	11.587
Non-performing loans (% of gross customer loans)	82%	0.081	0.327	0.000	14.223
Stock returns (avg. daily returns)	7.4%	0.007	0.058	-0.664	0.949
Stock returns (std. dev. daily returns)	7.4%	0.025	0.019	0.000	0.336
CDS spread (senior annual avg.)	3.0%	1.815	2.224	0.046	18.363
CDS spread (senior annual std. dev.)	3.0%	0.431	0.632	0.000	5.357
Srisk	100%	-0.042	0.362	-17.874	0.740
REGULATION					
Risk-weighted assets (RWA) (% of assets)	86%	0.601	1.264	0.001	108.634
Tier 1 capital ratio (% of risk-weighted assets)	82%	0.167	0.185	-0.209	9.853
Shortfall (% of RWA)	0.9%	0.008	0.022	0.000	0.135
Tangible common equity (% tang. assets)	98%	0.101	0.094	-2.333	1.000
Cumulative peak losses aided banks (% of total liabilities aided banks)[1]	2.5%	0.067	0.082	0.000	0.345
MREL	100%	0.104	0.210	0.029	19.554

Note: 1) The cumulative peak losses cover multiple years; the coverage is, therefore, calculated as share of total number of banks instead of bank-year observations.

In line with the Monitor's prime aim of identifying the business models of European banks and assessing their strengths and weaknesses, the analysis was conducted in two phases.

In the first phase, several variables from Table 3.1 are used as a basis for the identification of distinct business models, based on the Activity/Funding definition we have adopted.

In the second phase, the business models and ownership structures are evaluated over time in terms of economic performance, risk and response to regulation and resolution.

To identify the bank business model, we use the clustering methodology and Statistical Analysis System software is also used for the last edition of the Monitor (Ayadi et al, 2016).

It is important to highlight that cluster analysis is an inexact science. The assignment of individual banks to a specific cluster, or model, depends crucially on the definition adopted, the choice of instruments and procedures, such as the proximity metric, procedures for forming clusters and the stopping rules used. Although the literature on the technical aspects of cluster analysis is relatively well-developed, there is little theory on why certain procedures perform better than others.[3] In choosing instruments, attention was given to testing a variety of alternative configurations. The five indicators mentioned above led to the most consistent and distinct clustering. Dropping or adding variables resulted in a substantial worsening of the statistical measures of distinct clustering, which suggests that the chosen set adequately identifies the main distinguishing characteristics of the sampled banks. As the discussion below makes clear, the characteristics of the business models that are identified by the cluster analysis are, by and large, in line with expectations. Despite these efforts, it is certainly true that the outcomes may change when using other configurations. Notwithstanding this qualification, using this Monitor configuration is useful for a continuous dynamic analysis of bank business models.

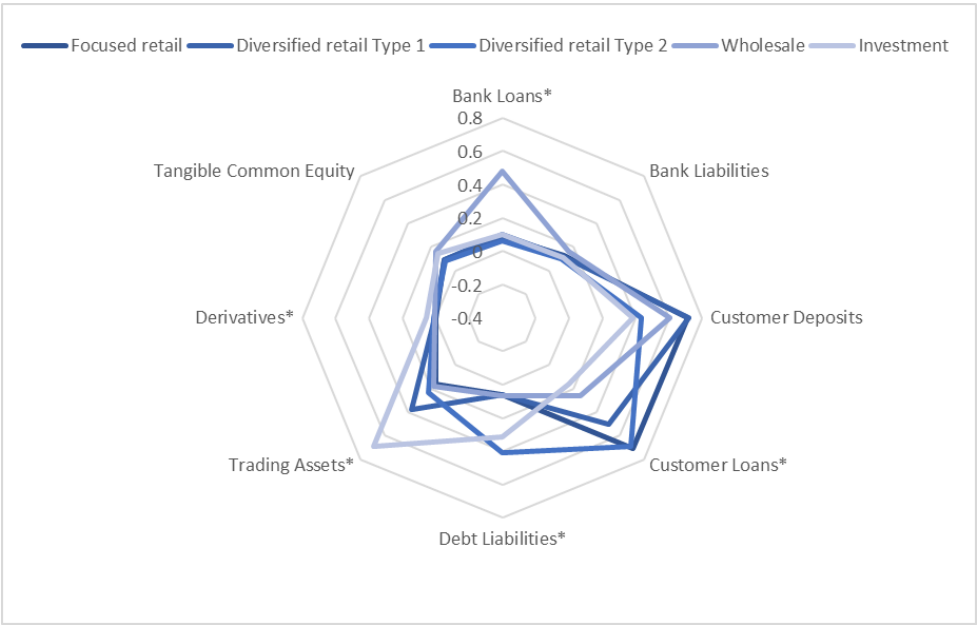
First, Table 3.2 gives the descriptive statistics of the five models resulting from the cluster analysis, on the sample of banks in Europe during the overall period of analysis (2005-2017), based on the five instruments used to define them.

Second, an overview of the main structural and financial attributes of the business models is provided.

Third, a complementary analysis is performed on the ownership structures of banks to better understand the interaction.

[3] See Everitt et al. (2001) for a highly readable introduction to cluster analysis and some of the practical issues in the choice of technical procedures.

Figure 3.2 Comparison of business models of European banks, standardised scores



Notes: Indicators marked with an asterisk (*) were used as instruments in the cluster analysis. The figures represent the number of standard deviations from the sample mean. *Customer loans* and C*ustomer deposits* represent the balance sheet share of deposits from and loans to non-bank customers, respectively. *Bank liabilities* and *bank loans* identify the share of liabilities of and loans to other banks, including bank deposits, issued debt, interbank transactions, and received funding from central banks. *Debt liabilities* are calculated by netting customer deposits, bank liabilities, total equity and negative fair values of all derivative transactions from total liabilities. *Derivative exposures* capture all negative carrying values of derivative exposures. *Trading assets* are defined as total assets minus liquid assets (cash & deposits at central bank) minus total loans and intangible assets. *Tangible common equity* is defined as common equity minus intangible assets and treasury shares as a share of tangible assets (i.e. total assets minus intangible assets).

Source: Authors

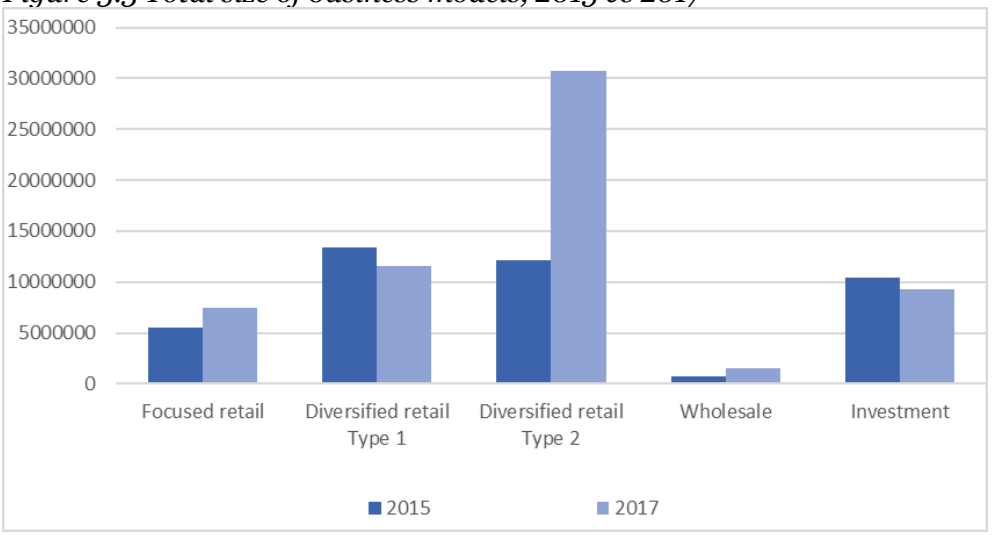
Focussed retail, Diversified retail (type 1) and Diversified retail (type 2) represent the retail-oriented banks, which are relatively more active in lending to customers. Hence, customer loans account for 70.95%, 50.38% and 68.54% of their total assets respectively. Customer loans, on average surpass, or are very close to, the sample averages.

Looking at the differences between the various retail-oriented banking models, Focussed retail-banks are, on average, most active in classical deposit-loan intermediation; customer deposits account for 71.01% of total funding (total liabilities including equity), whilst customer loans

account for 70.95% of total assets. The remaining exposures, such as trading assets and bank loans, are relatively limited, respectively with 16.46% and 8.47%. The Focussed retail model represents about 39% of the sample and includes the smallest banks amongst the retail-oriented models, both in terms of total and average assets (see Appendix III).

The other two retail models show a greater diversification in their activities and funding. Diversified retail (type 1) has relatively more trading assets and bank loans, 37.40% and 9.86% respectively. Funding is comparable to the Focussed retail model, with a relatively high dependence on customer deposits and limited reliance on both bank deposits and debt liabilities. Diversified retail (type 1) represents about 35% of sample observations and about 20% of the total assets.

Figure 3.3 Total size of business models, 2015 vs 2017



Source: Authors

Diversified retail (type 2) has more diverse assets and liabilities than the Focussed retail model. It has significantly more trading assets than the Focussed retail model, with trading assets accounting for 22.99% of total assets. The main difference from the other retail-oriented models is, however, the funding. Amongst the different business models, Diversified retail (type 2) relies most on debt liabilities (40.88%), although Diversified retail (type 2) represents only about 13% of the observations.

The Wholesale model primarily includes banks that are active in intermediation between banks, with a heavy reliance on interbank lending and funding. These banks are very active in non-traditional use of funds,

including bank loans and trading assets (i.e. all assets excluding cash, loans and intangible assets). On average, interbank lending represents 48.07% of total assets whereas trading assets account for 17.93% of their balance sheets. These banks are substantially less leveraged than their peers, with the highest tangible common equity ratio of 16.40%. In fact, the average of the five clusters is equal to 10.10% and, with the exception of Investment banks that show 14.78% of tangible common equity over total assets, the other three business models show a tangible common equity ratio lower than 10%.

The Wholesale banks are also more reliant on bank funding. Under this bank model, average bank to bank liabilities, including both deposits and other interbank debt, represent 16.38% of the total assets. In turn, customer loans account for only 26.20% of the total balance sheet. Other funds are primarily used for trading assets. The Wholesale banks are the smallest group, both in terms of number and total bank assets.

The last model groups together large **Investment-oriented banks**; these banks have substantial trading activities. The cluster averages for trading assets and derivative exposures represents respectively 68.73% and 5.38% of total assets. In terms of funding, the focus is on less stable and less traditional sources, such as debt liabilities.

The Investment banks are the largest banks, both in terms of total and average assets. The average size of a bank in this cluster, over the entire sample period, was approximately € 113 billion. This was almost double the size of a Diversified retail bank (type 2), about ten times the size of a Diversified retail bank (type 1) and about twenty times the size of a Focussed retail bank and Wholesale banks (See also Figure 2.3).

When looking at the share of assets across countries (Appendix V), banks in eastern, central and southern European countries are predominantly retail oriented, whereas in France, UK and Switzerland they are investment oriented. The trends from 2005 to 2017 are consistent and relatively stable, except for Belgium, where banks migrated from investment and wholesale to retail oriented business models in 2008, following the fallout of Dexia and Fortis.

Table 3.2 Descriptive statistics for business models

		Bank loans (% assets)	**Customer loans (% assets)**	**Trading assets (% assets)**	Bank liabilities (% assets)	Customer deposits (% assets)	**Debt liabilities (% assets)**	**Derivative exposures (% assets)**	Tang. Comm. eq. (% tang. assets)
Model 1 – Focussed retail	Mean	8.47%	70.95%	16.46%	12.98%	71.01%	5.95%	0.19%	9.50%
	St. dev.	0.0717***	0.1093***	0.0775***	0.1270***	0.1473***	0.0638***	0.0065***	0.0602***
	Min.	0.00%	0.00%	-8.86%	0.00%	0.00%	0.00%	0.00%	-42.78%
	Max.	40.20%	99.58%	32.91%	122.09%	98.31%	27.17%	10.34%	99.06%
	Obs.	9,681	9,418	9,594	9,694	9,422	9,230	9,266	9,654
Model 2 – Diversified retail (type 1)	Mean	9.86%	50.38%	37.40%	12.15%	71.96%	5.98%	0.41%	9.30%
	St. dev.	0.07076***	0.10578***	0.0896***	0.1032***	0.1519***	0.0701***	0.0226***	0.0547***
	Min.	0.00%	0.00%	1.59%	0.00%	0.00%	0.00%	0.00%	-16.21%
	Max.	37.26%	99.50%	66.23%	90.90%	108.04%	39.68%	57.17%	98.69%
	Obs.	8,716	8,484	8,645	8,719	8,477	8,407	8,445	8,701
Model 3 – Diversified retail (type 2)	Mean	6.26%	68.54%	22.99%	9.98%	43.68%	40.88%	1.41%	8.25%
	St. dev.	0.0583***	0.1175***	0.0951***	0.0862***	0.2363***	0.1634***	0.0298***	0.0632***
	Min.	0.00%	0.00%	0.07%	0.00%	0.00%	20.89%	0.00%	-197.47%
	Max.	56.37%	99.60%	53.49%	72.08%	775.33%	224.30%	31.03%	68.73%
	Obs.	3,368	3,368	3,328	3,395	3,364	3,391	3,434	3,395
Model 4 – Wholesale	Mean	48.07%	26.20%	17.93%	16.38%	60.18%	6.74%	0.56%	16.40%
	St. dev.	0.2075***	0.1941***	0.1285***	0.2466***	0.3208***	0.1367***	0.0273***	0.1927***
	Min.	0.00%	0.00%	0.00%	0.00%	0.00%	-0.05%	0.00%	-6.41%
	Max.	100.00%	94.50%	57.15%	99.49%	99.96%	103.10%	46.45%	100.00%
	Obs.	1,943	2,000	1,924	1,964	2,008	1,935	1,974	1,992
Model 5 – Investment	Mean	10.21%	16.48%	68.73%	11.36%	38.02%	31.27%	5.38%	14.78%
	St. dev.	0.1022***	0.1519***	0.1576***	0.1673***	0.3280***	0.3044***	0.1159***	0.2157***
	Min.	0.00%	0.00%	0.00%	0.00%	0.00%	-0.05%	0.00%	-6.41%
	Max.	59.44%	94.03%	100.00%	97.06%	101.36%	333.33%	75.84%	100.00%
	Obs.	1,301	1,316	1,281	1,344	1,321	1,331	1,357	1,366
All banks	Mean	**11.82%**	**56.96%**	**27.45%**	**12.46%**	**64.95%**	**12.08%**	**0.76%**	**10.10%**
	St. dev.	**0.1388**	**0.2047**	**0.1636**	**0.1319**	**0.2268**	**0.1719**	**0.0358**	**0.0947**
	Min.	**0.00%**	**0.00%**	**-8.86%**	**0.00%**	**0.00%**	**-0.05%**	**0.00%**	**-233.33%**
	Max.	**100.00%**	**99.60%**	**100.00%**	**122.09%**	**775.33%**	**333.33%**	**75.84%**	**100.00%**
	Obs.	**25,009**	**24,586**	**24,772**	**25,116**	**24,592**	**24,294**	**24,476**	**25,108**

Notes: The independence of clusters was tested using non-parametric Wilcoxon-Mann-Witney two-sample tests at 5% significance. According to the results of these tests, the number of asterisks (*, **, ***, and ****) stands for the statistical difference of any given cluster from that number of other clusters for that indicator. For example, two asterisks (**) implies that the cluster is statistically different from two other clusters but not the third and fourth (closest) ones. Variables in **bold** highlight the instruments used in forming the clusters. *Source:* Authors

Table 3.3 Descriptive statistics for ownership structures

		Bank loans (% assets)	Customer loans (% assets)	Trading assets (% assets)	Bank liabilities (% assets)	Customer deposits (% assets)	Debt liabilities (% assets)	Derivative exposures (% assets)	Tang. Comm. eq. (% tang. assets)
Commercial	Mean	17.27%	45.77%	28.22%	13.14%	53.33%	17.45%	1.95%	13.21%
	St. dev.	0.2090***	0.2787****	0.2283***	0.1907***	0.2974***	0.2236***	0.0616****	0.1583****
	Min.	0.00%	0.00%	-8.86%	0.00%	0.00%	0.00%	0.00%	-233.33%
	Max.	99.99%	99.60%	100.00%	98.07%	108.04%	333.33%	73.16%	100.00%
	Obs.	6,099	5,996	6,008	6,163	5,997	6,087	6,168	6,186
Cooperative	Mean	10.79%	58.96%	28.48%	12.38%	70.06%	8.84%	0.14%	9.12%
	St. dev.	0.0988**	0.1452****	0.1332****	0.0967***	0.1603**	0.1281***	0.0085****	0.0496****
	Min.	0.00%	0.00%	0.00%	0.00%	0.00%	-0.05%	0.00%	-7.65%
	Max.	100.00%	97.71%	100.00%	99.49%	98.31%	95.83%	22.00%	100.00%
	Obs.	12,482	12,253	12,410	12,509	12,255	12,039	12,091	12,492
Nationalised	Mean	7.45%	57.25%	31.63%	16.74%	44.34%	26.93%	4.69%	5.73%
	St. dev.	0.0812***	0.1741****	0.1441****	0.1619***	0.2365**	0.2003***	0.0834****	0.1000***
	Min.	0.15%	0.00%	2.95%	0.00%	0.00%	1.33%	0.00%	-42.78%
	Max.	80.44%	98.75%	79.88%	122.09%	93.27%	89.80%	75.84%	91.32%
	Obs.	310	307	310	316	304	314	316	316
Public	Mean	12.97%	62.51%	19.20%	14.57%	45.16%	27.53%	1.55%	11.33%
	St. dev.	0.1843***	0.2539****	0.1786****	0.2183***	0.3092***	0.2544***	0.0317****	0.1547****
	Min.	0.00%	0.00%	0.15%	0.00%	0.00%	0.07%	0.00%	0.38%
	Max.	96.46%	98.61%	97.20%	98.12%	95.12%	92.73%	18.47%	94.31%
	Obs.	662	644	658	666	647	662	663	657
Savings	Mean	8.22%	64.19%	24.98%	11.40%	69.81%	9.89%	0.33%	8.91%
	St. dev.	0.0885***	0.1646***	0.1312***	0.0998***	0.1814***	0.1352***	0.0156****	0.0468**
	Min.	0.00%	0.00%	0.04%	0.00%	0.00%	0.07%	0.00%	-7.68%
	Max.	99.96%	99.00%	97.15%	91.46%	775.33%	99.32%	34.45%	99.89%
	Obs.	5,456	5,386	5,386	5,462	5,389	5,192	5,238	5,457
All banks	Mean	**11.82%**	**56.96%**	**27.45%**	**12.46%**	**64.95%**	**12.08%**	**0.76%**	**10.10%**
	St. dev.	**0.1389**	**0.2048**	**0.1636**	**0.1319**	**0.2268**	**0.1719**	**0.0358**	**0.0947**
	Min.	**0.00%**	**0.00%**	**-8.86%**	**0.00%**	**0.00%**	**-0.05%**	**0.00%**	**-233.33%**
	Max.	**100.00%**	**99.60%**	**100.00%**	**122.09%**	**775.33%**	**333.33%**	**75.84%**	**100.00%**
	Obs.	**25,009**	**24,586**	**24,772**	**25,116**	**24,592**	**24,294**	**24,476**	**25,108**

Notes: The independence of the ownership structures was tested using non-parametric Wilcoxon-Mann-Witney two-sample tests at 5% significance. According to the results of these tests, the number of asterisks (*, **, ***, and ****) stands for the statistical difference of any given ownership structure from that number of other ownership structures for that indicator. For example, two asterisks (**) implies that the ownership structures is statistically different from two other ownership structures but not the third and fourth (closest) ones.

Source: Authors

4. BUSINESS MODELS AND OWNERSHIP

The descriptive statistics for the main variables describing the activities and funding strategies across ownership structures[4] are provided in Table 3.3 for the whole period.

The commercial banks account for the majority of banking assets (58%), whilst only accounting for 25% of the overall number of banks in the sample. The commercial banks are, on average, less active in retail activities than other ownership structures. Customer loans are 45.77% compared to the sample average of 56.96% and customer deposits are 53.33% compared to the average of 64.95%. In turn, these banks are relatively more active in market and inter-bank activities, with averages above the sample average. The main difference, however, is the high capital level; the tangible common equity is 13.21%which is significantly above the capital levels for the other ownership structures (on average 10.10%).

The cooperative banks are, with around 50% of the observations, the largest group of banks in the sample, whilst only accounting for 17% of assets. The activities of cooperative banks are relatively more retail oriented. Customer loans and deposits are respectively 58.96% and 70.06%. Despite the retail orientation, average inter-bank and trading activities are still sizable. Bank loans and trading assets are respectively 10.79% and 28.48%.

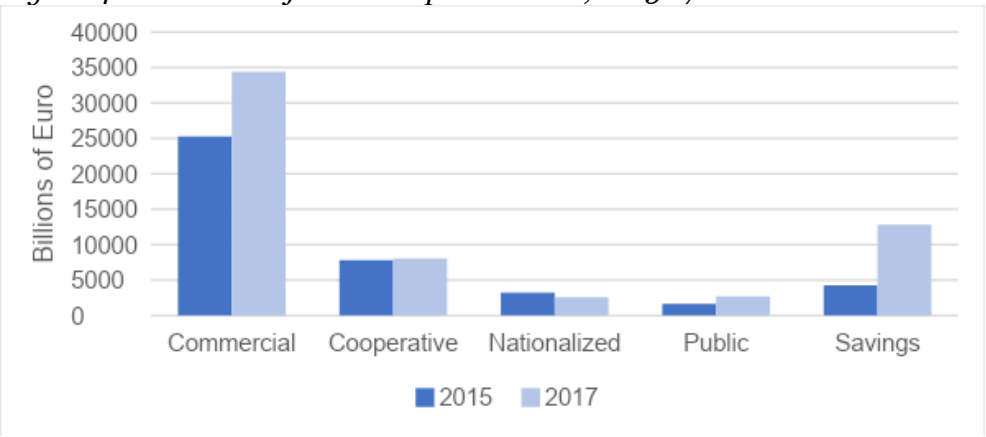
The nationalised banks are, in number, the smallest group, but on average size, the largest. The average size of the nationalised banks is €163bn, compared to €20bn for the entire sample. The restrictions put on recapitalisation make it less likely that small banks will be nationalised.[5] The nationalised banks are relatively more active in market activities, i.e. highest average trading assets. The nationalised banks obtained relatively most funds from other banks after deduction of loans to other banks, which signals that bank liabilities are obtained from central banks instead of other banks. Funding is mostly market based, with the highest share in derivatives and the second highest share in debt liabilities behind public

[4] See description on ownership structure in Ayadi (2019).

[5] The state recapitalisations of EU banks are subject to State aid rules. When assessing State aid, the European Commission, the banks' viability and need for lending to the real economy are taken into account. Smaller banks are, in particular, less likely to deliver a material contribution to the financing of the real economy. OJ C 216 of 30.7.2013 (http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013XC0730(01)&from=EN).

banks. The nationalised banks have, on average, the lowest capital level of all the ownership structures.

Figure 4.1 Total size of ownership structures, 2015-17



Source: Authors

The public banks represent only a small part of the sample, both in number of institutions and share of assets. The composition of public bank assets is comparable to the sample average. For their funding, the banks rely more on debt liabilities (27.53% compared to 12.08% for the entire sample) and derivative liabilities (1.55% compared to 0.76%), whilst they depend less on customer deposits (45.16% compared to 64.95%).

The savings banks form almost a quarter of banks in the sample, but only 12.22% as a share of the total assets (See also Figure 4.1). The savings banks are primarily active in retail-oriented activities, which are, to a large degree, similar to those of cooperative banks. Customer loans and deposits are respectively 64.19% and 69.81%. The average inter-bank and trading activities are still substantial (24.98%), but slightly less than those of commercial banks (28.48%) and cooperative banks (28.22%).

From a country perspective, there is a great dominance of commercial banking in Europe, in particular in Eastern Europe. Cooperatives and savings banks are active in countries like Austria, France, the Netherlands, and Norway[6].

Table 4.1 Ownership attributes of business models (% of institutions) (for 2005-17)

[6] In this Monitor, we do not include credit unions in the analysis.

	Model 1 - Focussed retail	Model 2 – Diversified retail (type 1)	Model 3 – Diversified retail (type 2)	Model 4 – Wholesale	Model 5 – Investment	ALL
Commercial	14.7%***	25.1%***	18.8%***	69.1%***	62.2%***	24.6%
Nationalised	0.9%****	3.4%***	0.8%***	2.3%**	0.3%**	1.25%
Shareholder-value	15.7%****	28.6%***	19.6%**	71.5%***	62.5%***	25.8%
Cooperative	63.8%**	47.2%***	47.5%***	16.8%**	28.4%***	49.8%
Savings	19.9%***	18.9%**	29.6%***	8.5%***	5.8%****	21.7%
Public	0.6%***	5.3%**	3.3%***	3.2%***	3.3%***	2.6%
Stakeholder-value	84.3%****	71.4%****	80.4%***	28.5%***	37.5%****	74.2%
Listed on stock exchange	5.5%****	22.1%***	8.6%**	15.3%****	3.6%***	9.3%

(% of institutions) (for 2017)

	Model 1 - Focussed retail	Model 2 – Diversified retail (type 1)	Model 3 – Diversified retail (type 2)	Model 4 – Wholesale	Model 5 – Investment	ALL
Commercial	16.6%**	16.8%***	41.7%***	49.1%***	72.7%**	23.8%
Nationalised	0.5%***	0.9%***	4.6%**	0.3%***	2.1%*	0.9%
Shareholder-value	17.1%****	17.7%****	46.3%***	49.5%**	74.7%***	24.8%
Cooperative	47.3%***	62.9%***	20.5%***	43.2%***	14.1%***	49.9%
Savings	32.5%*	18.3%**	21.2%**	4.5%**	10.1%***	22.7%
Public	2.9%***	0.9%***	11.9%***	2.4%***	1.0%***	2.6%
Stakeholder-value	82.8%****	82.2%****	53.6%****	50.2%****	25.2%****	75.2%
Listed on stock exchange	6.4%***	5.7%***	27.2%***	2.1%**	14.1%*	7.2%

Notes: All figures are the average values for the year-end observations for the business models. The independence of cluster sub-samples was tested using the Wilcoxon-Mann-Whitney non-parametric two-sample tests at 5% significance. According to the results of these tests, the number of asterisks (*, **,*** or ****) stands for the statistical difference of any given cluster from that number of other clusters for that indicator. Also, see in footnote 9 the precision about data on ownership structure.
Source: Authors

Turning to the variation in ownership structures, in terms of number of institutions, Table 4.1 shows that Investment banks are mostly owned by

profit-maximisers during the period from 2005 to 2017. Wholesale banks are owned nearly as often by shareholder and stakeholder value banks. In turn, retail banks are mostly stakeholder value banks which is reflected in the highest share of cooperative and savings banks. Moreover, a relatively large share of Wholesale banks is publicly owned or listed. In fact, 15% of Wholesale banks are listed whilst, on average, 9.3% of the banks in the sample have publicly listed shares. The highest share of listed banks can be found amongst the Diversified retail (type 2) banks (22%).

The second part of Table 4.1 shows the relationship between ownership structure and business models in terms of number of institutions with regard to the last year observed (2017). The data shows that in this latest year banks with a specific ownership structure adopt different business models compared to the past. In 2017, the number of shareholder value banks that adopt the Diversified retail (type 2) was, with 46.3%, more than double the percentage observed on average for the whole period. On the contrary, the stakeholder value banks move towards the wholesale and the Diversified retail model (type 1) in 2017, shifting from Diversified retail (type 2) and investment business models. These findings suggest that shareholder banks increase market activity, whilst stakeholder banks become more retail oriented and interbank oriented, reducing their adoption of more market oriented business models.

Table 4.2 Distribution of ownership structures across business models (2005-17, % of assets

	Model 1 - Focussed retail	**Model 2 – Diversified retail (type 1)**	**Model 3 – Diversified retail (type 2)**	**Model 4 – Wholesale**	**Model 5 – Investment**	**ALL**
Commercial	27.12%***	54.73%***	50.30%***	33.08%***	80.11%***	57.86%
Nationalised	8.12%***	20.42%***	8.31%***	7.48%***	6.45%***	10.13%
Shareholder	**35.24%*****	**75.15%*****	**58.61%*****	**40.56%*****	**86.57%*****	**67.99 %**
Cooperative	26.76%***	13.59%**	21.05%***	9.77%**	10.50%***	16.63%
Savings	29.46%**	10.19%***	16.75%****	22.95%***	2.07%***	12.22%
Public	8.54%****	1.07%****	3.60%****	26.71%**	0.87%****	3.16%
Stakeholder	**64.76%*****	**24.85%*****	**41.39%*****	**59.44%*****	**13.43%*****	**32.01 %**
Listed on stock exchange	35.25%**	70.01%**	61.61%**	1.84%***	72.56%**	63.11%

(2017, % of assets)

	Model 1 - Focussed retail	Model 2 – Diversified retail (type 1)	Model 3 – Diversified retail (type 2)	Model 4 – Wholesale	Model 5 – Investment	ALL
Commercial	31.38%****	72.86%****	45.74%***	71.73%***	91.01%***	56.75%
Nationalised	4.07%***	10.53%***	2.96%***	0.69%****	1.77%***	4.30%
Shareholder	**35.44%****	**83.38%***	**48.71%*****	**72.42%***	**92.78%***	**61.06 %**
Cooperative	20.10%***	6.50%**	17.03%***	3.47%***	5.74%**	13.32%
Savings	36.53%***	9.48%**	28.72%**	1.92%****	1.30%**	21.13%
Public	7.92%****	0.64%**	5.55%***	22.20%**	0.19%***	4.49%
Stakeholder	**64.56%*****	**16.62%****	**51.29%****	**27.58%*****	**7.22%*****	**38.94 %**
Listed on stock exchange	44.61%***	76.30%***	64.58%***	0.62%*	68.11%***	63.34%

Notes: All figures are the average total asset values for the year-end observations for the business models. The independence of cluster sub-samples was tested using the Wilcoxon-Mann-Whitney non-parametric two-sample tests at 5% significance. According to the results of these tests, the number of asterisks (*, **, *** or ****) stands for the statistical difference of any given cluster from that number of other clusters for that indicator. Also, see in footnote 9 the precision about data on ownership structure.
Source: Authors

In terms of assets the results are substantially different. As shown in *Table 4.2*, the dominance of commercial banks amongst investment-oriented banks is more apparent, whilst the share of wholesale bank assets is marginal. Commercial banks represent 69% of wholesale banks in number, but only 33% of assets. In turn, public banks represent only 3.2% of the banks, but 26.7% of assets. Savings banks that have relatively large shares of retail-oriented banks also have a substantial share of the wholesale assets (22.95%), whilst the share in investment bank assets is marginal (2.07%). Second only to commercial banks, cooperative banks relatively have the largest share of retail-oriented bank assets (mainly retail Focussed), except for retail diversified (type 1). In fact, in the Focussed retail, cooperative banks represent 26.76% of total assets and in the Diversified retail (type 2) they represent 21.05% of total assets, whereas in the Diversified retail (type 1) they represent only 13.59% of total assets. In fact, in this last business model, the second ownership structure in term of total assets is represented by nationalised banks (20.42%).

Also, in term of assets, the situation changes when we look at the data relating to 2017. In fact, commercial banks represent 71.73% and 91.01% respectively of wholesale and investment business models; that is a very

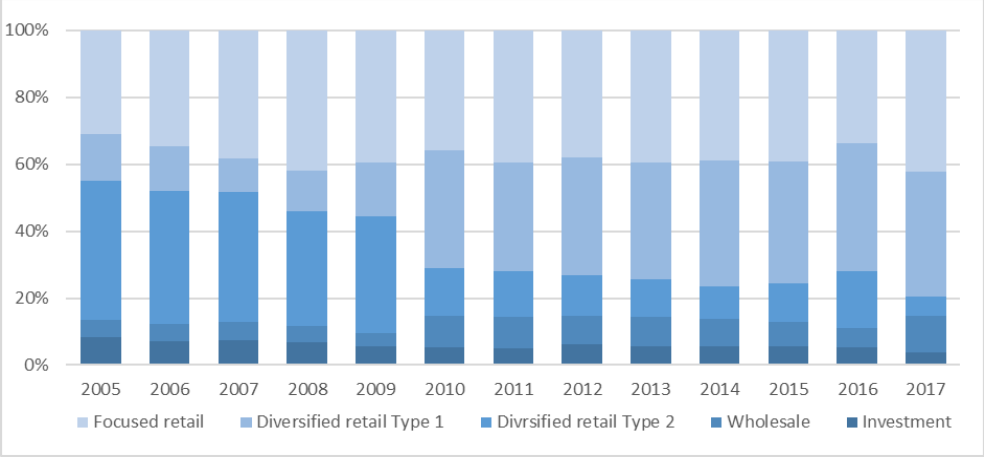
high percentage if compared with the average value of the total period. In 2017, in terms of total assets, shareholder banks represent similar shares of shareholder value banks. The only exceptions are Diversified retail (type 2) and Wholesale banks, which are a substantially lower share of shareholder value banks for Diversified retail (type 2) and a higher share for Wholesale banks.

Finally, Figure 4.2 shows the distribution of year observations across the period, both with regard to the business model adopted and the ownership structure assumed by banks. With regard to the business model, the number of Focussed retail banks remains the same during the observed period, the number of banks that adopt Diversified retail (type 2) drastically reduced after 2009, whilst Diversified retail (type 1) increased. Moreover, investment business model adoption decreases during the observed period, whilst the wholesale business model increases. This suggests that banks, during the period 2005-2017, tend to adopt market oriented business models.

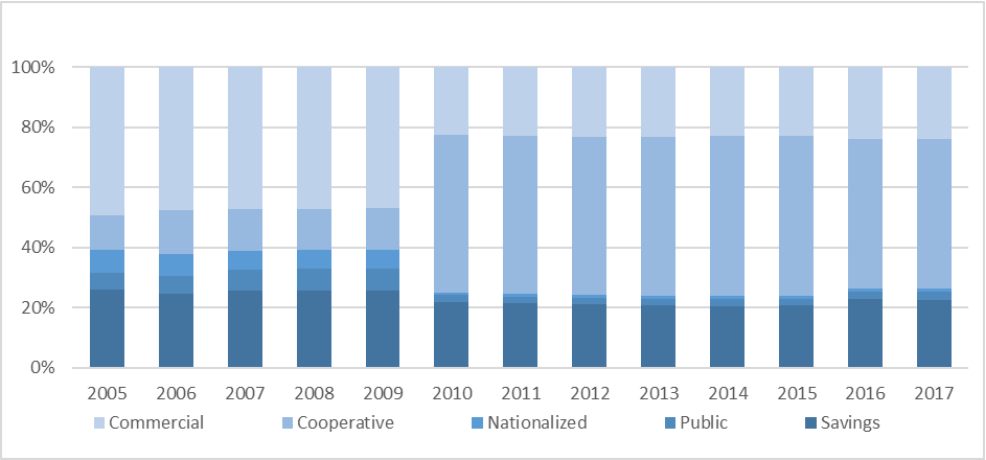
Looking at the composition of ownership structure composition, we observe that in 2010 the sample composition changes, with an increase in the number of cooperative banks. This is due to the great increase in the number of banks that are included in the sample. In fact, since 2010, our sample increases from about 300 to 3,000 institutions because the coverage of smaller European banks in SNL improved.

Figure 4.2 The distribution of yearly-observations throughout the period

(% of observation and business models adopted)



(% of observation and ownership structure)



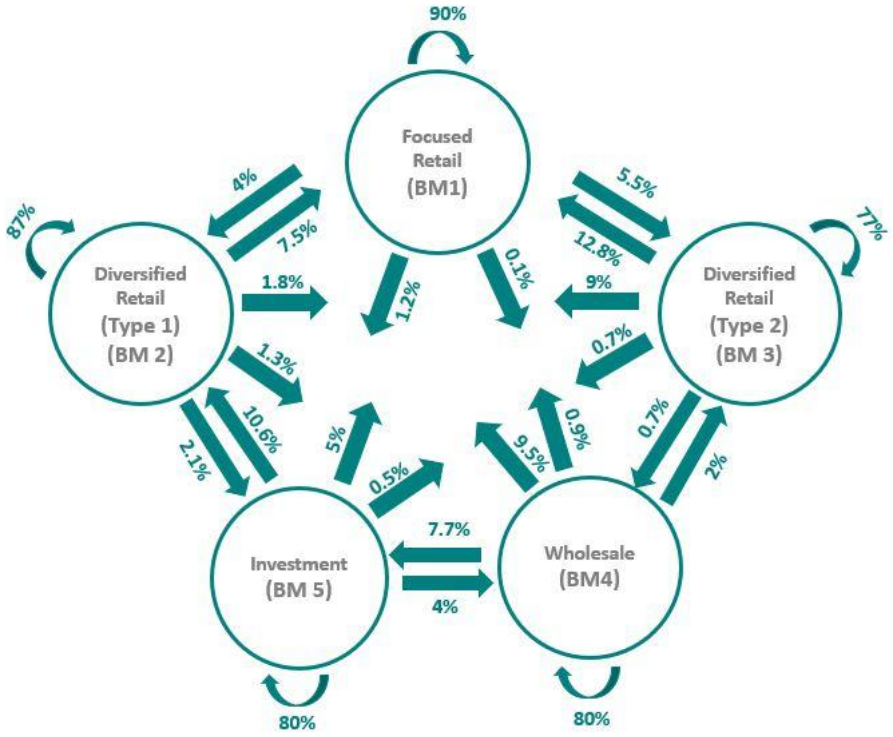
Source: Authors

5. MIGRATION OF BUSINESS MODELS

Banks change their business models, hereafter called "migration"[7]. The process of switching from one business model to another can provide a wealth of information about the strategy of banks and their behaviour in the market and about their risk profiles and their contribution to systemic risk over time.

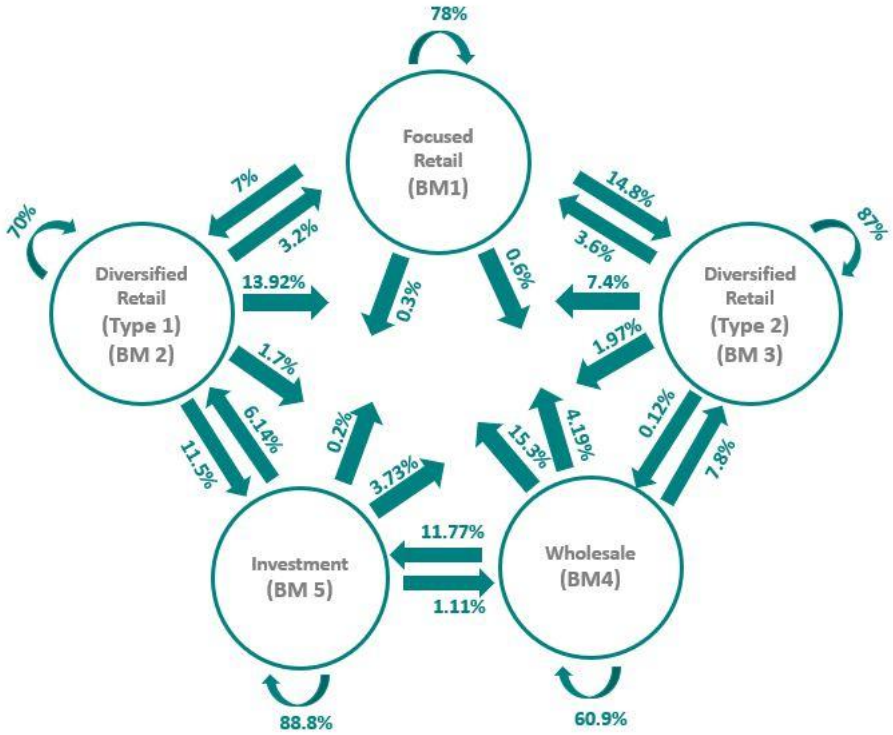
Figure 5.1 Model transition matrix, share of bank (%, 2005-17)

a) Number of Observations



b) Total assets

[7] Term used in Ayadi et al (2016), Ayadi et al (2017) and confirmed in Ayadi (2019) to describe the process of changing bank business models.



Note: The figures give the share of banks that belong to a specific model in one period switching to another model (or remaining assigned to the same model) in the next period. The first figure shows the number of observations that migrates, whilst the second figure shows migrations in terms of total assets.
Source: Authors

Although the composition of banks under the different models remains relatively steady over time, transitions do occur and more so in some models than in others.[8] Figure 5.1 provides the transition matrix for the five models during the years 2005 to 2017. The assignment of banks to the Focussed retail model shows the highest persistence; 90% of the banks remained the same from one year to the next. The vast majority of Diversified retail (type 1), Diversified retail (type 2), Wholesale and Investment banks remained within the same model throughout the sampled years (70%, 87%, 61%, and 89% respectively). The remainder of migration was primarily to Diversified retail (type 1), with flows ranging between 4% from Focussed retail to 10.6% from Wholesale banks. The other large transition flows are between retail banks. Indeed, a large share

[8] See Appendix X for a list of systemic banks including their business models.

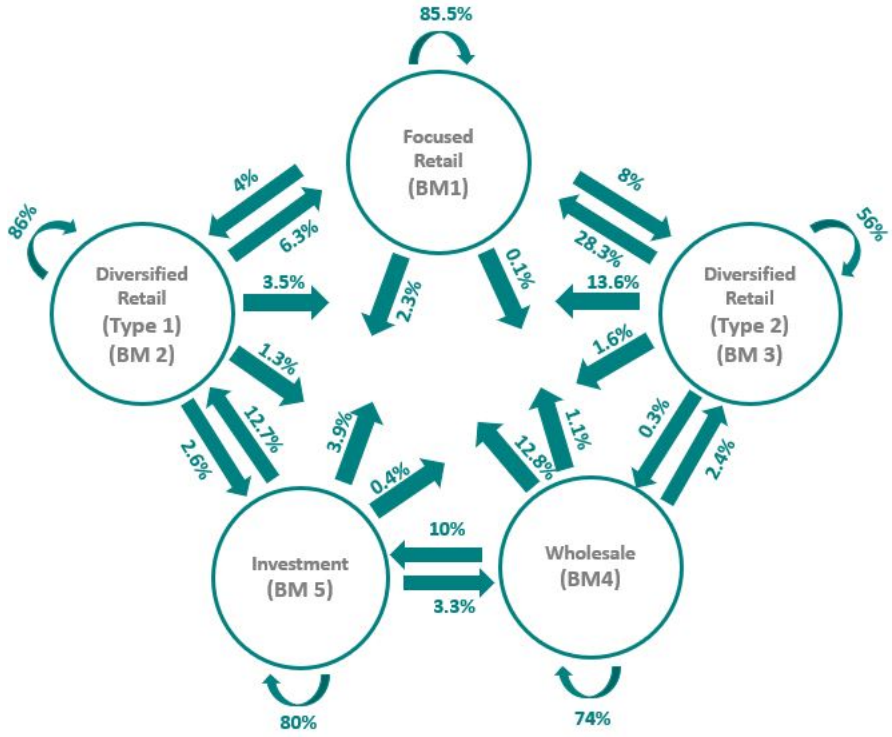
of Diversified retail (type 1) banks that migrated, was to Focussed retail (7.5%) and 12.8% of banks migrated from Diversified retail (type 2) to Focussed retail. Many Wholesale banks further migrated to Investment banks and vice-versa; 7.7% of Wholesale banks migrated to Investment banks and 4.0% went in the other direction.

However, looking at migrations in terms of total assets, the percentages are slightly different with Investment banks showing the highest persistence. Whilst regarding the Retail Focussed business models, we observe that larger retail banks move to Diversified retail business models (both type 1 and type 2).

Looking at the total migration, on 25,402 bank-year observations covering 3,287 banks, we observe 3,189 migrations and 1,709 banks that move at least once. Therefore, migrating banks on average move 1.9 times. This suggests that, although banks are stable and remain in the same business models, there is a group of banks that migrated and evolved their business model more than once during the last 13 years.

As shown in Appendix V, on average, bank business models seem stable over time across countries, except in Belgium where banks displayed a relatively quick move from the investment/wholesale oriented model to the retail-oriented business model, due to the collapse of the two large Belgian banks, Dexia and Fortis.

Figure 5.2 Model transition matrix latest two years, share of banks (%, 2015-2017)



Note: The figures give the share of banks (in number) that belong to a specific model in one period switching to another model (or remaining assigned to the same model) in the next period.

Source: Authors

Looking only at transitions during the last two years under examination, the changes are largely the same (See also Figure 5.2). The persistence is slightly higher for all business models, except for Diversified retail (type 2) banks (only 56% of banks remain in this business model). In particular, banks migrate from Diversified retail (type 2) to the Focussed retail business model (28%) and to Diversified retail (type 1) (13%).

With regards to the other bank business model, Figure 5.2 shows that banks that adopt the Investment business model migrate to the Wholesale (10%) and to the Diversified retail (type 1) business model (12.8%), whilst e, Wholesale banks mainly move to the Diversified retail (type 1) business model (12.7%). Finally, banks that adopt the Focussed retail business model show the highest persistence and banks that change their business model move primarily to Diversified retail (type 1) (4%) and to Diversified retail (type 2) (8%).

In terms of number of migrations, 1,568 are registered in the last two years and refer to 1,075 banks, suggesting that in the most recent period (after the financial crisis) banks are more willing to change their business models and there are some banks that move more than once. After the financial crises, banks tend to move more towards retail-oriented business models. In fact, between 2015 and 2017, Focussed retail and Diversified retail (type 1) are the only business models showing a positive net flow (inflow minus outflow of banks) respectively, equal to 25% and 29%, whilst the other business models show more banks moving to other business models than those joining them. In particular, Diversified retail (type 2) banks are the banks that move most frequently to the other Retail-oriented banks. Also, during the financial crisis, banks tend to move more towards retail-oriented business models. In fact, only these business models show a positive net-flow of migrations, yet inflows were lower than after the financial crises.

Table 5.1 Model transition matrix of aided banks (2005 to 2017)

		Business model in 2017				
		Focussed retail	**Diversified retail (type 1)**	**Diversified retail (type 2)**	**Wholesale**	**Investment**
Business model prior to intervention	**Focussed retail**	80.2%	13.2%	6.6%	0.0%	0.0%
	Diversified retail (type 1)	5.8%	82.6%	8.1%	0.0%	3.5%
	Diversified retail (type 2)	8.3%	4.8%	85.5%	0.4%	0.9%
	Wholesale	0.0%	16.7%	16.7%	66.7%	0.0%
	Investment	0.0%	27.3%	36.4%	0.0%	36.4 %

Note: The table shows the migration of banks that have received State aid in the period from 2007 up to 2017. A total of 68 banks are concerned. The business models in the year before the first intervention and the most recent year covered in the sample (i.e. 2017) are compared. Only banks that have benefitted from recapitalisation measures are included. Hence, only banks that received capital support were bound to restructure their activities, whilst banks that only received liquidity support (i.e. credit guarantees and loans) were not.
Source: Authors

Since the financial crisis erupted, many European governments have supported their banks in order to safeguard financial stability and to avoid

disruption to the real economy. The banks in the EU that required capital support had to fulfil certain conditions in order to become economically sound, to prevent a distortion of the market and a break-up of the lending chain. Most of the conditions stipulated in the restructuring plans contained bank specific conditions which, in general, foresaw a focus on more traditional banking activities, i.e. lending to the real economy using customer deposits[9]. For many of the banks, this meant the persistence or transition towards more retail-oriented business models. Table 5.1 shows that more than half of Investment banks that received state aid change their business model in the subsequent years, mainly moving to Diversified retail (type 1 and type 2) business models. Also Wholesale banks, after receiving state aid, are more encouraged to change their business model. They move primarily to Diversified retail (type 1) and type 2 business models. These results suggest that Investment and Wholesale banks that received state aid during the financial turmoil are more willing to shift to more retail-oriented business models.

The state-aided banks that were identified as Focussed or Diversified retail banks before the intervention show the highest persistence in the same business model (higher than 80%). Most of the retail-oriented banks that changed model turned to other retail business models. About 8.1% of Diversified retail (type 1) banks turned into Diversified retail (type 2) banks, whilst 5.8% shifted to Focussed retail in the period up to 2017 and 3.5% to the Investment model.[10] With regard to the Diversified retail (type 2) banks, they mainly move to the more retail-oriented business models. In fact, 8.3% move to the Focussed retail business model and 4.8% shift to Diversified retail (type 1).

[9] See Ayadi et al. (2015).

[10] An analysis of the year-by-year transitions (not provided here) shows that the transition to diversified retail (type 1) was particularly high in 2009 and from 2011 to 2014, in the midst of the crises and aftermath, when non-deposit funding was more difficult to attract and regulatory scrutiny more intense.

6. PERFORMANCE OF BUSINESS MODELS

The second phase of the analysis provides an assessment of the performance and the contribution of banks to the real economy across different business models and ownership structures.

Diversified retail banks (type 1) appear to do relatively well in return on assets (RoA) and return on equity (RoE) compared to the other retail-oriented banks, whilst their cost-to-income ratio (CIR) is not significantly worse than the other retail-oriented business models. In turn, the more market funded Diversified retail (type 2) banks appear to be on the other side of the spectrum, showing significantly the lowest RoA and RoE and significantly better CIR. The results of the other business models are more diffuse. Investment banks show better RoA and RoE than the other five business models and significantly higher than the median of the whole sample, whilst Wholesale banks are in the middle of the other business models. Moreover, the CIR of Wholesale and Investment banks is the worst of the five business models. Lastly, due to a substantial variation in RoE and CIR figures, the median values were used in the analysis in order to reduce the impact of outliers on the results.

Looking at the differences between ownership structures, commercial banks clearly stand out in terms of RoA and RoE, whilst in terms of CIR they are worse than the other four ownership structures. In turn, the other shareholder value type institutions do worst. Hence, nationalised banks quoted both the lowest RoA and RoE. The RoA of the three stakeholder-value ownership structures is around the sample median. Due to differences in leverage, the cooperative banks report significantly higher RoE than public and savings banks. Public banks quote the significantly lowest CIR, whilst commercial, cooperative and savings banks appear significantly less efficient.

The contribution to the real economy of the Focussed retail model has been significantly higher than other business models. The loan growth of the Diversified retail (type 2) banks was significantly lower than any of the other types. The loan growth of the predominantly deposit funded Diversified retail (type 1) and Wholesale banks are clearly in between.

The loan growth of the nationalised banks has even been negative in the period from 2005 to 2017. The other government-owned type of banks - public banks - reported the highest loan growth, followed by commercial banks that show the second highest growth.

The median performances of the business models and ownership structures shown in Table 6.1 hide the evolution of profits over recent years. As depicted in Figures 6.1 and 6.2, when the time span of the profit indicators is considered, a distinction should be made between the financial crisis from 2007 to 2009, the Eurozone economic crisis from 2010 to 2013 and the post-crisis period (2014-2017).

Table 6.1 Performance, income and contribution to real economy indicators

a) Business models

	Model 1 - Focussed retail	**Model 2 – Diversified retail (Type 1)**	**Model 3 – Diversified retail (Type 2)**	**Model 4 – Wholesale**	**Model 5 – Investment**	**All**
Return on assets (RoA)	0.51%***	0.48%***	0.42%***	0.50%***	0.51%***	**0.49%**
Return on equity (RoE)	5.98%***	5.73%***	5.26%***	5.32%***	6.67%***	**5.80%**
Cost-to-income (CIR)	67.55%***	68.20%**	63.50%***	74.16%***	71.17%***	**67.77%**
Net interest	73.84%**	72.67%**	66.50%***	50.07%**	30.36%***	**71.93%**
Commission & fees	20.55%***	20.72%***	20.02%**	31.42%***	24.20%***	**20.81%**
Trading	0.00%**	0.00%***	3.51%***	1.33%**	5.60%***	**0.62%**
Other	3.38%***	3.75%***	6.71%***	2.22%***	3.36%***	**3.77%**
Customer loan growth	4.37%***	3.45%***	1.81%**	2.76%***	2.13%***	**3.63%**

b) Ownership structures

	Commercial	Cooperative	Nationalised	Public	Savings	**All**
Return on assets (RoA)	0.61%***	0.49%***	0.20%***	0.48%***	0.43%***	**0.49%**
Return on equity (RoE)	6.73%***	5.81%***	4.56%***	6.20%**	5.34%***	**5.80%**
Cost-to-income (CIR)	68.57%***	68.51%***	58.46%**	57.82%***	66.16%***	**67.77%**

Net interest	55.94%***	73.00%***	69.73%***	72.52%****	73.80%**	**71.93%**
Commission & fees	24.15%***	20.55%***	17.80%***	16.80%**	20.67%***	**20.81%**
Trading	4.64%**	0.00%***	5.00%***	5.62%***	0.09%***	**0.06%**
Other	2.77%***	4.00%***	2.78%***	1.81%***	4.06%***	**3.77%**
Customer loan growth	4.55%***	3.83%**	-2.84%***	5.69%***	2.95%***	**3.64%**

Notes: All figures are the median values for the year-end observations for the relevant sub-sample. The independence of clusters was tested using non-parametric equality-of-means two-sample tests at 5% significance. According to the results of these tests, the number of asterisks (*, **, *** or ****) stands for the statistical difference of any given cluster from that number of other clusters for that indicator. For example, three asterisks (***) imply that the cluster or ownership structure is statistically different from the three (furthest) clusters/ownership structure but not the fourth (closest) one.

Source: Authors

Looking at the highest and lowest bank performances (Table 6.2), Investment banks, on average, record both the highest and lowest performances in terms of return on assets and return on equity, whilst in terms of efficiency, Investment banks show the lowest ratio (highest cost efficiency), and Wholesale the highest – with 47.62% of total Wholesale banks being in the first quartile. Retail-oriented business models emphasise a similar average value both in terms of return on assets and cost efficiency. However, in terms of RoE, Diversified retail (type 2) banks show the lowest and the highest percentage level amongst retail-oriented banks, with a high number of banks distributed in the first and last quartiles. Looking at the net interest income, retail-oriented banks show similar levels, whilst Investment and Wholesale banks highlight both the highest and lowest average net interest income, with more than half of these banks distributed in the first quartile (69.84% and 58.03%, respectively). Also, with regard to commissions & fees, retail-oriented business models, although showing lower commissions than market-oriented banks, record higher average commissions than other banks in the first quartile, confirming that, although commission income is not the most important income, on average, commissions represent an important component of total revenues. As expected, Investment banks have the highest average value of trading commissions, with more than half of them distributed in the last quartile. Finally, Wholesale and Investment banks show the highest and lowest growth of customer loans, with a high percentage of banks distributed in the first and last quartiles; whilst retail-oriented banks show similar growth ratios, lower than -5.90% in the first part of the distribution (0-25%) and higher than 21% in the last quartile (75%-100% of the distribution). This

suggests that, on average, retail-oriented banks are more capable of keeping a constant growth of loans than other business models. Table 6.2 emphasises that retail-oriented business models are more stable and the differences between the quartile distributions are not very large. Looking at distribution, most retail-oriented banks are distributed in the middle quartile (not the worst or the best), whilst Wholesale and Investment banks show a very high percentage of banks in the first and last quartiles.

Table 6.2 Performance, income and contribution to real economy indicators, highest and lowest banks' performances

Ratio	Quartile	Focussed retail	Div. type 1	Div. type 2	Wholesale	Investment	Tot
Return on assets (RoA)	*Lowest*	-0.35%	-0.35%	-0.81%	-2.68%	-4.26%	***-0.99%***
	N%	*20.41%*	*21.68%*	*36.75%*	*33.93%*	*36.20%*	***25.00%***
	Highest	1.43%	1.31%	1.73%	3.25%	5.11%	***1.92%***
	N%	*26.48%*	*19.74%*	*25.15%*	*33.68%*	*36.94%*	***25.00%***
Return on equity (RoE)	*Lowest*	-8.53%	-4.85%	-15.75%	-11.16%	-23.81%	***-10.13%***
	N%	*20.46%*	*22.38%*	*34.90%*	*35.92%*	*33.08%*	***25.00%***
	Highest	14.36%	15.55%	19.46%	23.02%	33.92%	***17.97%***
	N%	*24.77%*	*20.11%*	*30.61%*	*29.54%*	*38.34%*	***25.00%***
Cost to income	*Lowest*	48.79%	49.34%	43.59%	-2.44%	-49.00%	***37.06%***
	N%	*24.76%*	*18.60%*	*38.59%*	*25.67%*	*32.12%*	***25.00%***
	Highest	90.35%	109.98 %	144.17%	200.98%	195.27%	***127.44 %***
	N%	*22.59%*	*23.09%*	*17.60%*	*47.62%*	*43.12%*	***25.00%***
Net interest income	*Lowest*	46.13%	42.13%	45.01%	17.12%	13.13%	***34.73%***
	N%	*13.02%*	*19.64%*	*36.30%*	*58.03%*	*69.84%*	***25.00%***
	Highest	84.95%	85.18%	100.26 %	95.92%	233.67%	***92.51%***
	N%	*29.64%*	*24.70%*	*20.22%*	*18.79%*	*16.54%*	***25.00%***
Commissions & fees	*Lowest*	8.84%	9.64%	5.17%	-4.55%	1.71%	***6.98%***
	N%	*25.02%*	*21.24%*	*31.24%*	*23.00%*	*35.74%*	***25.00%***
	Highest	33.78%	37.06%	33.63%	58.03%	66.86%	***42.33%***
	N%	*19.85%*	*21.43%*	*22.25%*	*57.74%*	*48.77%*	***24.69%***
Trading commissions	*Lowest*	-4.61%	-8.49%	-19.15%	-27.42%	-168.74%	***-22.10%***
	N%	*27.76%*	*26.16%*	*21.47%*	*20.53%*	*20.13%*	***25.00%***
	Highest	12.88%	18.80%	19.13%	32.90%	34.67%	***20.79%***
	N%	*11.85%*	*30.87%*	*29.72%*	*33.40%*	*51.36%*	***25.00%***
Other income	*Lowest*	-0.19%	-2.35%	-4.98%	-2.75%	-3.56%	***-1.90%***
	N%	*25.45%*	*20.94%*	*17.00%*	*45.69%*	*38.53%*	***25.00%***
	Highest	17.32%	15.87%	18.17%	45.70%	45.60%	***20.69%***
	N%	*19.49%*	*23.97%*	*44.25%*	*22.16%*	*32.13%*	***25.00%***

Customer loans growth	*Lowest*	-5.91%	-6.29%	-5.90%	-18.93%	-21.11%	***-8.27%***
	N%	*18.94%*	*21.76%*	*37.34%*	*41.39%*	*44.35%*	***25.00%***
	Highest	19.23%	20.76%	19.65%	30.28%	24.87%	***20.92%***
	N%	*27.06%*	*21.03%*	*22.87%*	*37.36%*	*31.74%*	***25.00%***

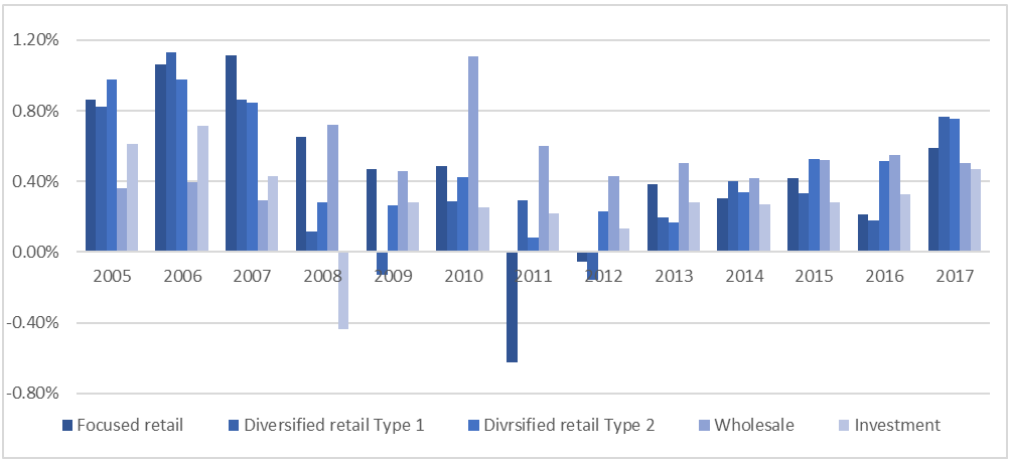
Notes: The Table presents the highest and lowest performances in each indicator. Using quartile distribution, we define the first and fourth quartile for each indicator over the whole observed period . Highest bank performances are shown in the fourth quartile (from 75% to 100% of distribution), whilst lowest banks performances are shown in the first quartile (from 0% to 25% of distribution). In the N% line we report the percentage of banks that are in the observed quartile..

Since the outbreak of the crises, the performance of banks across all business models has worsened. Indeed, in the period from 2008 to 2013, none of the business models quoted returns above the RoA levels of 2005 and 2006, except for Wholesale banks. More specifically, in the run-up and during the financial crisis, Investment and Diversified retail (type 1) banks clearly lagged behind their peers, profits turning to losses or close to break-even. Thereafter, during the Eurozone economic crisis, the profits of Investment banks recovered to levels that were well below pre-crises levels. On the other hand, the returns from retail banks only fell in 2008, turning the profits of Focussed and Diversified retail (type 1) banks into losses for some years during the economic crisis. Interestingly, only Diversified retail (type 2) managed to maintain persistently positive results for every year.

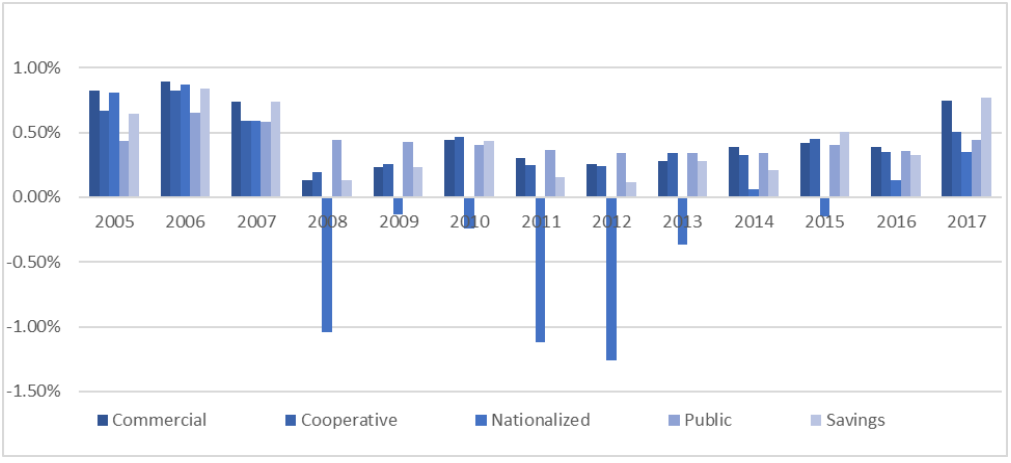
Looking across ownership structures, before the crises, public and savings banks reported slightly lower profits than the other types of bank. During the first year of the crisis (i.e. 2007) banks across all ownership structures were able to continue making profits close to their pre-crisis levels. Afterwards, profits dropped to levels close to break-even, before recovering to slightly higher profit levels. The differences between ownership types are small, except for nationalised banks. The latter has been continuously loss-making between 2008 and 2015, except for 2014 where they show a small profit. During the last two years observed, nationalised banks made a small profit again.

Figure 6.1 Evolution of return on assets (RoA)

a) Business models



b) Ownership structures



Note: All figures are the weighted average values for each accounting year, by business model/ownership structure. The weighting scheme uses individual total assets.

Source: Authors

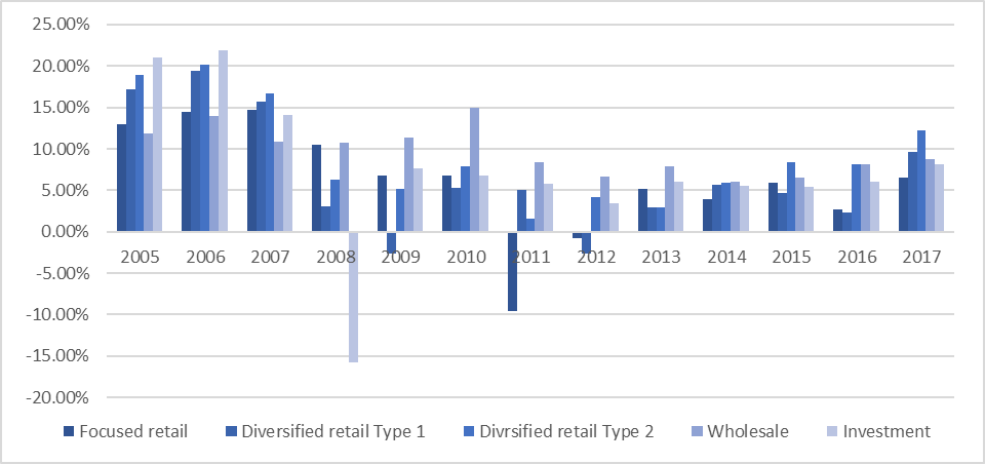
Turning to RoE, the results are broadly similar. Hence, only the distance between the business models changed, due to differences in leverage (i.e. total assets over [tangible common] equity). Before the financial crisis, every bank business model shows a positive RoE of above 10%. During the financial crisis 2007-2009, profitability decreased and, in particular, Investment and Diversified retail (type 1) emphasised a negative value. Also, during the Eurozone economic crisis, more retail-oriented

banks, such as Focussed retail and Diversified retail (type 1) showed negative results, whilst Wholesale and Investment banks highlighted low but positive RoEs.

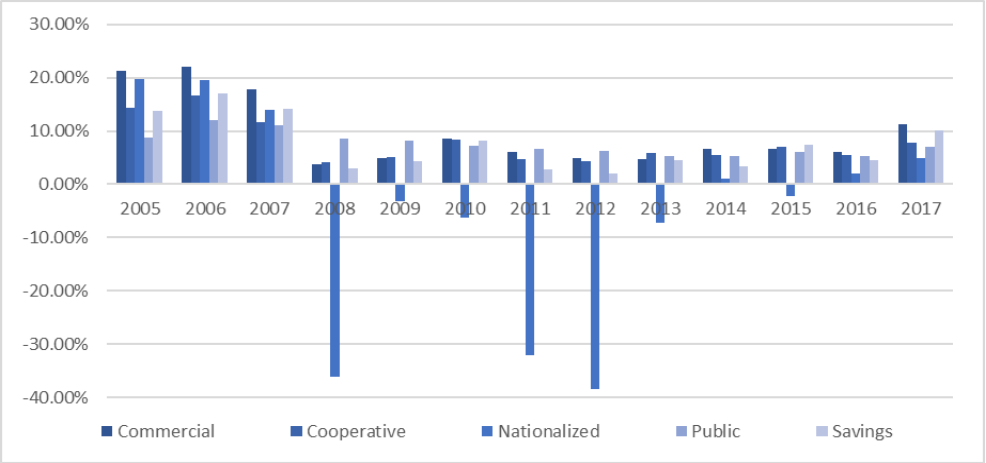
The results are also broadly similar for ownership structures. Since 2005, the leverage ratios across ownership structures have switched and, with it, RoE ratios. In fact, the low leverage of public and savings banks increased the gap with commercial and cooperative banks having higher RoE ratios. The losses of nationalised banks are most apparent, however, during the crises. Hence, nationalised banks were up to four times more leveraged during that period, compared to the other ownership structures. Only in the later years, do nationalised banks show an increase in their profitability ratio, higher than zero.

Figure 6.2 Evolution of return on equity (RoE)

a) Business models



b) Ownership structures



Note: All figures are the weighted average values for each accounting year, by business model/ownership structure. The weighting scheme uses individual total equities.

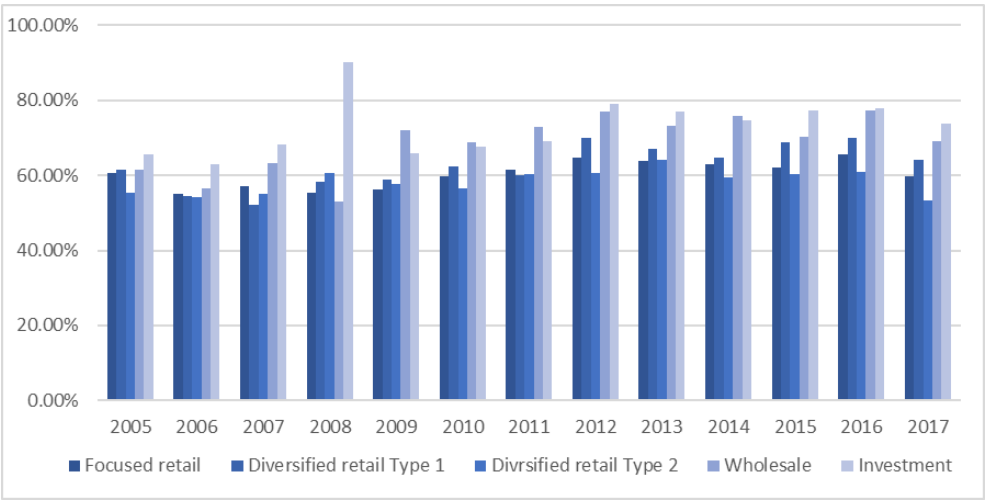
Source: Authors

Operational efficiency is measured by using the cost-income ratio (CIR). The efficiency across all business models has deteriorated in the past decade, from 59.9% to 68.9% - at the height of the crisis - for the entire sample, falling again in the final year of the analysis (60.4%). In particular, Figure 6.3 shows that Investment and Wholesale banks were especially inefficient at the height of the financial crisis and in the aftermath of the economic crisis. The retail banks saw their efficiency ratio initially improve, before their CIR deteriorated during the European financial crisis. The efficiency ratio of Diversified retail (type 2) banks improved over the last two years, whilst Diversified retail (type 1) and Focussed retail improved in 2017.

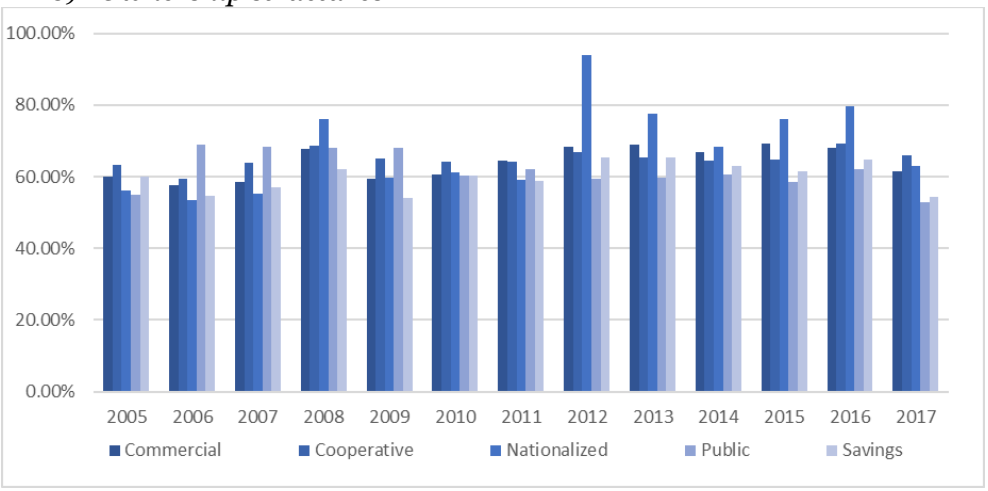
Also, the CIR deteriorated across all ownership structures, after an initial improvement in the years before the financial crisis. Nationalised banks initially scored amongst the most efficient banks, but turned out to be the least efficient between 2012 and 2016. The worst years were at the height of the economic crises, with CIR of 93.8% in 2012. The efficiency ratios of the other ownership structures were more stable over time. Commercial and cooperative banks appear less efficient than public and savings banks.

Figure 6.3 Evolution of cost-income ratio (CIR)

a) Business models



b) Ownership structures



Note: All figures are the weighted average values for each accounting year, by business model/ownership structure. The weighting scheme uses individual total operational incomes.

Source: Authors

A more detailed analysis of the breakdown of income reveals a mixed picture. Figure 6.4 shows that Wholesale and Investment banks clearly have substantial non-interest earnings, most notably from fees, trading and other earnings (including insurance). Meanwhile, retail banks rely substantially more on interest income. In fact, interest income is most important to Focussed retail banks, followed by the primarily debt liability reliant Diversified retail (type 2) banks and deposit funded Diversified retail (type 1) banks.

The figures also highlight several less straightforward results. In particular, all business models on average earn between 21% and 41% of their net incomes in commissions and fees.

With regards to commissions and fees, Wholesale banks show the highest value, followed by Investment banks. This is in line with the main activities of these banks.

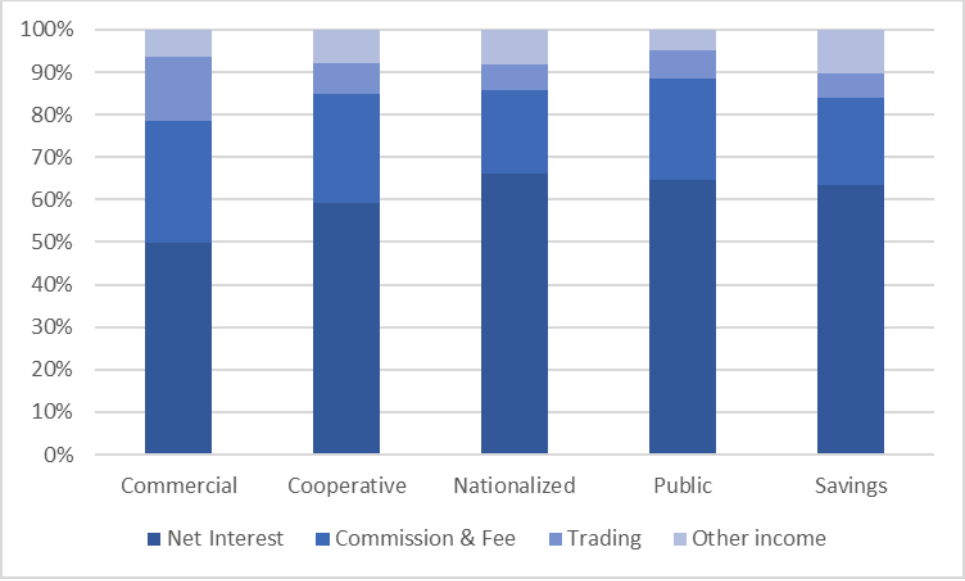
Looking at the median values displayed in Table 6.1, the aggregate values show an important difference compared to the median values. Hence, retail-oriented and Wholesale banks reported lower aggregate net interest earnings than the median values, whilst Investment banks reported higher aggregate net interest income than the median value, suggesting that other earnings from Investment banks are more varied.

Income varies across ownership structures. The stakeholder value banks rely relatively more on net interest income than commercial banks. For commercial banks, commission and fee income is more important than for other ownership structures. Trading income is significantly more important for commercial banks than for cooperative, savings and nationalised banks. Yet, there is no clear distinction between the trading income of commercial, nationalised and public banks, for which the aggregates are relatively different from the medians shown in Table 6.1. In particular, the aggregate net trading income of cooperative and savings banks is not reflected in the median trading income. In particular, cooperative banks and savings banks show an aggregate value of 7% and 6% versus a median value of 0.00% and 0.09% respectively.

Figure 6.4 Main income sources, 2005-2017

a) Business models

b) Ownership structures



Note: Since annual results are substantially varied, the figures represent the aggregate proportions obtained by summing up the observations for each income item and ownership structure for the period from 2005 to 2017.

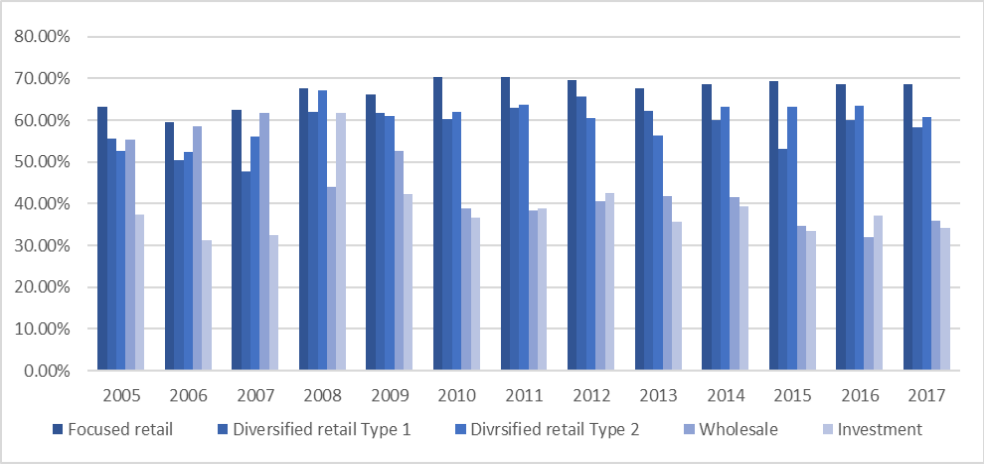
Source: Authors

The net interest income has become relatively more important since the outbreak of the financial crisis. The net interest income of retail-oriented banks has increased during the 2007-09 financial crisis. Net interest income levels remain above pre-financial crisis levels, however, as shown in Figure 6.5. The Wholesale banks were, especially during the period from 2006 to 2009, heavily reliant on interest income, whilst afterwards net interest income, as a share of the total, dropped to lower than the pre-crisis level, with an average value lower than 40%. Net interest income accounted for up to 37% of Investment bank income before it jumped to 62% in 2008. Afterwards, between 2009 and 2014, the share fell sharply, ranging between 33% and 43%.

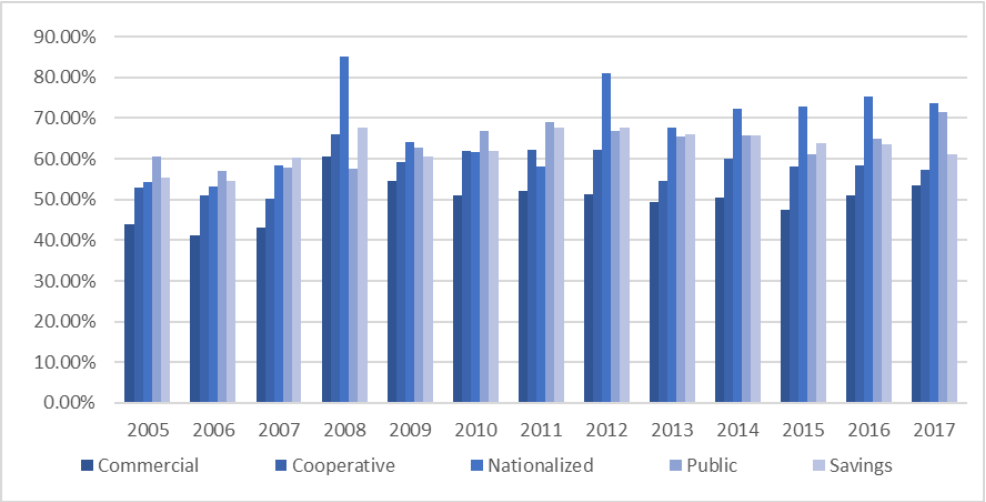
The net interest income of commercial banks has continuously been the lowest amongst ownership structures, except in 2008 for public banks. This development was similar to that of Investment banks. In turn, public banks relied most on net interest income up until the Eurozone economic crisis. In the period after 2011, nationalised banks became more dependent on interest income. Savings and cooperative banks were already predominantly relying on net interest rate income before the crisis, but their share of interest income increased substantially during the financial crisis and stabilised afterwards. For all ownership structures, net interest income formed the majority of total operational income and increased during the period under investigation, in the case of public and nationalised banks.

Figure 6.5 Evolution of net interest income

a) Business models



b) Ownership structures



Note: Since annual results are substantially varied, the figures represent the average proportions obtained by dividing net interest income by total income. The values are presented by ownership structure and accounting year.

Source: Authors

An analysis of the evolution of trading income, depicted in Figure 6.6, shows that Investment banks earned a substantially larger share of their income from trading and investment activities, except at the height of the financial crisis in 2008. In that particular year, the trading earnings of Investment banks actually turned negative (-23%). Trading earnings represented less than a tenth of the earnings of Wholesale banks before and after the 2007-2009 financial crisis. In 2007 and 2008, however, Wholesale banks showed trading losses of about 5%. To a large extent, the concentrated losses in the Wholesale banking sector were due to the write-downs on US subprime exposures in the early phases of the financial crisis, in some cases well before the fall of Lehman Brothers in September 2018. The first large write-downs by Wholesale banking groups were already made public by August 2008, including the state-owned German Landesbanken that, combined, added up to approximately €29 billion. Landesbanken accounted for nearly two-thirds of the year-end trading losses reported by all the Wholesale banks.[11]

Turning to ownership structures, commercial banks reported the highest share of trading income, except for 2008 and 2009. In fact, banks across all ownership structures reported losses at the height of the financial

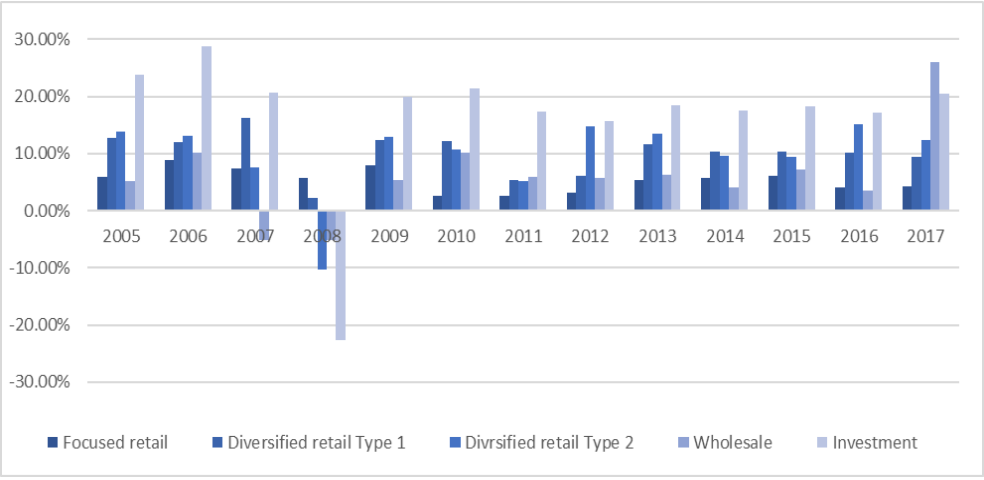
[11] The data on losses was obtained from Bloomberg, *Banks' Subprime Losses*, 12 August 2008 (http://www.bloomberg.com/apps/news?pid=newsarchive&sid=a8sW0n1Cs1tY).

crisis, except for public banks. Commercial banks lost relatively the least, whilst nationalised banks lost the most; albeit, the latter were able to recover part of this in 2009, when the nationalised banks reported trading earnings above the pre-crisis level. Nationalised banks were the only ownership structure that also reported losses at the height of the economic crisis (2012). However, savings and public banks, during most years,reported fairly low trading earnings (less than 10% of total earnings).

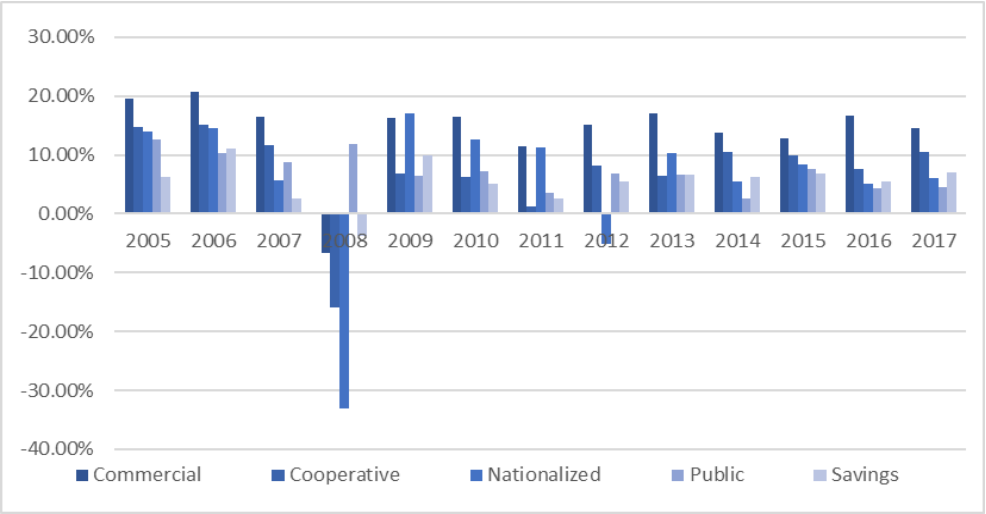
The volatility of earnings renders the assessment of business models and ownership structures less reliable using income characteristics. Indeed, the share of trading income would not be able to correctly identify the sets of Diversified retail, Wholesale and Investment-oriented banks, as already noted above. In addition, the results highlight the relative stability of retail-oriented banks, which appear to outperform their peers in terms of performance indicators.

Figure 6.6 Evolution of trading income

a) Business models



b) Ownership structures



Note: Since annual results are substantially varied, the figures represent the average proportions obtained by dividing the trading and dividend income by total operating income. The values are presented by ownership structure and accounting year.

Source: Authors

An additional question that remains to be answered is the extent to which the different business models and ownership structures continued to contribute to economic activity, by essentially providing loans to the private sector. Faced with eroding capital bases and higher capital requirements from regulators, supervisors and other market participants, banks had to improve their capital position. There are four broad ways in which banks have been able to improve their capital positions during financial and economic crises: i) internal resources (e.g. retained earnings, improving operational margins, changing internal rating based models, etc.); ii) external market sources (e.g. issuing new capital instruments, changing asset mix, deleveraging, etc.); iii) government funds (e.g. recapitalisation, asset relief measures, guarantees, etc.); and iv) monetary facilities (e.g. low policy rates, cheap funding, etc.).[12] The state-aid rules connected to the government interventions make government funds *de facto* a last source of funds that are only accessible to larger banks when all other possibilities to improve the capital position have been exhausted. The monetary facilities are only indirect capital gains due to lower interest costs. Most of the monetary facilities are further limited in size and maturity and the possibility of issuing new capital instruments was limited during the periods of financial distress, limiting the potential contribution to capital

[12] See Ayadi et al (2015) for a more comprehensive overview of channels used to improve the financial position of banks in recent years.

from these types of measures. For most banks, therefore, the internal sources to increase capital and external market sources to deleverage were the prevailing option to improve the capital position. However, booked losses and falling asset prices often make it difficult for banks with low levels of capital to raise further capital, making the reduction of balance sheet size the optimal choice (Myers, 1977; Myers & Majluf, 1984). Moreover, crisis conditions increase credit costs across the board, leading to higher agency costs of lending and pushing the less diversified banks to engage in 'flight to quality' in search of more stable securities than loans (Lang & Nakamura, 1995; Bernanke et al., 1996). Thus, due to various difficulties, banks may choose to shrink their balance sheets by rationing loans and other investments.[13]

The extent to which the slowing down of loan growth or deleveraging has occurred depended, crucially, on the risk characteristics and capital levels associated with the different bank business models. Based on the arguments outlined above, there is reason to suspect that banks with less diversified credit risks (such as Focussed retail-oriented banks) and lower capital levels (such as Investment banks) would slow their supply of credit more than others.

Figure 6.7 shows that the growth of loans subsided substantially after 2007 across all business models, except for Wholesale banks that already experienced a decline in 2007. In particular, the results confirm that outstanding customer loans shrank for Investment banks during the financial crisis, turning negative in 2009. All groups managed to expand their outstanding loans in 2010. Thereafter, Focussed retail and Diversified retail (type 1) business models continued to expand their loan books at gradually lower rates between 2011 and 2013, despite the crisis. Meanwhile, the debt liability dependent Diversified retail (type 2) banks reported a growth of loans close to zero during 2012 and 2013, up to the point of negative growth in customer loans in 2014. In the final year of the sample (2017), the loan growth of all business models increased,[14] except for

[13] It should not be forgotten that a decline in credit growth may not necessarily be a negative outcome, but largely the result of a realignment of asset prices with fundamentals. Borio & Lowe (2002) and Reinhart & Rogoff (2009) show that rapid credit growth, in conjunction with rising real estate prices, can lead to financial instability and are the primary drivers of crises. Several authors suggest that various macro-prudential and monetary policy tools should be used to respond to these challenges and to the build-up of risk over time. See Allen & Carletti (2011) for an excellent discussion and literary review of these issues.

[14] Besides the supply factors summarised above, demand factors also play a role in credit growth. Hence, during the financial and economic crises, the demand for loans has, for example, decreased due to a reduction in profitable investment opportunities. Moreover,

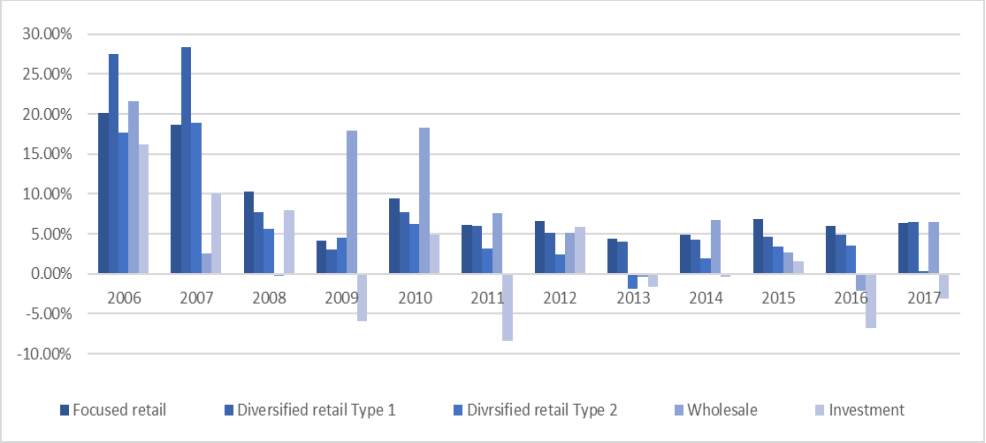
Investment and Diversified retail (type 2) that still decreased their loan growth. This might indicate that loan growth is less responsive to changes in financial and economic conditions than trading income, for instance.

The ownership structures that expanded their loan portfolios the most before the financial crisis, were the ones that contracted their loan portfolio the most during the crisis and vice-versa. Hence, nationalised banks increased their loan portfolios annually by 24.90% to 25.49% between 2005 and 2006, whilst their loan portfolio shrank by -0.51% to -10.95% annually in the period that followed. In turn, the loan portfolios of public banks barely grew in the years before 2008, whereas they were reported as being amongst the highest growth figures during the crises. An important explanation might be the contribution of these banks to the expansionary policies of the governments owning these banks. Commercial, cooperative and savings banks have been able to continue lending at a slower pace during the crises, though the commercial and savings banks were more vulnerable during the financial and economic crises.

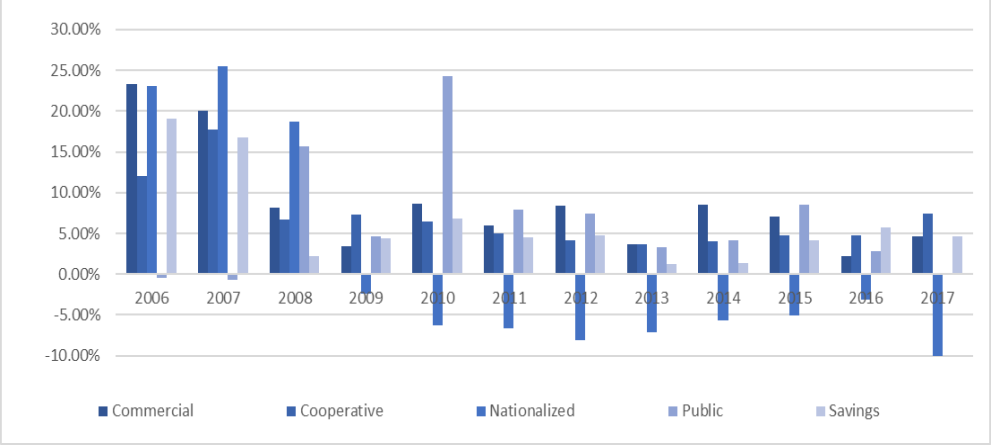
many projects require some preparation time before credit is requested and granted, which is reflected in a delayed response to changes in economic conditions.

Figure 6.7 Growth of outstanding customer loans (% change from last year)

a) Business models



b) Ownership structures



Note: All figures are the median values of growth of gross loans for each accounting year, by business model/ownership structure.

Source: Authors

To sum up, the results presented in this section show that the returns of banks across all business models have deteriorated since the 2007-2009 financial crisis. The returns of retail-oriented banks appeared to be the most resistant in withstanding the financial crisis, whilst the Wholesale and Investment banks fared better through the 2010-2012 economic crises. Afterwards, in 2013 and 2014, bank profitability increased to levels below what the banks were used to before the crisis. Most ownership structures have been able to remain profitable during the crises, except for

nationalised banks (2008 to 2013 and 2015). One of the main drivers behind the lower returns during the financial crisis was the losses on trading assets and investments, whilst during the economic crisis, loan losses seem to have been a more important determinant, particularly for the retail business models, as discussed in the next section.

The results of the cost-cutting measures that many banks have undertaken in the past years have been insufficient to avoid a deterioration in operational efficiency.

The results also show that credit growth has slowed down for all banks and business models, in some cases leading to deleveraging. This is especially the case for the debt liability funded Diversified retail (type 2) banks and the more leveraged Investment banks. In turn, Focussed retail and Diversified retail (type 1) banks have continued to extend credit, despite the financial and economic crises, even if at lower growth rates. Across ownership structures, the reverse trends of the two government-owned types of banks are notable; nationalised and public banks respectively reduced and increased their lending during the crises. The customer loan portfolios of commercial, cooperative and savings banks increased during the crises, but at a slower pace.

Lastly, income characteristics are shown to be poor proxies for identifying business models, largely due to the variability and responsiveness of earnings to market conditions.

7. RISKS OF BUSINESS MODELS

This section provides a risk assessment of bank business models and ownership structures.

The eight key risk indicators are summarised in Table 7.1.

For the most part, the results reconfirm earlier arguments on the risk attributes of various models, suggested in Ayadi et al. (2011, 2012), Ayadi & De Groen (2014a) and Ayadi et al. (2015). The deposit funded Focussed retail and Diversified retail (type 1) banks have the greatest distance to default (i.e. less prone to default), whereas the more market funded Diversified retail (type 2), Wholesale and Investment banks are closer to default. In turn, the markets perceive the default probabilities for the Focussed retail and Diversified retail (type 1) banks to be higher than for the other business models (in term of CDS spread). In terms of loan loss provisions, Diversified retail (type 2) banks are those that show the highest value. In terms of non-performing loans, the more retail-oriented banks show the highest ratio. On the contrary, the more market-oriented banks (wholesale and investment) shows the lowest NPL ratio. The systemic risk, assessed by SRISK, shows the highest median amongst Diversified retail (type 2) banks, which indicates that they contribute more to systemic risk.

The results across ownership structures are relatively straightforward. Stakeholder value banks are farthest away from default, whereas shareholder value banks are closest to default. In particular, nationalised banks remain risky with, as well as a low Z-score, they have the highest loan loss provisions, the highest stock return volatility and the highest CDS spread for both senior and subordinated bonds. Commercial banks perform considerably better on the different risk indicators and are within the range of cooperative and savings banks. Public banks seem to benefit from close ties with government. Loan loss provisions are close to zero and the CDS-rates and Stock returns volatility are the lowest amongst all ownership structures. With regards to non-performing loans, nationalised banks show the worse credit portfolio quality, confirming the importance of government intervention. The SRISK values are higher for cooperative and nationalised banks, which indicates that they contribute more to systemic risk.

Table 7.1 Risk indicators

a) Business models

	Focussed retail	Diversified retail (Type 1)	Diversified retail (Type 2)	Wholesale	Investment	All
Z-score (std.dev. from default)	47.21****	48.85****	21.78****	21.63****	15.77****	37.95
Loan loss provisions (% of gross customer	0.13%***	0.25%****	0.45%***	0.13%**	0.25%**	0.21%
Non-performing loans (% of gross customer loans)	2.12%***	2.72%***	1.51****	0.06%**	0.94%***	2.44%
Stock returns (avg. daily returns)	0.02%*	0.064%	0.041%**	0.019%*	0.044%	0.037%
Stock returns volatility (std. dev. of daily returns)	2.03%*	2.23%**	1.99%	1.91%	2.06%*	2.06%
CDS spread (senior, annual	2.06%***	1.30%***	1.06%**	0.25%**	0.89%**	1.17%
CDS spread (subordinated, annual avg.)	3.15%***	2.33%***	1.63%**	0.27%**	1.41%**	1.81%
SRISK	-0.2%***	-0.1%***	1.9%**	-0.1%***	-0.7%***	-0.2%

b) Ownership structures

	Commercial	Cooperative	Nationalised	Public	Savings	All
Z-score (std. dev. from default)	15.26****	51.80****	3.04****	28.93****	56.31****	37.95
Loan loss provisions (% of gross customer	0.36%***	0.23%**	0.56%***	0.03%****	0.13%****	0.21%
Non-performing loans (% of gross customer loans)	1.99%****	2.44%***	4.35%***	2.35%**	2.62%***	2.45%
Stock returns (avg. daily returns)	0.038%	-0.006%	0.039%	0.018%	0.051%	0.037%
Stock returns volatility (std. dev. of daily	2.1%****	2.81%****	3.99%****	0.97%****	1.91%****	2.06%
CDS spread (senior, annual	1.06%**	1.14%**	1.81%****	0.53%****	1.19%**	1.17%
CDS spread (subordinated, annual avg.)	1.62%	1.81%	2.71%	..	2.07%	1.81%
SRISK	-0.4%**	-0.1%***	-0.1%**	-1.6%*	-0.4%***	-0.2%

Notes: All figures are the median values for the relevant sub-sample. The independence of clusters and ownership structures was tested using non-parametric equality-of-medians two-sample tests at 5% significance. According to the results of these tests, the number of asterisks (*, **, *** or ****) stands for the statistical difference of any given cluster/ownership structure from that number of other clusters/ownership structures for that indicator. For example, two asterisks (**) implies that the cluster is statistically different from two (furthest) clusters but not the third (closest) one. See Appendix VII for the assumptions pertaining to the construction of the systemic risk exposure indicator (SRISK).

Source: Authors

The first indicator, Z-score, is a balance sheet based indicator that provides an estimate of a bank's distance to default.[15] In essence, the risk measure uses historical earnings volatility and returns, as well as current capital levels, to construct the level of a (one-time) shock beyond the historical average that would lead to default. The greater the Z-score, the less probability of a default.

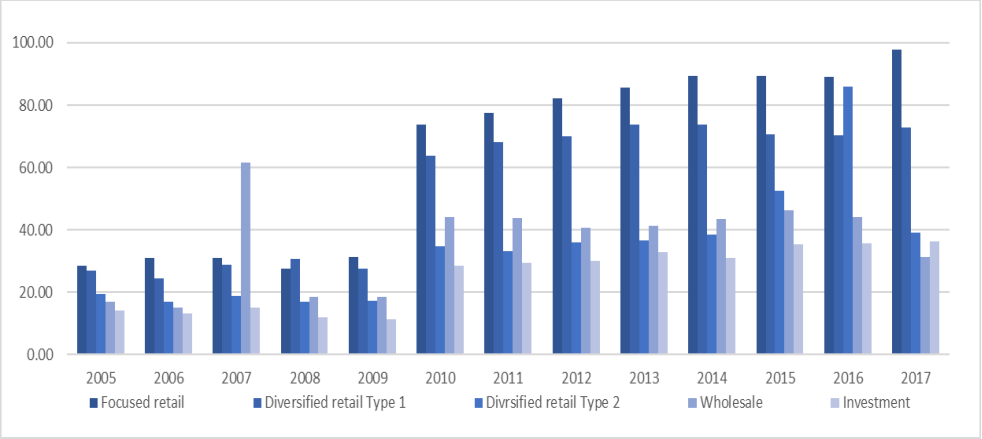
All business models have seen their distance to default increase during the financial and economic crises, in particular the Focussed retail and Diversified retail (type 1) banks. Figure 7.1 shows that the differences in Z-scores across business models have primarily been created in the most recent years.

The Z-scores of the cooperative, savings and, to a lesser extent, commercial banks increased over time, due to deleveraging. Contrary to most other banks, the Z-scores of the public banks remain stable over time and, up until the economic crisis, are the highest amongst ownership structures. The Z-scores of nationalised banks remained close to zero throughout the sample period 2005-2017. Starting from the economic crisis (2010-12), the Z-scores of cooperative and savings banks increase, with the latter exceeding the public banks.

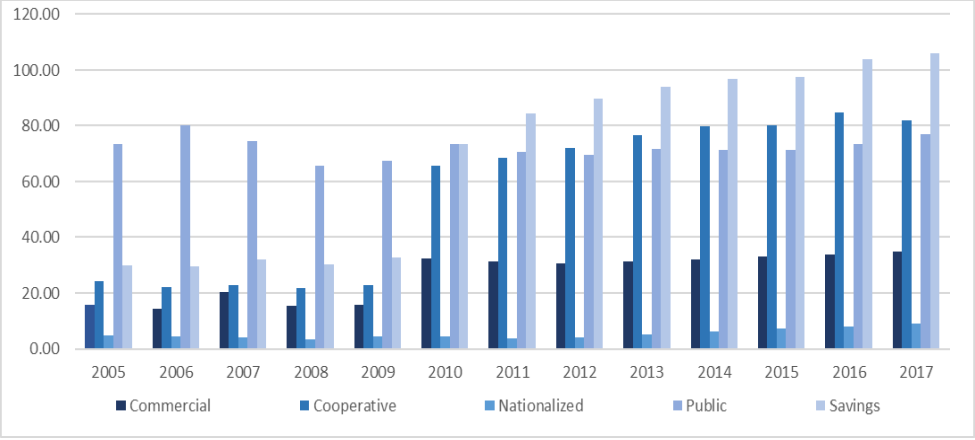
[15] See Appendix V for the calculation of the Z-score.

Figure 7.1 Evolution of Z-scores

a) Business models



b) Ownership structures



Note: The amounts expressed in the figure are asset weighted averages of distance to default. Since the standard deviation of returns, as well as the mean returns, are constant over time, the differences across years are due to changes in levels of equity, as well as the composition of the business models.

Source: Authors

The second indicator, **loan loss provisions as a share of gross customer loans**, is a proxy-measure for credit quality. The loans to banks are excluded, since the losses on loans to banks have historically been lower than on loans to other customers. Notwithstanding some high-profile cases, like the collapse of Lehman Brothers, even during the crisis, the banks were largely shielded from bearing losses on loans to banks. This was

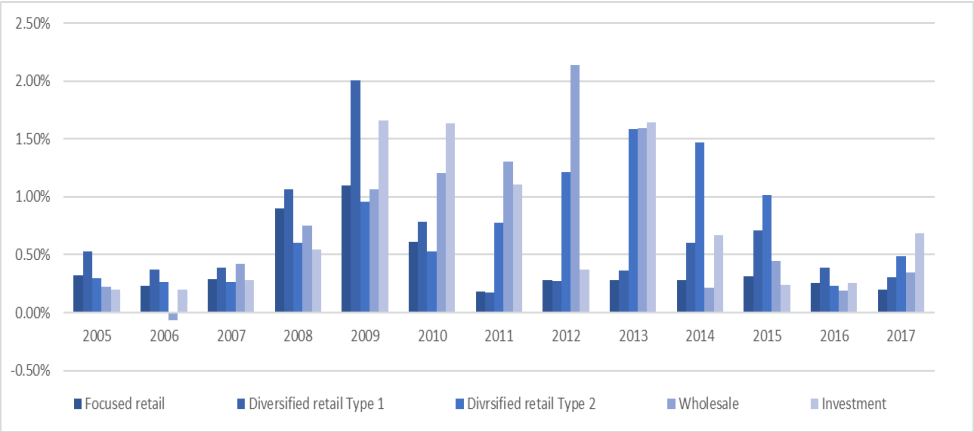
primarily due to the various government and central bank interventions that prevented banks from going bankrupt and limited burden sharing to equity holders and junior debt holders. This might change under the new resolution regime, which is discussed in the regulation section.

The results displayed in Figure 7.2 show that the pre-crisis risk-costs of Wholesale banks and, to a lesser extent Investment banks, were lower than those of retail banks. During the financial crisis, in particular in 2008 and 2009, all business models posted higher risk-costs. Afterwards, during the economic crisis, the credit losses of most business models dropped, with the exception of the Diversified retail (type 2), Wholesale and Investment banks. The difference might be explained by a difference in the composition of the credit portfolio. The wholesale and, to a lesser extent, Investment banks have relatively more credit outstanding to larger corporates and public bodies, compared to other customers.

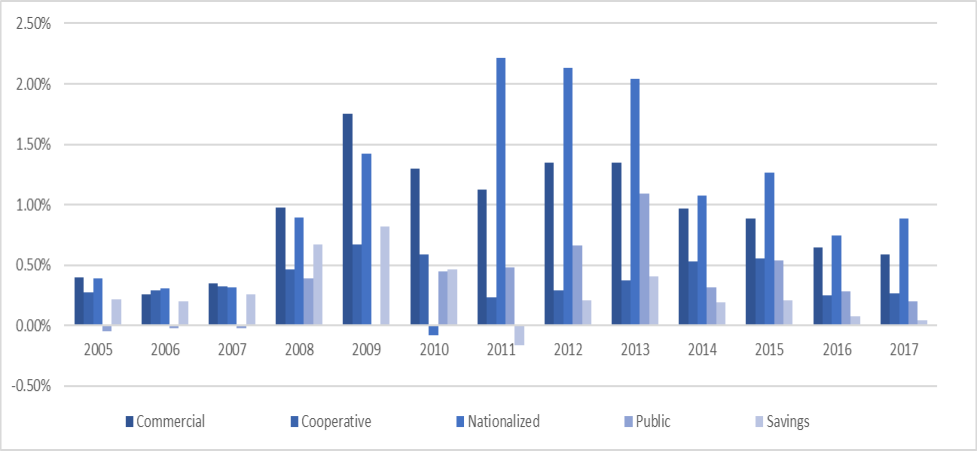
Turning to results across ownership structures, in the pre-crisis period, commercial banks took the highest loan loss provision, whilst the public banks actually released provisions. During the financial and economic crises, shareholder value banks (i.e. commercial and nationalised banks) took the highest provisions, whilst savings and, to a lesser extent, cooperative banks also booked higher loan loss provision compared to the previous period. However, these banks show lower provisions than shareholder value banks.

Figure 7.2 Loan loss provisions (% of gross customer loans)

a) Business models



b) Ownership structures



Note: The amounts expressed in the figure are the total loan loss provisions as share of total gross customer loans.

Source: Authors

The third indicator, **the non-performing loans over gross customer loans,** proxies the quality of credit portfolio. The results reported in Figure 7.3 show that, during the financial and economic crises, the deterioration of bank loans increases. In particular, retail-oriented banks show a stronger increase of NPLs, which is in line with the asset composition of these banks, for which the loans component is dominant compared to investment and Wholesale banks. Since 2014, the ratio starts to decrease for two main reasons: i) the economic crisis ends and customers start paying their loans again, but most of all, ii) banks sell part of their deteriorated loans, cleaning their balance-sheets.

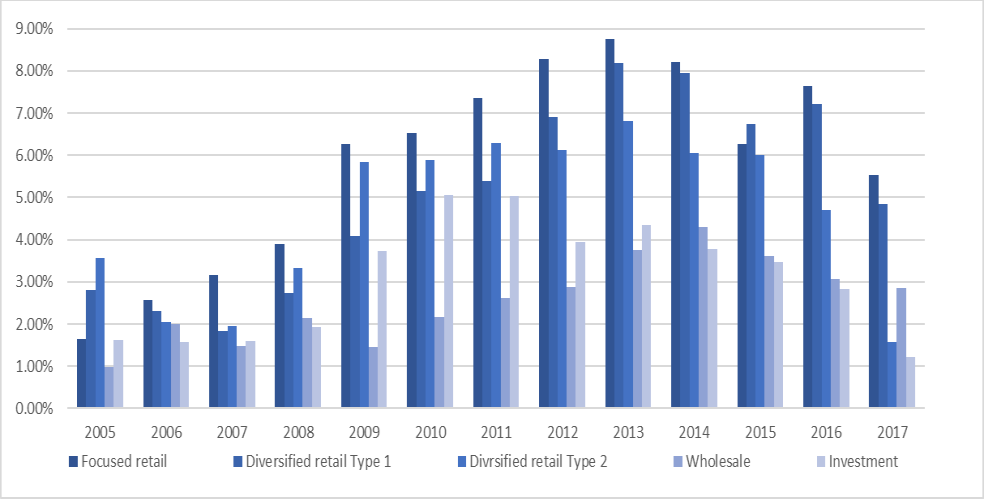
With regards to ownership structure, during the financial crisis (2008-2010), commercial and savings banks show the highest amount of NPLs in their balance-sheets. Starting from the economic crisis, nationalised banks show the highest ratio of NPL over gross customer loans. This suggests that nationalised banks are the riskiest banks in terms of credit risk with the worse credit portfolio quality. Cooperative banks always show the best credit portfolio quality, with the lowest NPL ratio.

The weight of non-performing loans over gross loans ratio generally differs during the Sovereign debt crisis (2010) and after the crisis (2017). In fact, after the financial crisis the percentage of NPL held by Focussed retail banks increases in most observed countries, whilst investment banks decrease their NPL from 2010 to 2017 (See Appendix V). With regards to

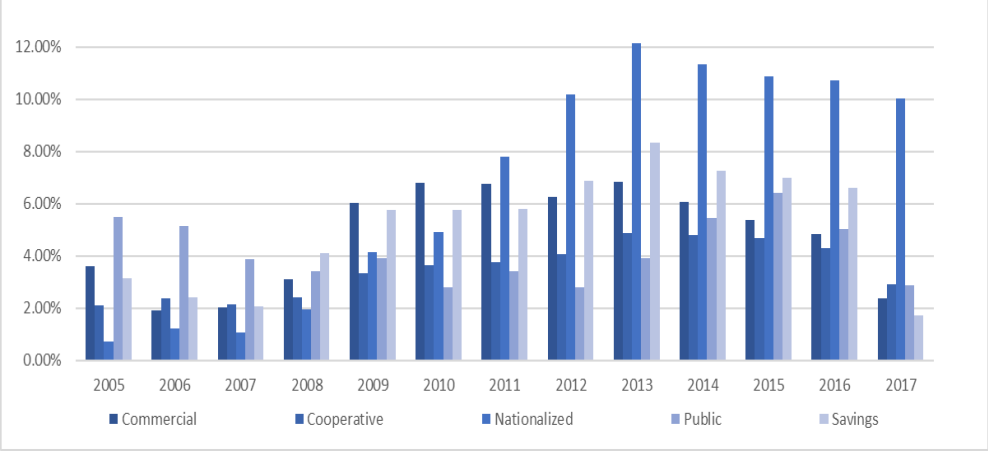
the ownership structure, commercial and cooperative banks remain the most exposed banks to the NPL problem. In Iceland, Ireland, Portugal Denmark and Slovenia the share of nationalised banks that hold a high percentage of NPL increased after the crisis (See Appendix V).

Figure 7.3 Non-performing loans (% of gross customer loans)

a) Business models



b) Ownership structures



Note: The amounts expressed in the figures are the non-performing loans as share of the total gross customer loans.

Source: Authors

The fourth indicator, **average daily stock returns**, is a rough proxy-measure for the evolution of market values. Only a proportion of bank assets are accounted for at fair value, whilst the equity markets consider valuing the entire bank according to market principles. The changing economic circumstances are, therefore, considered to impact market values faster than book values. The share-based indicators have a significant limitation, however, in that they are only available for listed banks. For example, only a few of the stakeholder value cooperative and savings banks are listed.

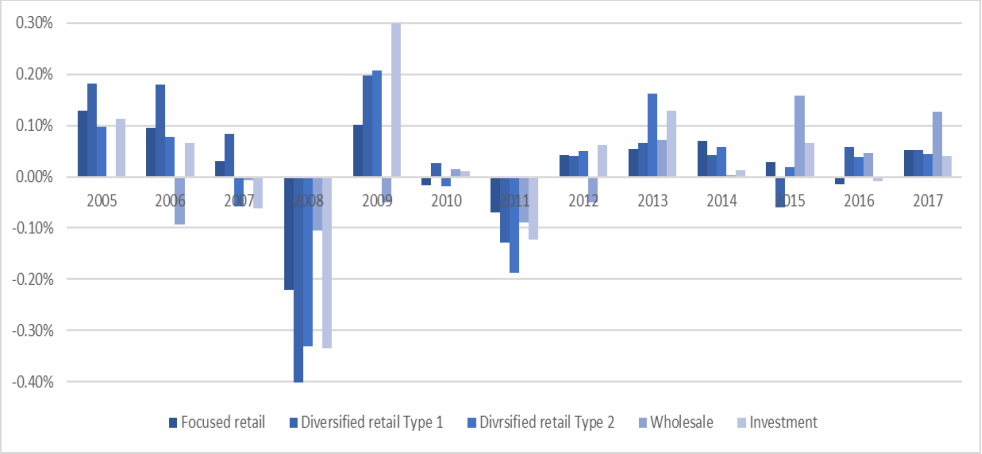
The results displayed in Figure 7.4 show that, pre-crisis, shares increased in value across all business models, except for Wholesale banks. This changed during the financial crisis, when banks across all business models quoted negative returns on their shares. These financial crisis losses were partially recovered in 2009, except for Wholesale banks. During the economic crisis, the average returns were close to zero or negative and, in 2011, all business models showed negative returns; only afterwards, were shareholders able to recover part of their losses. In the post-crises period, banks recover to show positive returns, except for Focussed retail (2016), Diversified retail (type 1) (2015), and Investment banks (2016) that continue to show negative returns.

The results across ownership structures show a large consistency in the direction of returns during the crises. In 2010, cooperative and nationalised banks lost value whilst public and savings banks gained in value. A similar situation is observed in the post crisis period. In 2015, nationalised banks show the worst returns and the following year, both nationalised and cooperative banks underline negative stock returns, whilst other ownership structures highlight positive returns.

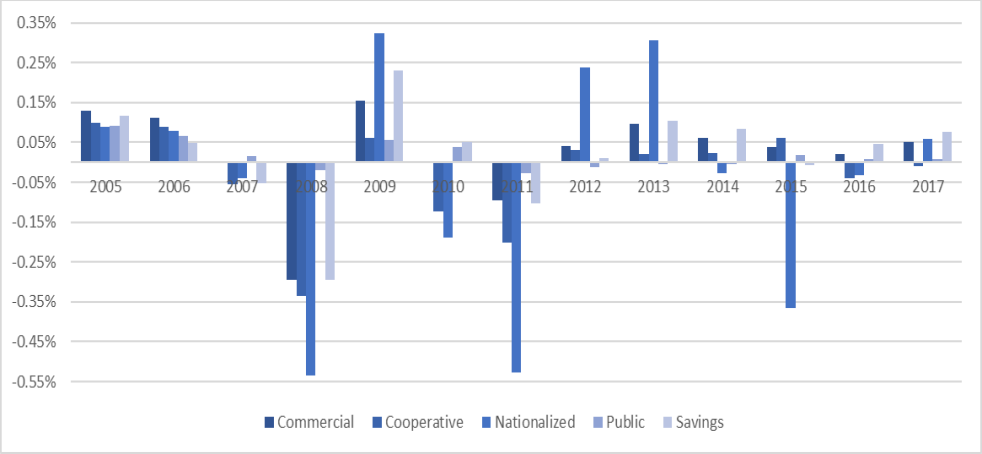
Both in terms of business models and ownership structure, the initial years of the financial and economic crises revealed the most negative stock returns.

Figure 7.4 Evolution of stock returns (avg. daily returns)

a) Business models



b) Ownership structures



Note: The figure shows the average values of annual average daily returns on publicly listed shares. There are no observations for Wholesale banks in 2005.

Source: Authors

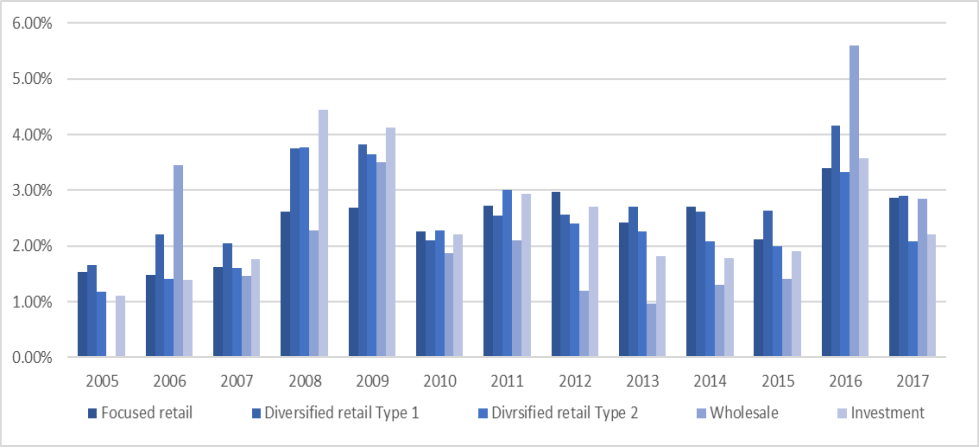
The fifth indicator, **annual standard deviations in daily stock returns,** measures the risk sensitivity of listed banks.

The volatility of stock returns has been similar across most business models, except for Wholesale banks over several years and for Investment banks during 2008 and 2009. Volatility increased substantially during the financial crisis. Only in 2016 are the volatility returns high for all business models.

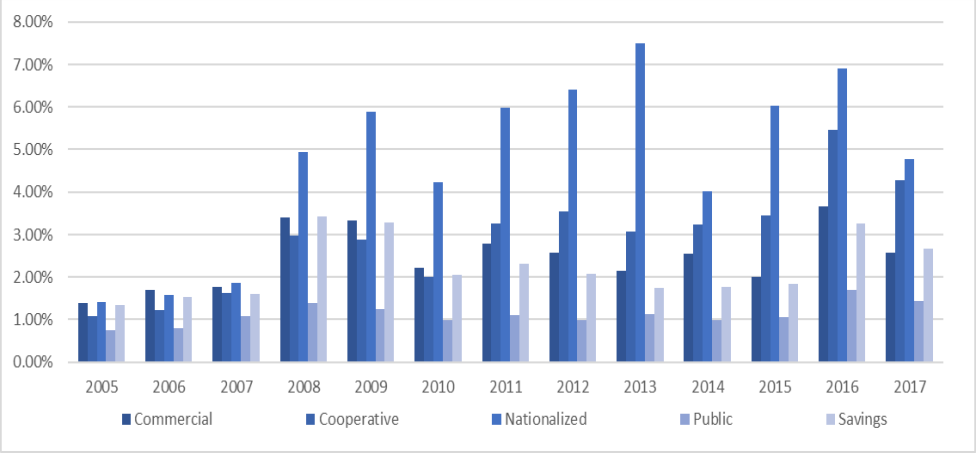
Figure 7.5 also shows that the differences between ownership structures are more substantial. Before the financial crisis, volatility was fairly similar, except for public banks. The share returns of public banks were less volatile throughout the sample period. The volatility of all the other ownership structures increased during the financial crisis. The volatility of commercial and savings banks decreased afterwards to levels slightly above the pre-crisis levels. The share returns of nationalised and cooperative banks remained more volatile; in particular, nationalised banks show the highest volatility throughout the financial crisis and post crisis period.

Figure 7.5 Evolution of stock return volatility

a) Business models



b) Ownership structures



Note: The amounts expressed in the figure are average annual standard deviations of daily stock returns. There are no observations for Wholesale banks in 2005.

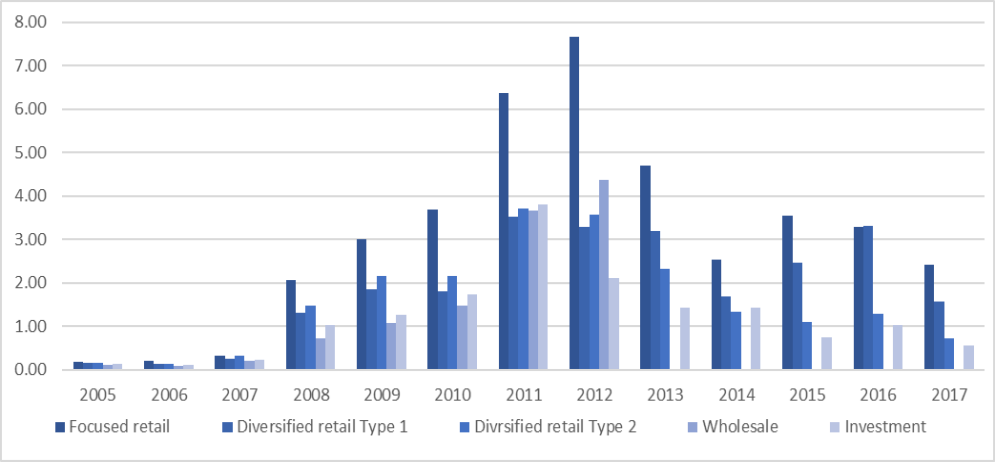
Source: Authors

The sixth indicator, **median CDS spreads for senior securities**, displays a very low level for all business models during the pre-crisis period (2005-2007). The CDS spreads strongly increase during financial and economic crises. There is a significantly higher CDS spread for the deposit funded Focussed retail and Diversified retail (type 1) banks than for all other banking business models (see also Figure 7.6). The difference between Investment, Wholesale, and Diversified retail (type 2) banks is not significant, implying that their underlying distributions may be similar. Echoing the results in Ayadi et al. (2011, 2012, 2014 and 2015), concerning market participants there does not appear to be anything to distinguish between these three models in terms of their inherent risks.

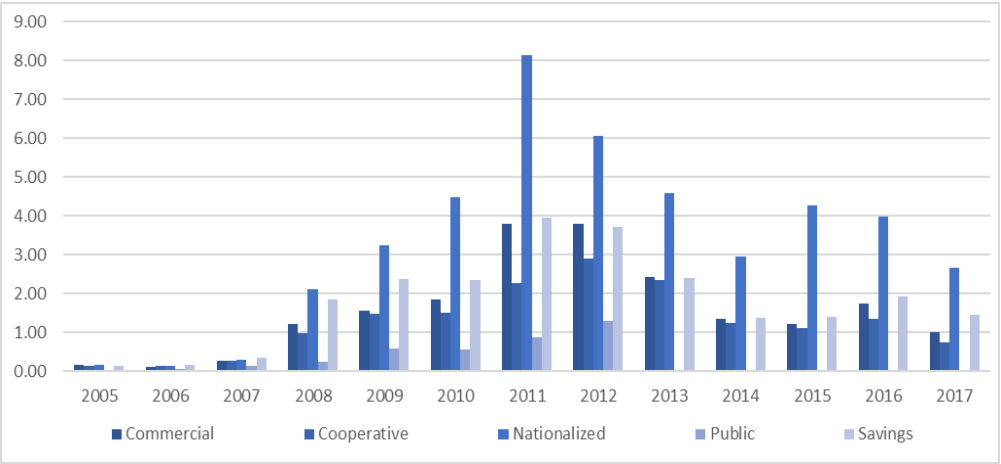
The comparison across ownership structures shows that, except for government owned banks, the CDS-rates are not significantly different. In particular, nationalised banks and public banks respectively quoted the highest and the lowest CDS-rates. Provided that other indicators do find substantial differences in the underlying risks, it is likely that the market participants have already factored in the likelihood of government interventions, resulting in the comparability of market perception of default risks. Once again, these findings give support to the significance of moral hazard risks, due to the dilution of market discipline in the eventuality of bank bail-outs or state guarantees (Calomiris & Kahn, 1991).

Figure 7.6 Evolution of CDS spreads (senior) (%)

a) Business models



b) Ownership structures



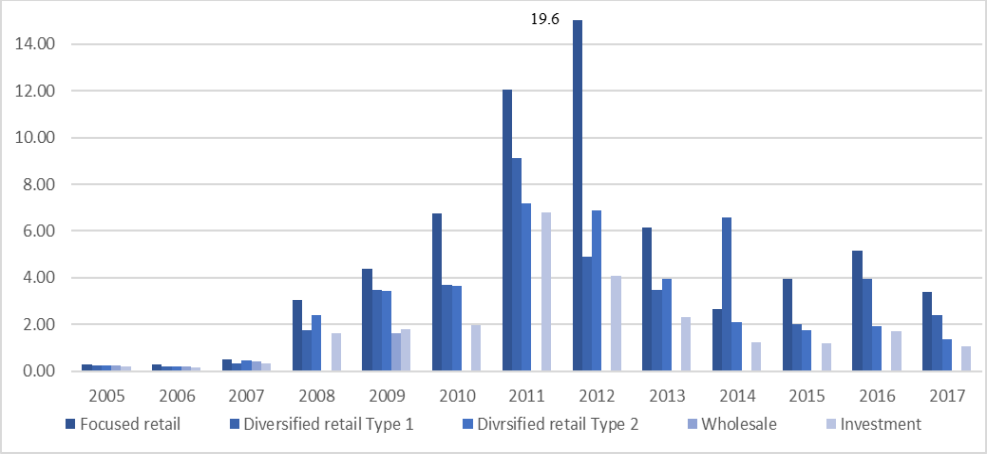
Note: The figure presents the average annual average CDS spreads on senior bonds. Since 2013, no CDS spread of senior bonds for public banks is observed.

Source: Authors

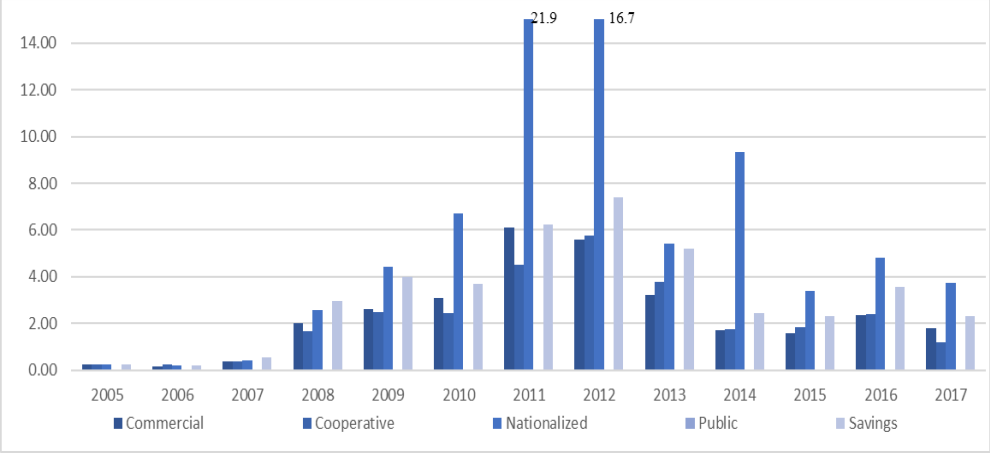
The seventh indicator, **median CDS spreads for subordinated securities** are clearly higher than the rates for senior securities. Hence, contrary to the senior securities, subordinated securities were in certain exceptional cases subject to bail-ins during the financial and economic crises. The number of observations for subordinated securities is, however, much lower than for CDS rates on senior securities. Figure 7.7 displays a substantially higher CDS spread for the small and least financially integrated Focussed retail banks than for all other banking business models. After the crises, the CDS spread of subordinated securities returns to lower levels. Notwithstanding much higher CDS rates for nationalised banks during the financial and economic crises, the other ownership structures do not show significant differences.

Figure 7.7 Evolution of CDS spreads (subordinated) (%)

a) Business models



b) Ownership structures



Note: The figure presents the annual average CDS spreads on subordinated bonds. There are no CDS rates available for subordinated bonds issued by Wholesale banks after 2008 and public banks.

Source: Authors

The seventh indicator, SRISK is a new introduction to this edition of the Monitor. This indicator measures the systemic risk contribution of a bank per business model and ownership structure. SRISK measures the capital shortfall of a firm, conditional on a severe market decline and is a function of its size, leverage and risk. SRISK is an estimate of the amount of capital that a financial institution would need to raise, in

order to function normally if we have another financial crisis (Brownlees & Engle, 2017). When the capital shortfall is negative, i.e. the firm has a capital surplus, the firm functions properly. In turn, when this quantity is positive, the firm experiences distress. The definition of SRISK and the methodology adopted to measure this indicator are reported in Appendix IX.

Looking at the SRISK indicator of the whole banking system, Figure 7.8 reveals that, on average, during the period under investigation, banks show a negative capital shortfall. Therefore, the systemic risk is low. Investment banks are those banks with the lowest systemic risk, whilst Focussed retail and Wholesale banks show a ratio closer to zero.

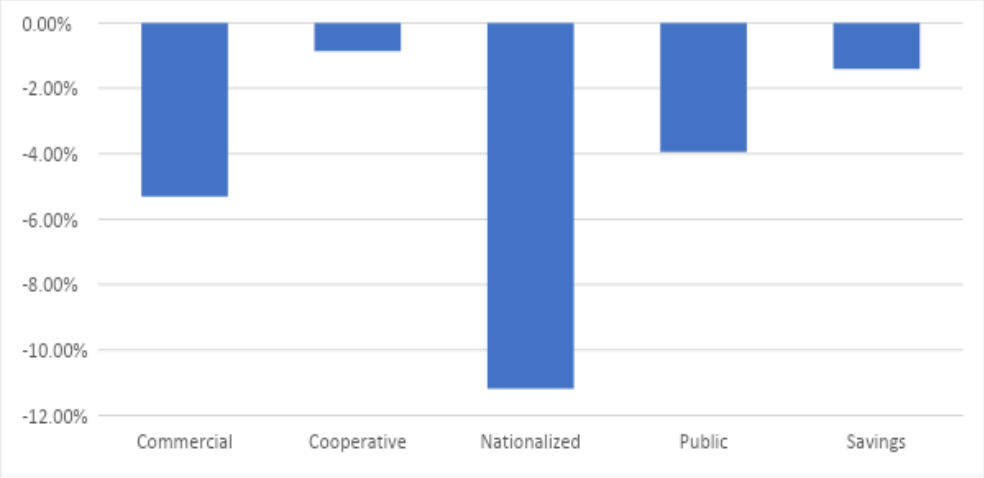
The sum of SRISK across all banks can be used as a measure of overall systemic risk throughout the entire financial system. It can be approximated as the total amount of capital that the government would have to provide to bail out the financial system in case of a crisis.

Focussing on ownership structure, Figure 7.8 shows that the nationalised banks are the lowest contributors to systemic risk in the banking sector, whilst the highest contributors are cooperative banks. This can be explained by the difficulty this type of bank has accessing the markets to raise capital.

Figure 7.8 Systemic exposure of the banking system (2005-2017) (SRISK)

a) Business model

b) Ownership structure



Notes: The figure above shows the systemic exposure of banks during the period 2005-2017, with reference to the whole banking sector. The capital shortfall is defined as the difference between the 8% of risk-weighted assets and total equity (SRISK), all divided by the sum of the positive SRISK of each year. The figures show all banks with both positive and negative capital shortfall.

Source: Authors' elaborations

To sum up, this section assessed the risks associated with the different business models. Using a rich palette of risk measures, Focussed retail banks appear to be the safest. Wholesale and Investment banks were more exposed to the 2008-09 financial crisis, whilst the retail banks suffered most during the 2010-12 economic crisis.

Looking at the results across ownership structures, the public banks appear to be the safest, both based on balance sheet and market indicators. In turn, the other type of government owned banks, the nationalised banks, appear to be the riskiest ones. The cooperative banks, furthermore, seem to be safer than the commercial banks.

In addition, some of the risk indicators largely fail to distinguish between business models. This is the case for the more volatile stock related indicators, but also the CDS rates. In fact, the CDS spreads only distinguish the Focussed retail banks as they are smaller and less significant banks. This can be the consequence of the realisation of the moral hazard.

8. BANK BUSINESS MODELS RESPONSE TO REGULATION AND RESOLUTION

Regulators and supervisors increasingly influence the behaviour of banks. This section assesses the robustness and resilience across business models and ownership structures, using the evolution of the different regulatory and supervisory indicators. Robustness and resilience refer to the capacity of banks to withstand stress conditions, respectively at a point in time and over time. The key regulatory and supervisory indicators and analysis are summarised in Table 8.1.

The regulatory capital ratios suggest that retail-oriented banks have significantly higher median risk weights than Wholesale and Investment banks. In turn, these have significantly higher Tier 1 ratios. Taken both indicators together, Wholesale banks have the least leverage (i.e. tangible assets over tangible common equity) and Investment banks the highest.[16] Amongst ownership structures, the median average risk weights are close to the sample median, except for public banks. The latter, however, have the highest capital ratios. Overall, nationalised banks have the weakest capital position, whilst commercial banks have the highest capitalisation ratio.

The medians of liquidity ratios within the market-oriented business models are substantially higher than those of the retail-oriented models. The differences across ownership structures are less apparent. Except for the nationalised banks, the median values are all above the future requirement of 100%.

The preliminary calculation of the potential bail-in contribution shows that the market-oriented and state-owned banks are likely to be able to absorb higher losses before they would need to receive a contribution from the resolution fund. Yet, looking back at government interventions during the recent crises, retail-oriented and public banks would have posted the highest losses. Hence, if resolution funds had been in existence in recent years, Focussed retail and publicly owned banks would have seen the largest share of their losses covered.

[16] In the table we report the capitalization ratio, i.e. tangible common equity over tangible assets that is the reciprocal of leverage ratio.

Lastly, the Minimum Requirement for Own Funds and Eligible Liabilities (MREL) is higher for retail-oriented banks. Looking at ownership structure, cooperative banks show the highest median requirement, whilst public and nationalised banks the lowest.

Table 8.1 Regulatory & supervisory indicators

a) Business models

	Focussed retail	**Diversified retail (Type 1)**	**Diversified retail (Type 2)**	**Wholesale**	**Investment**	**All**
Risk-weighted assets (RWA) (% assets)	61.1%***	53.8%***	60.6%***	46.6%***	34.7%***	57.0%
Tier-1 capital ratio (% of RWA)	13.5%***	14.8%***	13.4%***	18.9%***	17.2%***	14.2%
Tang. common eq. (% of tang. assets)	8.59%***	8.4%***	7.9%**	10.2%**	7.5%***	8.5%
NSFR (Avail./req. funding)	111.8%***	125.0%***	95.5%***	226.2%***	133.4%**	116.1%
Bail-in contribution (% of total liabilities)	3.0%***	3.6%****	3.0%***	4.2%****	5.1%****	3.3%
Cumulative peak losses (% of total liabilities aided banks)	9.2%*	8.4%	3.7%	..	2.9%	6.9%
Max. contribution SRF (% of losses)	1.9%*	0.5%	0.0%	..	0.0%	0.0%
MREL/TLAC	10.6%**	9.33%*	10.6%*	6.9%**	6.7%**	9.7%

b) Ownership structures

	Commercial	Cooperative	Nationalised	Public	Savings	All
Risk-weighted assets (RWA) (% assets)	56.09%***	57.99%**	51.26%***	47.69%***	56.34%***	57.03%
Tier-1 capital ratio (% of RWA)	15.00%**	13.79%***	12.39%***	16.18%***	14.76%***	14.26%
Tang. common eq. (% of tang. assets)	8.87%***	8.55%***	4.75%***	7.60%***	8.36%***	8.50%
NSFR (Avail./req. funding)	124.90%**	116.66%***	93.68%***	107.75%***	112.66%***	116.19%
Bail-in contribution (% of total liabilities)	3.4%**	3.2%**	3.8%*	4.1%****	3.4%***	3.3%
Cumulative peak losses (% of total liabilities aided banks)	7.5%*	1.1%	6.7%	35.2%	6.9%	6.9%
Max. contribution SRF (% of losses)	0.00%*	0.00%	0.00%	2.7%*	0.00%	0.0%
MREL/TLAC	8.6%**	10.15%*	7.9%*	7.6%**	9.6%**	9.7%

Notes: All figures are the median values for the relevant sub-sample. The independence of clusters/ownership structures was tested using non-parametric equality-of-medians two-sample tests at 5% significance. According to the results of these tests, the number of asterisks (*, *** or ****) stands for the statistical difference of any given cluster/ownership structure from that number of other clusters/ownership structures for that indicator. For example, two asterisks (**) implies that the cluster/ownership structure is statistically different from the two (furthest) clusters/ownership structures but not the two (closest) ones. See Appendix VII for the assumptions pertaining to the construction of the net stable funding ratio (NSFR) measure and Appendix VIII for the assumptions pertaining to the construction of the TLAC.

Source: Authors

The first indicator, **risk-weighted assets (RWA) to total assets**, or the average risk-weight, provides a regulatory measure of risk. Banks with higher RWA are expected to be more sensitive to risks and are thus required to hold more regulatory capital to account for their risk-

weighted balance sheet, without counting the risk pertaining to the off-balance sheet.[17]

According to the statistical analysis of this indicator, both Investment and Wholesale banks appear to be less risky, with distinct median risk weights of 35% and 47% respectively, which is substantially lower than the risk weights of the retail-oriented banks (between 54% and 61%). In 2017 alone, Diversified retail (type 2) banks show a lower risk than all the other business models. The finding that Wholesale banks have less exposure to risks in their assets is intriguing and clearly inconsistent with the previous Z-score, which indicates higher default risks than retail-oriented banks.[18] Figure 8.1 shows that the average risk weights across all business models have gradually been declining during the financial and economic crises and during the period since the crisis. The largest change was observed in Diversified retail (type 2) banks, which decreased their average risk weights from the highest risk in 2005, to a similar level to Wholesale and Investment banks in 2017.

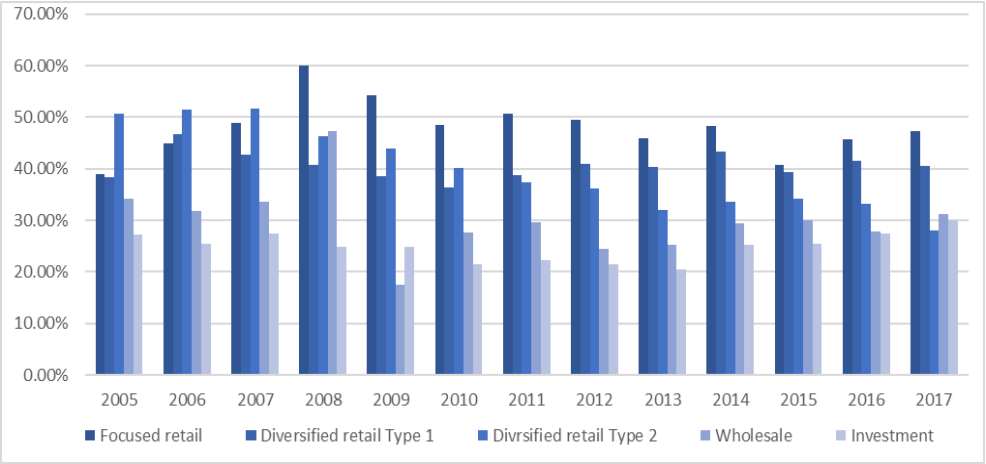
The differences between the ownership structures are, in general, rather limited, except for public and savings banks. In fact, the average risk weights of commercial, cooperative and nationalised banks range between 32% and 45%. Savings banks reported the highest risk weights, albeit the distance from the other ownership structures declined over time. In turn, the distance between the other structures and public banks that reported the lowest risk weights, remained similar over time.

Figure 8.1 Evolution RWAs (% of total assets)

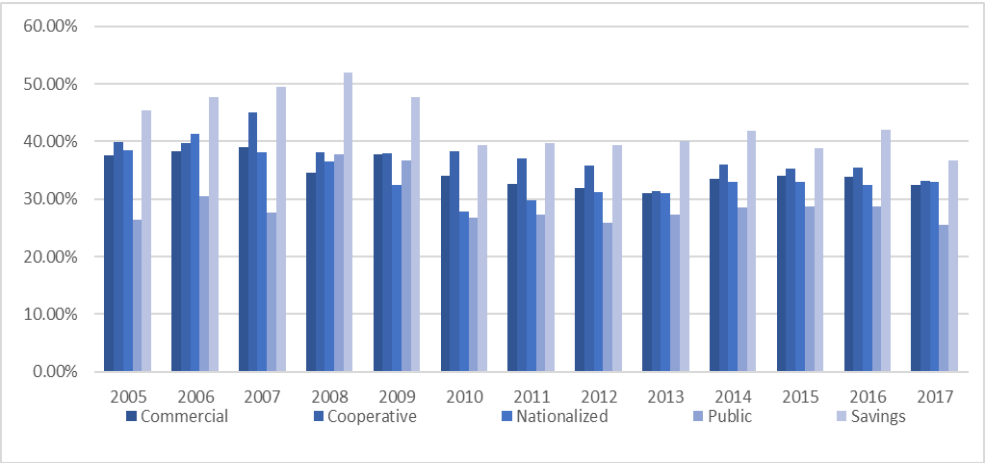
a) Business models

[17] The off-balance sheet exposures could not be included in this Monitor because of too few observations and insufficient comparability.

[18] See below for a deeper inquiry into why the regulatory and estimated risk measures may differ so radically.



b) Ownership structures



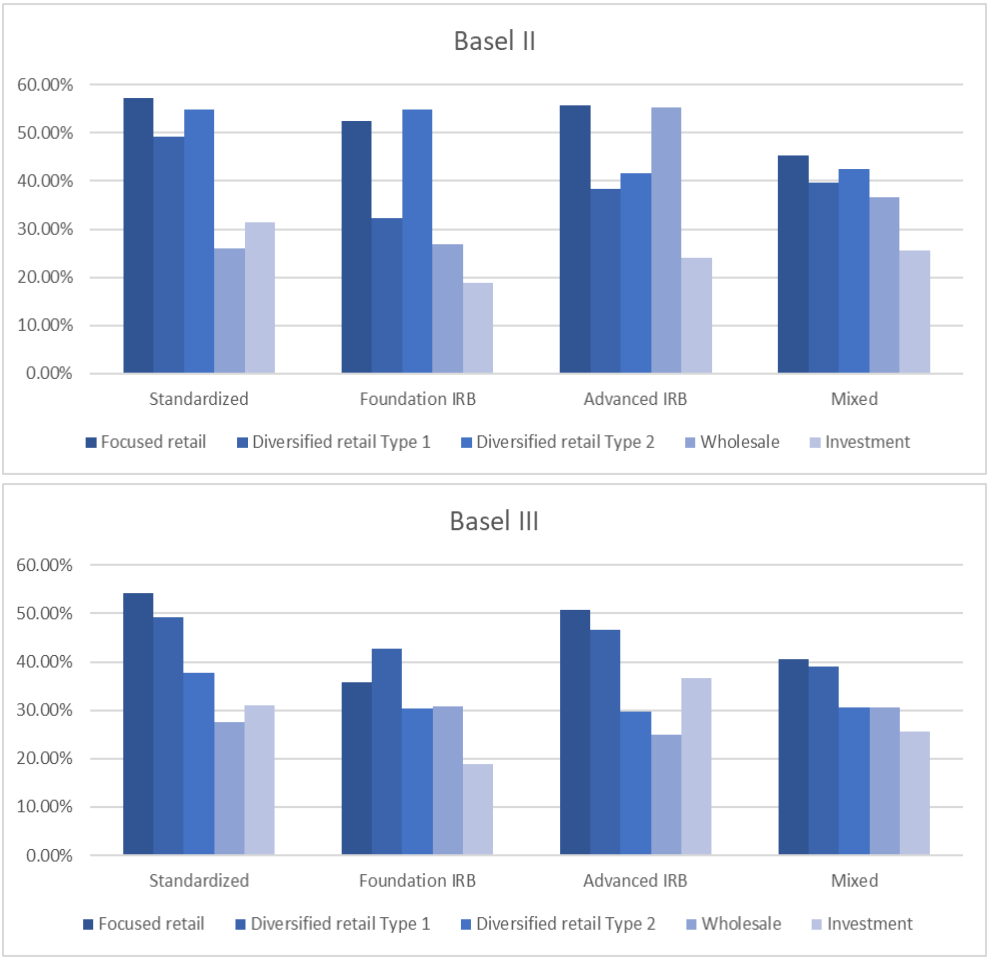
Note: The amounts expressed in the figure are the total weighted assets as share of total assets.

Source: Authors

Observing the average of RWA density of banks under Basel II and Basel III regulation, Figure 8.2 underlines that, in general, passing from Basel II to Basel III reduces their RWA density (risk weight over total assets). The only exception to this reduction is those banks that adopt the Diversified retail (type 1) model that show an increase of RWA over total asset ratio. Regarding Investment banks, the level of RWA density remains substantially the same from Basel II to Basel III, except for Investment banks using the Advanced IRB approach, for which the RWA density is higher under Basel III.

In general, banks more oriented to lending activity (Focussed retail and Diversified retail type 1 and type 2) show a higher RWA density ratio than banks that adopt more market-oriented business models (i.e. Investment or Wholesale).

Figure 8.2 Average RWA density (%) by Business Model



Notes: The figure above shows the average level of RWA density ratio that is a proxy of a bank's risk appetite. The figure underlines the difference amongst business models, the credit risk measurement approach and the Basel version adopted by institutions.

Source: Authors

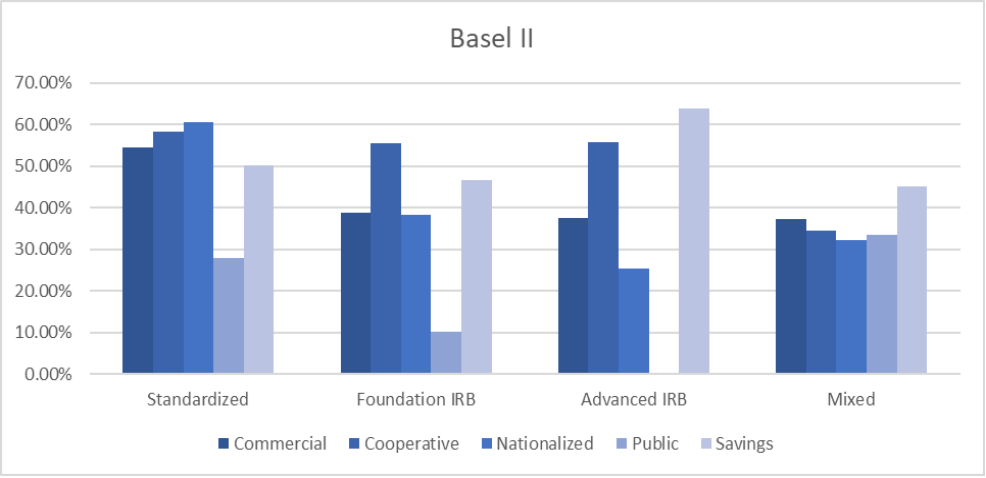
Referring to ownership structure, Figure 8.3 shows a generic reduction of RWA density from Basel II to Basel III. However, nationalised

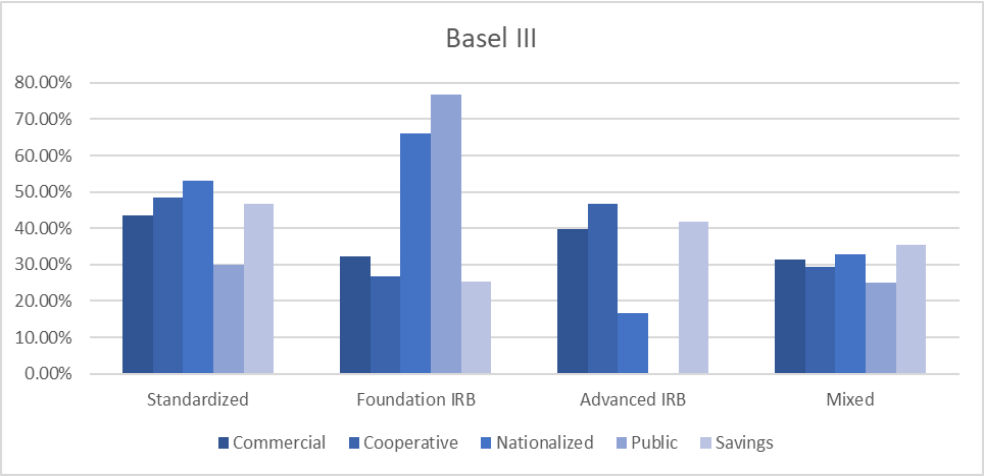
and public banks using the Foundation IRB show an increase in RWA over total assets ratio. Moreover, on average, mixed models under Basel III exhibit a lower RWA, with the exception of nationalised banks that adopt Advanced IRB.

In general, the standardised approach under Basel III shows a higher RWA density than other credit risk measurement approaches, except for nationalised and public banks that show the highest RWA density level when using the Foundation IRB approach.

These findings suggest that the passage from Basel II to Basel III, generally, decreases the risk weighted assets over total assets ratio and the highest savings are registered by those banks that adopt the standardised and FIRB approaches, whilst, unlike what might be expected, some banks that adopt the AIRB actually increase the RWA density under Basel III.

Figure 8.3 Average RWA density (%) by Ownership Structure





Notes: The figure above shows the average level of RWA density ratio that is a proxy of a bank's risk appetite. The figure underlines the difference amongst business models, the credit risk measurement approach and the Basel version adopted by institutions.

Source: Authors

The second indicator measures the **loss-absorption capacity of banks under the Basel capital rules** (the Tier-1 capital over risk-weighted assets, i.e. Tier 1 ratio). For any given level of risk, holding more capital could, in principle, imply a greater stability.

The results in Figure 8.4 show that Tier-1 ratios have been gradually increasing since the financial crisis. However, the ratios are statistically almost indistinguishable amongst the five business models during most years, implying a more or less identical absorption capacity. Only the Tier-1 ratio of wholesale and investments banks is significantly higher than that of retail-oriented banks, particularly during the economic crisis. In 2010, Investment banks show a peak of the indicator and in the subsequent years, both Wholesale and Investment banks show a higher capital requirement than the other business models. It is only in the latest year that they realign with the other models.

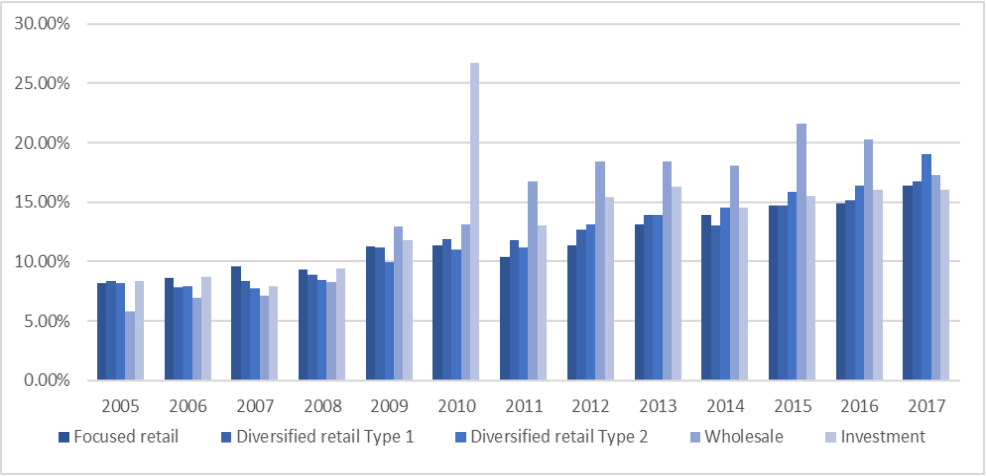
The results across ownership structures show a similar pattern. Banks across all the structures showed an increase in Tier-1 ratios. The ratios are statistically almost indistinguishable amongst the ownership structures, except for public banks that have significantly higher capital ratios (increasing from 11% to 18% between 2005 and 2012) and for commercial banks in 2010 which show a peak of 16.3%.

The fact that the differences in risk and absorption capacity are barely reflected in the risk weights and Tier-1 ratios is intriguing and suggests the

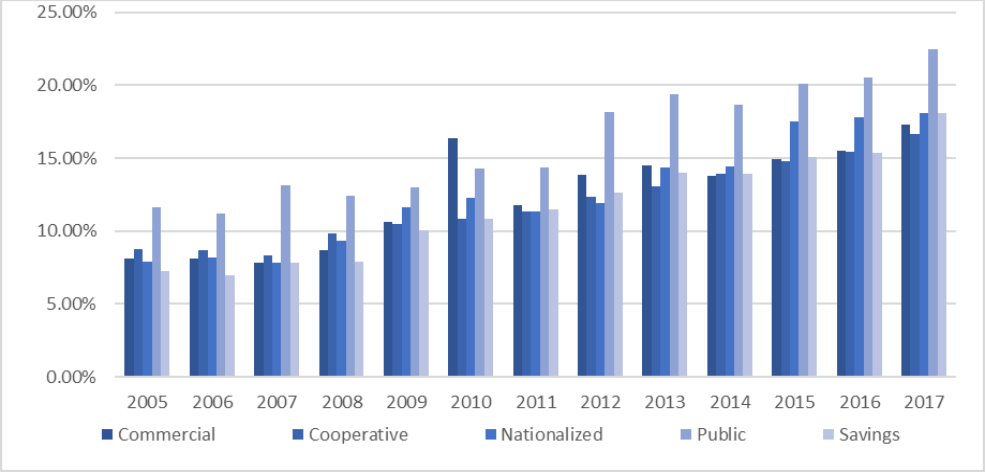
possibility that either the main regulatory instruments currently in use may not be adequate for capturing (or signalling) the loss-absorption capacity of a bank, in particular for Investment and Wholesale banks, or there is potential evidence of a misallocation of capital, particularly for public banks.

Figure 8.4 Evolution of Tier-1 capital ratios (as % of risk-weighted assets)

a) Business models



b) Ownership structures



Note: The amounts expressed in the figure are total values of Tier-1 capital ratios, Tier-1 capital as percentage of risk weighted assets.

Source: Authors

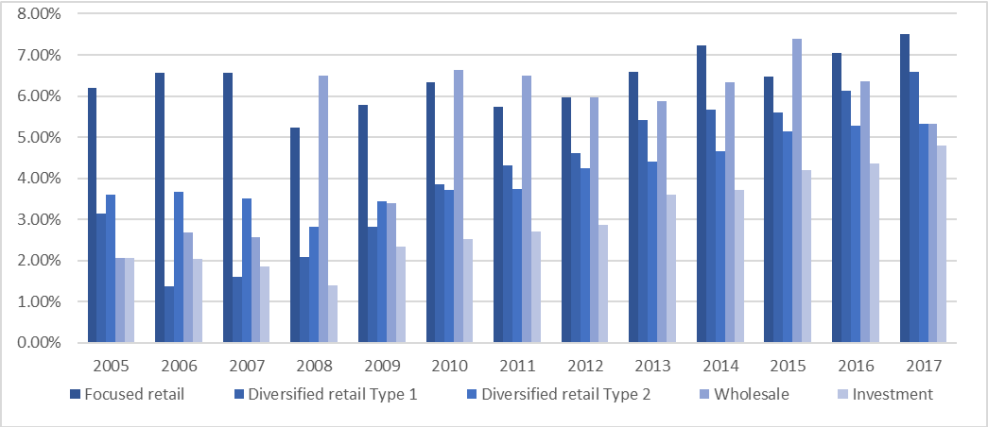
The third indicator measures the loss-absorption capacity using a simple **leverage ratio**[19] (i.e. tangible common equity over tangible assets). The tangible common equity ratios are statistically distinct for all business models. Figure 8.5 shows that banks across all business models have increased their tangible common equity ratios. Focussed retail banks hold substantially more tangible common equity than all the other business models (i.e. more than 5%), which made them capable of absorbing more losses (at least for the period under investigation). Similarly, diversified retail banks have continued to increase their ratio since the 2008 crisis, yet deposit funded diversified retail banks (type 1) seem more robust than diversified retail market funded banks (type 2). Moreover, the results suggest that Wholesale banks can absorb relatively more losses than Investment banks. The ratio has more than doubled for Investment banks during the final years that were observed, whilst the leverage ratio has been volatile for Wholesale banks during the financial crisis.

The tangible common equity ratios are also statistically distinct for most ownership structures. Although the tangible common equity ratios have converged in the most recent years, public banks still hold more tangible common equity than any of the other ownership structures. This finding reconfirms the previous one for public banks. Moreover, since the outbreak of the financial crisis, the tangible common equity across all ownership structures has increased; it was only the nationalised banks that struggled to recover during the Eurozone economic crisis.

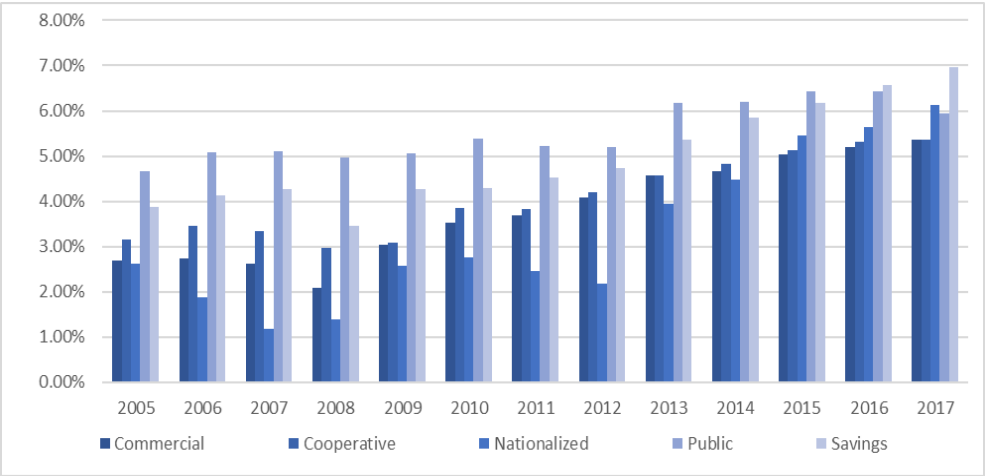
Figure 8.5 Leverage ratios (tangible common equity)

a) Business models

[19] Ayadi et al (2012) recommended a legally binding leverage ratio in order to curb excessive leverage in the banking sector.



b) Ownership structures



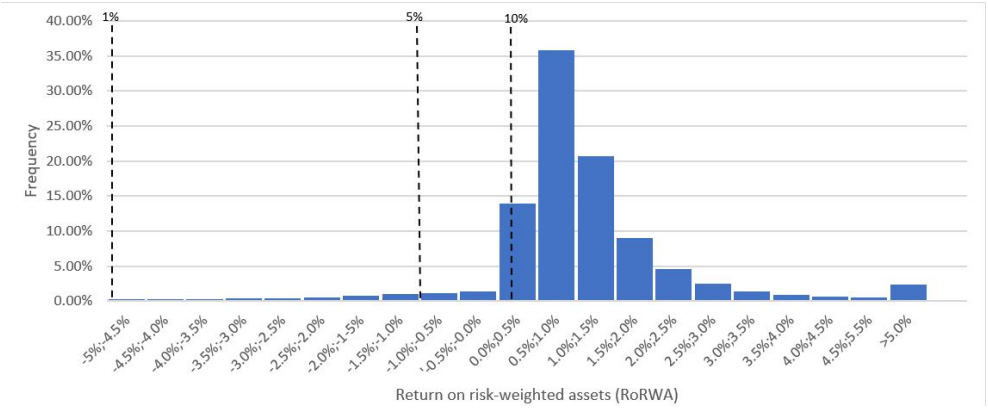
Note: The leverage ratios in the figure above are total tangible common equity as share of total tangible assets.

Source: Authors

An alternative assessment of default risks follows the 'top-down' approach to calibrating regulatory minimum capital requirements under stress conditions, as described in BCBS (2010b). This method allows for assessing the resilience of banks, per business model, to external shocks. More specifically, the quantiles of the return to risk-weighted assets (RoRWA) are used to construct expected losses that banks may face under a stress scenario. If the most loss-absorbing parts of equity (i.e. the tangible common capital ratio) remain below or close to such a measure, then the likelihood of a default would be equally higher under those stress conditions.

As an illustrative example, consider a bank that achieves 3% RoRWA during normal years. Let us assume that in a bad year, which occurs randomly once every 20 years, the bank faces a 7% loss. Note that the loss corresponds precisely to the 5^{th} percentile of the distribution function. Although effective average earnings of 2.5% RoRWA may be considered healthy, the bank will nevertheless default if its risk-adjusted capital level is below 7% in a bad year. Assuming a similar distribution for other banks, the regulators should ensure that the banks have at least this amount of capital at all times, to cope with stress conditions when needed.

Figure 8.6 Distribution of risk-weighted returns (RoRWA)



Note: This figure depicts the distribution for all banks covered in the study for the years 2005 to 2017.

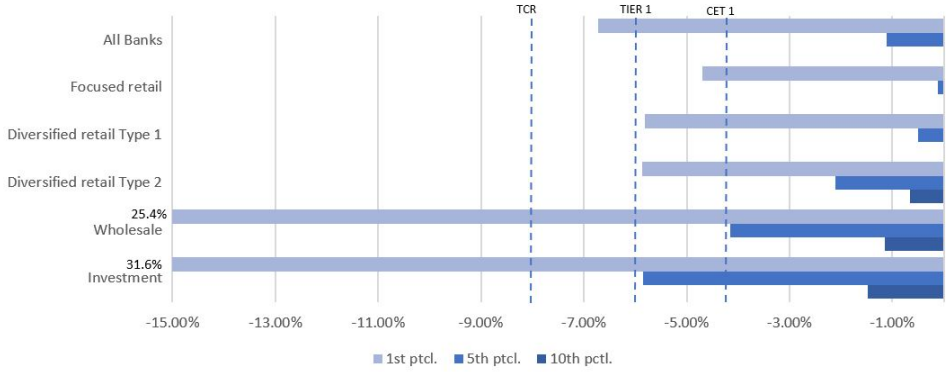
Source: Authors

Naturally, the distribution of returns of actual banks is substantially more varied than the example above. In particular, it provides an illustration of the distribution of the risk-weighted returns for all banks and years in the sample. The highest frequency of distribution is around 0-1% RoRWA, implying healthy returns for most banks in normal years. Assuming that a bad year is defined as a once-in-a-10-year event, i.e. lower 10th percentile losses, banks face RoRWA no losses (see also Figure 8.6). If a bad year is defined as rarer, thus a more destructive event, i.e. lower 5th percentile, the losses are 1.1% in a single year.[20]

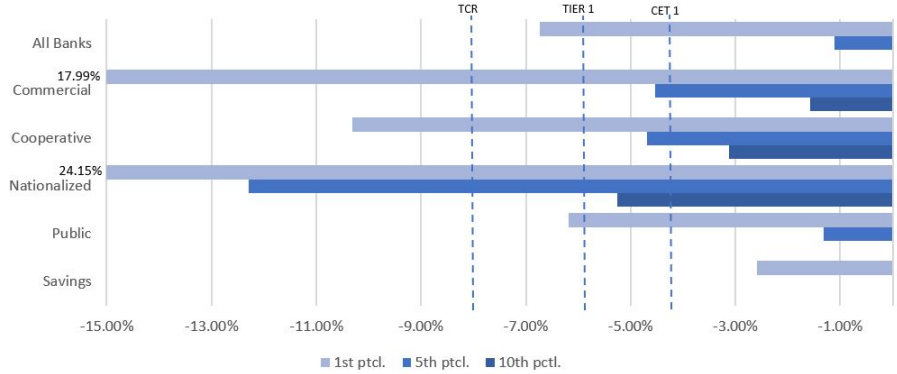
[20] Assuming that earnings are randomly and independently distributed, the estimates would imply that a bank with risk-adjusted capital of less than 1.1% would face a default likelihood of 5% at any given point in time. However, the earnings distributions of different banks are typically highly correlated, especially when interbank activities and common exposures are substantial. It is also assumed that losses are not correlated over time, which is also not likely to be the case. Based on these shortcomings, the actual default likelihoods are likely to be much higher than the levels implied by the percentile estimates.

Figure 8.7 Return on risk-weighted assets (top percentiles)

a) Business models



b) Ownership structures



Notes: This figure depicts the RoRWA of the top percentiles (1st, 5th, and 10th) for all banks covered in the study for the years 2005 to 2017. The dotted lines show the minimum regulatory requirements under CRDIV, common equity Tier 1 (CET1) requirement of 4.5%, Tier 1 requirement of 6% and Total Capital requirement (TCR) of 8% respectively.

Source: Authors

By using such estimates for different business models and ownership structures, one can assess the adequacy of the capital requirements to cope with stress conditions.

The relevant order statistics may be substantially biased if the underlying distribution is not normal. In order to address the latter concern, the distribution-free quantile estimator, first proposed by Harrell & Davis (1982), was used to generate alternative estimates for the lower

percentiles, in addition to the statistics obtained from the original sample.[21] The estimation results should, nevertheless, be interpreted with caution due to potential estimation errors.

The lower percentile estimates depicted in Table 8.2 provide an insight into the losses that banks have faced in recent years. When the entire sample is considered, the risk-adjusted losses, as measured by RoRWA, are approximately 6.7% at the 1st percentile. However, the depicted period had a large impact on returns. Losses were substantially greater during the financial and economic crises years than during the pre-crises period, with the pooled sample of banks facing risk-adjusted 1st percentile losses of respectively 6.4% and 0.6%.[22]

The distinction between the sample statistics and the Harrell-Davis estimates hint that concerns over the consistency of estimates could be well-placed for a few sub-samples. Significantly, results in the more extreme periods for the business models and ownership structures depicted percentile estimates that differ from the original figures. In particular, the estimated RoRWA loss at the 1st percentile is diverted during the pre-crisis period and financial crisis.

Looking at results by business models, it is shown that, following the financial crisis, both Wholesale and Investment banks suffer greater losses at the 1st percentile, as compared to the retail-oriented banks, regardless of the statistical procedure used[23]. This leads one to question the resilience of these two business models when they face extreme stress conditions. In the most recent years of this analysis, i.e. 2013-2017, it seems that Investment banks fare relatively better than Wholesale banks, in terms of their capacity to withstand extreme shocks, although both drive the overall sample to levels of losses that are far greater than retail-oriented banks all together. However, such a finding must be closely monitored annually in order to form a view on the long-term resilience of bank business models.

As for ownership structures, commercial banks and, understandably, nationalised banks are subject to more losses than others in extreme stress conditions (See also Figure 8.7). This result may suggest that these types of

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[21] Harrell & Davis (1982) provide a kernel quantile estimator in which the order statistics (i.e. smallest observations) used in traditional nonparametric estimators are given the greatest weight.

[22] Although the estimates for different years can clearly not be used to build the different scenarios, the substantial differences highlight the need for balanced data. The extent to which the crisis years are included in the dataset has a substantial impact on the severity of the stress scenarios and the relevant capital requirements.

[23] It is difficult to make a firm statement due to the low data coverage before 2007.

bank are intrinsically riskier and less resilient than other types of bank such as public, saving banks and cooperatives banks, which exhibit much lower losses in extreme stress conditions. Commercial and Nationalised banks show the highest losses in all the sub-periods analysed.

These results are important evidence showing that, during this period of investigation, retail-oriented, cooperative and savings banks were more resilient than wholesale, investment and commercial banks. Nationalised banks were, and potentially still are, not resilient and, hence, should be dealt with by their respective governments or resolution authorities to avoid any future detrimental impact on financial stability.

Table 8.2 Lower percentile estimates for return on risk-weighted assets (RoRWA)

a) Business models

		Sample statistics			Harrell-Davis estimates		
	Obs	1st	5th	10th	1st	5th	10th
ALL YEARS (2005-17)							
Model 1 – Focus. retail	8338	-4.69%	-0.08%	0.25%	-5.7%	-0.4%	0.2%
Model 2 – Div. retail (T1)	7575	-5.8%	-0.4%	0.2%	-6.0%	-2.1%	0.6%
Model 3 – Div. retail (T2)	3181	-5.8%	-2.1%	-0.7%	-4.6%	-0.1%	-0.2%
Model 4 – Wholesale	1445	-25.4%	-4.2%	-1.2%	-33.4%	-6.3%	-1.6%
Model 5 – Investment	944	-31.6%	-5.8%	-1.5%	-27.8%	-4.4%	-1.2%
All banks	21483	-6.7%	-1.1%	0.1%	-6.8%	-1.1%	0.1%
PRE-CRISIS (2005-06)							
Model 1 – Focus. retail	102	0.1%	0.8%	0.9%	-0.2%	0.5%	0.9%
Model 2 – Div. retail (T1)	40	0.2%	0.6%	0.9%	-0.0%	0.5%	0.8%
Model 3 – Div. retail (T2)	175	0.1%	0.5%	0.8%	0.0%	0.6%	0.9%
Model 4 – Wholesale	19	-24.8%	-24.8%	-24.4%	0.2%	0.4%	0.8%
Model 5 – Investment	39	0.3%	0.3%	1.8%	0.3%	0.5%	0.9%
All banks	366	-0.6%	0.5%	0.8%	-0.5%	0.5%	0.8%
FIN. CRISIS (2007-09)							
Model 1 – Focus. retail	345	-4.7%	-1.5%	0.0%	-13.5%	-2.5%	-1.3%
Model 2 – Div. retail (T1)	106	-11.3%	-2.0%	-1.2%	-4.8%	-1.2%	-0.0%
Model 3 – Div. retail (T2)	348	-4.7%	-1.1%	-0.6%	-4.6%	-1.5%	-0.2%
Model 4 – Wholesale	47	-15.5%	-10.2%	-7.1%	-8.4%	-4.5%	-1.7%
Model 5 – Investment	57	-9.1%	-5.7%	-1.4%	-15.2%	-4.5%	-1.7%
All banks	897	-7.1%	-1.8%	-0.4%	-7.4%	-1.8%	-0.4%
ECON CRISIS (2010-12)							
Model 1 – Focus. retail	2825	-5.5%	-0.3%	0.2%	-5.1%	-0.2%	0.3%
Model 2 – Div. retail (T1)	2440	-4.9%	-0.1%	0.3%	-5.8%	-1.9%	-0.6%
Model 3 – Div. retail (T2)	1165	-5.6%	-1.8%	0.5%	-5.6%	-0.4%	0.2%
Model 4 – Wholesale	584	-17.2%	-5.3%	-1.2%	-86.2%	-10.8%	-3.2%
Model 5 – Investment	375	-48.1%	-8.5%	-3.1%	-17.5%	-5.5%	-1.4%
All banks	8229	-7.8%	-1.3%	0.1%	-7.9%	-1.3%	0.1%
FIN+ECON CRISES (2007-12)							
Model 1 – Focus. retail	3170	-5.4%	-0.5%	-0.2%	-5.3%	-0.5%	0.3%
Model 2 – Div. retail (T1)	2546	-5.1%	-0.4%	0.2%	-5.4%	-1.8%	-0.4%
Model 3 – Div. retail (T2)	1513	-4.8%	-1.7%	-0.4%	-5.4%	-0.6%	0.2%
Model 4 – Wholesale	625	-15.9%	-5.9%	-1.3%	-65.6%	-8.7%	-2.8%
Model 5 – Investment	539	-27.1%	-5.2%	-1.2%	-17.2%	-6.3%	-1.5%
All banks	12888	-6.4%	-1.0%	0.2%	-7.8%	-1.3%	-0.1%
POST-CRISIS (2013-2017)							
Model 1 – Focus. retail	5066	-3.8%	0.0%	0.3%	-6.0%	-0.5%	0.3%
Model 2 – Div. retail (T1)	4989	-6.0%	-0.5%	0.2%	-7.2%	-2.5%	-1.1%
Model 3 – Div. retail (T2)	1493	-6.8%	-2.5%	-1.1%	-3.9%	0.0%	0.3%
Model 4 – Wholesale	801	-39.5%	-3.2%	-0.9%	-26.8%	-5.8%	-1.2%
Model 5 – Investment	3	-21.9%	-2.9%	-0.6%	-43.5%	-3.3%	-1.1%
All banks	3452	-8.4%	-1.8%	-0.1%	-6.5%	-1.0%	-0.2%

b) Ownership structures

	Obs	Sample statistics			Harrell-Davis estimates		
		1st	5th	10th	1st	5th	10th
ALL YEARS (2005-17)							
Commercial	4844	-18.0%	-4.5%	-1.6%	-18.2%	-4.5%	-1.6%
Cooperative	4109	-3.0%	-0.4%	0.2%	-3.0%	-0.5%	0.2%
Nationalised	279	-28.1%	-12.8%	-5.3%	-31.9%	-13.4%	-5.2%
Public	545	-6.2%	-1.3%	0.4%	-7.2%	-1.4%	0.2%
Savings	4567	-2.6%	-0.1%	0.3%	-2.7%	-0.1%	0.3%
All banks	21483	-6.7%	-1.1%	0.1%	-6.8%	-1.1%	0.1%
PRE-CRISIS (2005-06)							
Commercial	196	-24.4%	0.4%	0.8%	-15.1%	0.4%	0.9%
Cooperative	53	0.7%	0.8%	1.0%	0.2%	0.3%	0.7%
Nationalised	40	-1.4%	0.0%	0.7%	0.8%	0.8%	0.9%
Public	16	0.3%	0.3%	0.6%	0.3%	0.4%	0.5%
Savings	76	0.2%	0.5%	0.8%	0.3%	0.5%	0.8%
All banks	366	-0.5%	0.5%	0.8%	-0.5%	0.5%	0.8%
FIN. CRISIS (2007-09)							
Commercial	437	-10.2%	-2.7%	-0.7%	-11.1%	-2.7%	-0.8%
Cooperative	129	-1.4%	-0.7%	0.1%	-1.4%	-0.7%	0.0%
Nationalised	62	-5.8%	-2.7%	-1.9%	-5.6%	-3.6%	-2.2%
Public	64	-0.6%	0.0%	0.3%	-5.4%	-0.3%	0.3%
Savings	206	-3.9%	-0.7%	-0.1%	-4.5%	-1.2%	-0.2%
All banks	897	-7.1%	-1.8%	-0.4%	-7.3%	-1.8%	-0.4%
ECON. CRISIS (2010-12)							
Commercial	1539	-18.4%	-5.8%	-2.5%	-20.2%	-5.7%	-2.6%
Cooperative	4147	-2.1%	0.1%	0.3%	-2.1%	0.1%	0.3%
Nationalised	71	-49.0%	-21.2%	-12.2%	-43.4%	-22.0%	-13.6%
Public	172	-10.1%	-3.1%	0.0%	-11.6%	-2.7%	-0.3%
Savings	1403	-3.5%	-0.0%	0.2%	-3.4%	-0.1%	0.2%
All banks	7332	-7.92%	-1.3%	0.0%	-7.9%	-1.3%	0.1%
FIN+ECON CRISES (2007-12)							
Commercial	1976	-15.7%	-5.2%	-2.1%	-16.5%	-5.2%	-2.2%
Cooperative	4276	-2.1%	0.1%	0.3%	-2.0%	0.1%	0.3%
Nationalised	132	-28.1%	-12.9%	-5.8%	-37.0%	-14.6%	-6.6%
Public	236	-8.8%	-1.4%	0.1%	-9.6%	-1.6%	0.0%
Savings	1609	-3.7%	-0.2%	0.1%	-3.6%	-0.2%	0.2%
All banks	8229	-7.8%	-1.3%	-0.1%	-7.8%	-1.3%	-0.1%
POST-CRISIS (2013-2017)							
Commercial	2672	-18.8%	-4.1%	-1.4%	-20.4%	-4.1%	-1.4%
Cooperative	6926	-3.7%	-0.0%	0.2%	-3.8%	-0.1%	0.3%
Nationalised	115	-23.0%	-18.5%	-5.3%	-33.4%	-16.3%	-6.0%
Public	293	-6.1%	-1.5%	0.1%	-10.7%	-1.7%	-0.1%
Savings	2882	-2.3%	0.2%	0.3%	-2.3%	0.2%	0.4%
All banks	12888	-6.4%	-1.0%	0.1%	-6.5%	-1.0%	-0.2%

Note: The figures correspond to the 1st, 5th, and 10th percentile estimates of the distribution of the RoRWA, conditional on the business models/ownership structures and time periods across the sample.

Source: Authors

A more dynamic analysis shows that the order in peak-losses differs substantially for the different sub-periods in the sample. During the pre-crisis years of 2005 and 2006, losses occurred only for the 1st percentile, whilst during each crisis, losses were observed in the 10th percentile and below. The losses climbed gradually during the crises. During the 2007-09 financial crisis, the losses were less than during the 2010-12 Eurozone economic crisis.

The order of the business models also shifted. Looking at the 1st percentile, Investment banks reported losses below those of Wholesale banks during the financial crisis, whilst Investment banks reported the highest losses during the economic crisis. The Diversified retail (type 1) banks clearly lost more during the financial crisis than during the economic crisis, whilst the losses of the Focussed retail and Diversified retail (type 2) banks were more comparable.

The order of ownership structures remained the same, except for nationalised and public banks. In fact, the peak losses of both ownership structures increased substantially between the financial and economic crises. Moreover, peak losses diverged in the aftermath of the crises. The peak losses of commercial banks with higher losses during the economic crisis, remained high after the crisis, whilst the peak losses of savings banks with the lowest RoRWA during the crises decreased.

The dynamic analysis of the different crisis periods shows that diversity of business models and ownership structures can be a factor in resilience, as the capacity of different business models and ownership structures to withstand extreme stress conditions differs, depending on the nature of the crisis and, hence, the overall banking system remains afloat. In this analysis and at least during this period of investigation, retail-oriented, savings and cooperatives banks have provided systemic resilience for the European banking sector. Conversely, Investment, Wholesale and Commercial banks have dragged the overall banking system to levels of losses akin to extreme stress conditions.

Another dimension is the comparison of the mean values for RoRWAs (Table 8.3), which shows that the distinctions are fairly insignificant for the financial crisis period when tested using Wilcoxon-Mann-Whitney non-parametric two-sample tests. Indeed, for the period between 2005 and 2009, far fewer observations were available. The results for all the years show that Wholesale and Diversified retail (type 2) banks, on average, reported distinctly higher RoRWAs than banks belonging to the other retail-oriented models and to the investment models. Looking at all the

crises years (2007-12), Wholesale banks still perform significantly better, whilst Focussed retail banks are the worst performers.

In the aftermath of the crisis, both Focussed retail and Diversified retail (type 1) banks perform significantly worse than the other three business models.

The averages for different ownership structures show that nationalised banks were the only ones reporting losses for the entire sample period. In turn, public and commercial banks reported the significantly highest returns.

The findings show clear distinctions across business models and ownership structures in terms of peak losses, which suggests that the average risk weights do not reflect the underlying risks of certain banks. In particular, Wholesale and Investment banks faced severe default risks during the financial and economic crises. Nevertheless, these differences appear in the underlying risks, not in the average risk weights.

Table 8.3 Mean RoRWA

a) Business models

	Focussed retail	**Diversified retail (type 1)**	**Diversified retail (type 2)**	**Wholesale**	**Investment**	**ALL**
All years (2005-17)	0.73%***	0.78%***	1.27%***	1.64%***	1.07%**	1.06%
Pre-crisis (2005-06)	2.31%***	2.33%**	1.91%***	1.13%**	2.52%***	2.10%
Financial Crisis (2007-09)	1.27%	0.53%	0.96%	1.25%	0.11%	0.71%
Economic Crisis (2010-12)	-0.19%**	0.34%***	0.66%***	2.58%***	0.92%***	0.56%
Crises years (2007-12)	0.35%***	0.42%***	0.82%***	1.92%***	0.51%***	0.63%
Post-crisis (2013-17)	0.90%***	0.96%***	1.63%***	1.72%***	1.25%***	1.26%

b) Ownership structures

	Commercial	**Cooperative**	**Nationalised**	**Public**	**Savings**	**ALL**
All years (2005-14)	1.32%***	1.08%**	-0.59%***	1.42%**	1.05%***	1.06%
Pre-crisis	2.27%***	1.88%***	2.10%***	1.92%***	1.61%**	2.10%

(2005-06) Financial Crisis (2007-09)	0.97%*	0.84%*	-0.58%*	1.39%*	0.72%	0.71%
Economic Crisis (2010-12)	1.02%***	0.85%***	-2.89%***	1.38%***	0.59%**	0.56%
Crises years (2007-12)	0.99%****	0.85%*	-1.60%***	1.39%**	0.65%*	0.63%
Post-crisis (2013-14)	1.42%***	1.15%*	-0.05%***	1.41%*	1.31%***	1.26%

Notes: All figures are the mean values for all banks in the sample. The independence of clusters/ownership structures was tested using Wilcoxon-Mann-Whitney non-parametric two-sample tests at 5% significance. The number of asterisks (*, **, ***, ****) stands for the statistical difference of any given cluster from that number of other clusters/ownership structures for that indicator. For example, a single asterisk (*) implies that the clusters/ownership structure is statistically different from the furthest clusters/ownership structure but not the other three.

Source: Authors

One explanation for the finding that regulatory measures appear to be misaligned with underlying risks, is the possibility that greater risk-weights are associated with more capital, which leads banks to report lower RWA to avoid matching it with additional capital. If banks with greater RWA also hold more capital, partly to fulfil the binding regulatory requirements, they should face lower default risks. This may possibly explain the distorted relationship.

An alternative explanation is that banks may be engaging in 'risk optimisation' to reduce their risk-weights (and the implied capital charges) without shedding any risks or transferring the risk off balance sheet. Indeed, despite sound arguments for making capital requirements risk-sensitive, the complexity and flexibility of these rules has led to concerns over the potential for regulatory arbitrage.[24] Since raising capital is not always possible during the crisis periods, some banks choose to respond to regulatory shortfalls by decreasing their risk-weighted assets. This can be

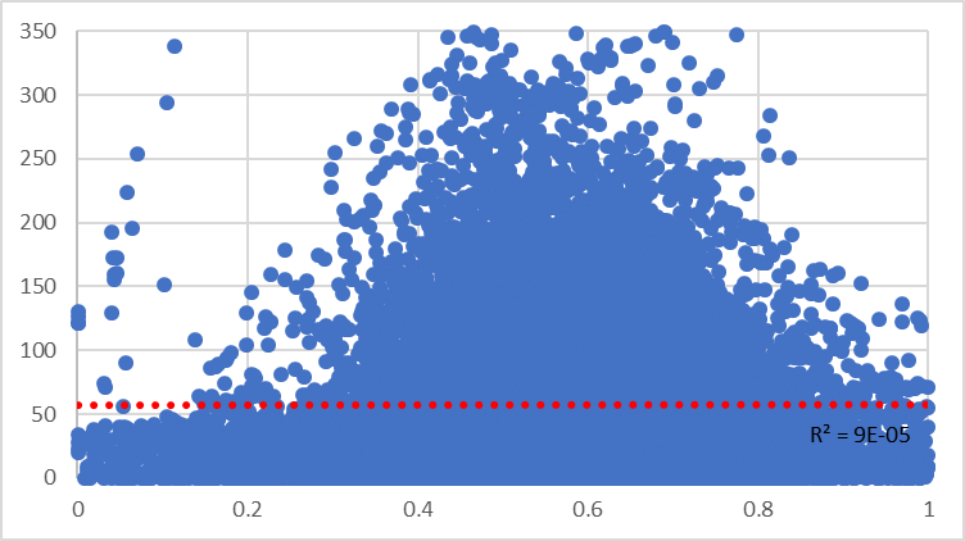
[24] The theoretical literature provides a simple argument for making capital requirements risk-sensitive. Faced with purely linear (i.e. risk-insensitive) capital requirements, banks may shift their portfolios towards riskier assets, offsetting their losses from higher capital levels by increasing their portfolio risks (Kahane, 1977; Koehn & Santomero, 1980; Kim & Santomero, 1988; Rochet, 1992). Empirical studies have confirmed that fixed capital requirements may increase risks, conditional on the size and the adequate capitalisation of the bank (Keeley & Furlong, 1990; Gennotte & Pyle, 1991; Calem & Rob, 1999).

done through deleveraging or changing the composition of the assets to assets with lower risk-weights, or changing the calibration of the risk-weights (i.e. changing from standard to internal models with lower average ratios or changing the internal models). There is a concern amongst researchers, supervisors and policy makers about the usage of internal models, which implies that the risk-weights and, thus capital requirements, are reduced without reducing the underlying risks (i.e. regulatory arbitrage).[25]

Empirical evidence on the potential misalignment of risk-sensitive capital requirements is growing. Ayadi et al. (2011, 2012) and Ayadi & De Groen (2014a) provide evidence of a negative relationship between average risk-weights and a number of risk factors for the EU's top banks in recent years, including estimates of default likelihood, Tier-1 ratio and earnings volatility. Supplemental evidence from the study also shows that investment-oriented banks may have found ways to take on more risk than their regulatory risk measures would reflect. More recently, Das & Sy (2012) have shown that banks with lower average risk-weights (measured by the risk-weighted-assets to asset ratio) do a poor job in predicting market measures of risk, especially during the crisis. The Basel Committee on Banking Supervision (2013) conducted a benchmarking exercise using data for more than 100 banks, which showed that there are large differences between the internal models used to determine the risk- weighted assets (see BCBS (2013)), the univariate regressions of Ayadi & De Groen (2014a) are repeated. It provides the results of censored regressions to assess whether the average risk weights explain distance from default (Z-Score). To be an effective regulatory risk measure, there should be a strong relation between the risk-weighted assets and the underlying risk. Notwithstanding differences in capital levels, the relationship between Z-score and RWA to assets should be negative, which implies that banks with a higher RWA are closer to default.

[25] Jones (2000) discusses several forms of 'cosmetic' adjustments that banks can undertake to reduce risk-weights, including the concentration of assets in the highest risk classes for a given risk-weight, various forms of credit enhancements, remote-origination, and structured transactions. More recently, some observers note that the introduction of the IRB approach under Basel II has effectively enlarged the opportunities of the more sophisticated banks to engage in regulatory arbitrage, (Blundell-Wignall & Atkinson, 2010; Dewatripont et al., 2010; Independant Commission on Banking, 2011). More specifically, there is substantial evidence from the financial crisis of 2007-09 that losses from off-balance sheet, asset-backed commercial paper (ABCP) conduits have remained with the originating banks (Acharya et al., 2010).

Figure 8.8 Relation between Z-score and RWA



Notes: The business models to which the different observations are expressed with the first letter of the models: Investment (I), Wholesale (W), Diversified retail (D), and Focussed retail (F). The axes have been cut at a Z-score of 100 and RWA 100% of assets to make it easier to visualise the large majority of observations.

Source: Authors

The estimation results for the retail-oriented banks (Focussed retail and Diversified retail type 2) show a significantly negative relation between the regulatory risk measure and distance to default. However, the results for the entire sample are insignificant at the 10% level. (See also Figure 8.8 for a scatter plot of the observations). In turn, the results for Diversified retail (type 1), Wholesale and Investment banks show a positive relation, which implies that RWA are inversely related to underlying risks. But these results are only significant at the 10% level in the case of Investment banks.

The estimations for the ownership structures are more in line with expectations; namely, that the risk-weights for nationalised, public and savings banks seem to be negatively related to the Z-score. Only the risk-weights for nationalised and savings banks have a significantly negative relation with Z-score at the 1% level. The result for public banks is insignificant. With regard to commercial and cooperative banks, the results show a positive relationship, however, the relationship is only significant in the case of commercial banks. Furthermore, capital levels have the expected significantly positive effect for all structures, except for savings banks, but the relationship is not significant (See Table 8.4). In fact, the capital level actually has a significantly negative impact on the Z-score of savings banks.

Overall, RWA does appear to be able to capture the underlying risks for the business models with most exposure to customer loans (i.e. Focussed retail and Diversified retail type 2 banks), as well as nationalised, public and savings banks. In turn, it fails to do so for Wholesale, Investment and Diversified retail (type 1) banks, as well as commercial and cooperative banks. The relationship between the two measures of risk is ambiguous for these business models and ownership structures, even after allowing for capital levels. The findings suggest that the risk-weighted assets of these banks are not well calibrated. Hence, this implies that the risk-weights of certain assets or activities, conducted primarily by these banks, might be incorrect. Wholesale and Investment banks, for example, engage more in interbank and trading activities. The effective risk-weights for these activities are rather low, due to the possibility of lowering exposures (e.g. derivative exposures are reduced using compression, hedging, offsetting and netting), which is particularly attractive to banks with larger market activities that can benefit from the advantages of scale.

It is important to remember that, during 2017, the Basel Committee introduces a new reform to improve Basel III. The Committee's Basel III reforms complement the initial phase of the Basel III reforms announced in 2010. The 2017 reforms seek to restore credibility to the calculation of risk-weighted assets (RWAs) and improve the comparability of banks' capital ratios. RWAs are an estimate of risk that determines the minimum level of regulatory capital a bank must maintain to deal with unexpected losses. A prudent and credible calculation of RWAs is an integral element of the risk-based capital framework (BIS, 2017).

Table 8.4 Relationship between Z-score and RWA, 2005-17

a) Business models

	Focussed retail	Diversified retail (type 1)	Diversified retail (type 2)	Wholesale	Investment	All models
RWA	-18.55***	0.69	-48.45***	1.45	0.79**	0.57
	(4.33)	(0.48)	(5.95)	(3.38)	(0.30)	(0.39)
TCE	-1.38	-23.19	363.19***	-21.97*	39.67***	-5.06
	(20.80)	(15.56)	(26.30)	(9.46)	(9.36)	(7.33)
Cons.	74.72***	57.92***	37.93***	39.02***	20.82***	53.58***
	(3.06)	(1.61)	(3.26)	(2.30)	(1.53)	(0.86)
Obs.	8,307	7,544	3,151	1,445	945	21,392
Log L.	-43887.121	-38006.53	-16566.31	-7153.25	-4417.68	-111,202.43
F-stat.	19.70	3.47	186.92	5.65	29.88	2.28
p-value	0.0001	0.1764	0.0000	0.0594	0.0000	0.3202
Left censored	997	919	140	145	79	2280
Right censored	0	0	0	0	0	0
Pseudo R2	0.0002	0.0000	0.0056	0.0004	0.0034	0.0000

b) Ownership structures

	Commercial	Cooperative	Nationalised	Public	Savings	All
RWA	0.87**	0.57	-10.25***	-26.98	-21.47***	0.57
	(0.29)	(3.37)	(1.35)	(26.29)	(6.98)	(0.39)
TCE	21.09***	71.50***	57.92***	217.30***	-14.23	-5.06
	(6.44)	(19.49)	(7.47)	(80.59)	(26.31)	(7.33)
Cons.	20.00***	55.74***	6.76***	56.29***	79.76***	53.58***
	(1.07)	(2.45)	(0.64)	(10.87)	(4.32)	(0.86)
Obs.	4,805	11,229	277	535	4,545	21,392
Log L.	-23,568.07	-58216.94	-772.32	-2,942.74	-23888.34	-111,202.43
F-stat.	23.11	14.39	69.77	7.59	10.92	2.28
p-value	0.0000	0.0008	0.0000	0.0225	0.0042	0.3202
Left censored	522	1130	21	61	545	2280
Right censore	0	0	0	0	0	0

d Pseudo R2	0.0005	0.0001	0.0432	0.0013	0.0002	0.0000

Notes: Regressions present results for Tobit univariate regressions with the Z-score as the dependent variable and left-censored at zero. Robust standard errors are in parentheses. ***, **, and * signify significance at 1%, 5%, and 10% p-values. RWA: risk-weighted-assets as % of total assets; TCE: tangible common equity as % of tangible assets; Log L.: log likelihood ratio.

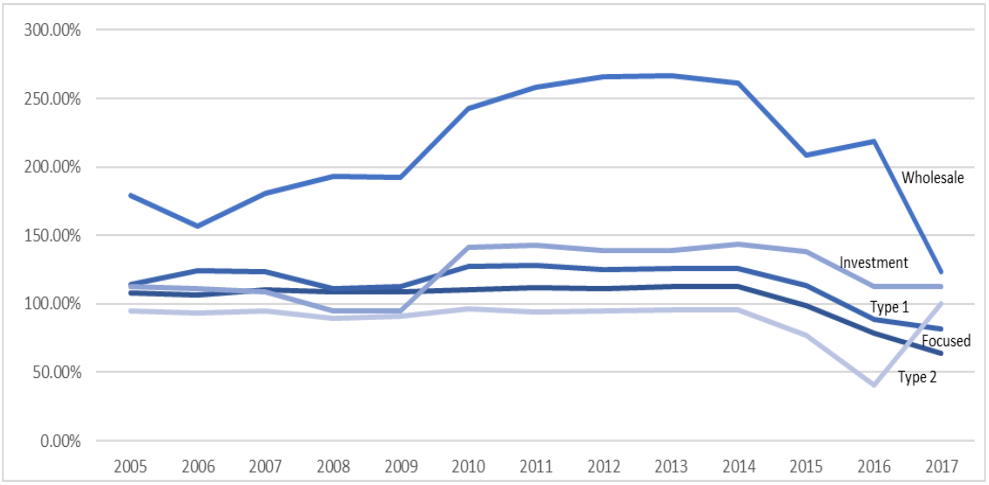
Source: Authors

The fourth indicator, the **net stable funding ratio (NSFR),** is an estimate of the proposed long-term liquidity risk measure, part of the Basel III rules, (BCBS, 2010a). Expressed simply, the measure gives an estimate of the available stable funding sources as a share of required stable funding, which is constructed with the available data. Although the measure should be interpreted with caution, a greater value should point to lower liquidity risks.[26] Figure 8.9 shows that the Wholesale and Investment banking models face relatively lower liquidity risks, whilst the retail-oriented models may face higher risks. It is important to note that not all models satisfy the 100% funding requirement, as it will become a binding requirement in the future. In fact, Diversified retail (type 2) banks show a NSFR lower than 100% for the entire period, with the exception of the last observed year. Also Investment banks, that show the second highest ratio since the economic crisis, reveal a NSFR lower than 100% during the financial crisis. However, liquidity conditions have gradually improved for most models, particularly for the Wholesale and Investment models. The differences between the ownership structures are much smaller, whilst, savings and cooperative banks, after an initial period of increase in NSFR, show an average ratio lower than the requirement in the last two observed years.

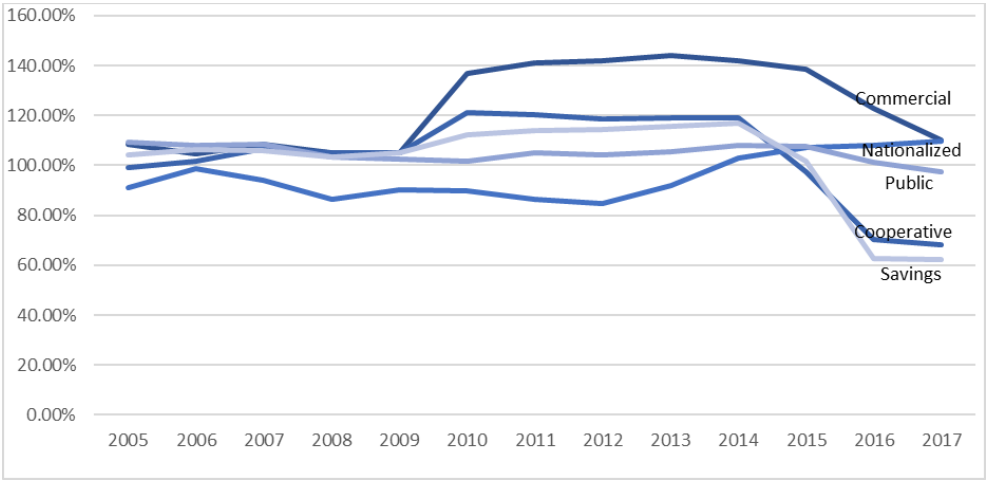
[26] See Appendix VI for a detailed description of the measure used in this study. Note that the developed indicator suffers substantially from the unavailability of detailed information. In particular, the disclosure requirements that are currently applicable do not require banks to distinguish between different maturities, secured transactions and many specific asset and liability classes that are relevant for determining liquidity in an institution.

Figure 8.9 Evolution of net stable funding ratio (NSFR)

a) Business models



b) Ownership structures



Note: See Appendix VI for the assumptions pertaining to the construction of the net stable funding ratio (NSFR).

Source: Authors

Finally, in what follows, we supplement the Monitor analysis with the resolution capacity per bank business model and ownership structure.

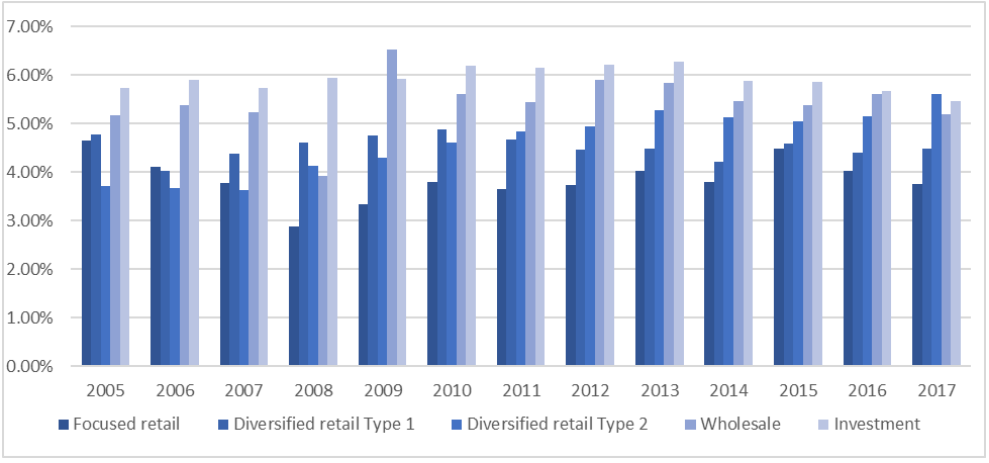
When the bank is unable or unlikely to meet the capital requirements, the recovery and resolution mechanism will need to ensure that the bank will either be orderly resolved or viably restored. The following indicators assess various aspects of the Bank Recovery and Resolution Directive and the Single Resolution Mechanism that are currently being phased-in.

The fifth indicator, bail-in contribution, is an estimate of the minimum bail-in under the resolution mechanism, as share of total liabilities incl. own funds before resolution funds can be tapped. The legislation prescribes that banks need to have at least 8% of bail-inable liabilities, which is equal to the minimum amount that needs to be bailed-in before an amount up to 5% of liabilities can be contributed from the resolution fund. However, since the banks need to hold at least 8% of risk-weighted assets to fulfil the total regulatory capital requirement, the minimum losses that can be covered under the bail-in is the difference between the minimum total capital requirement and the minimum bail-in requirement.

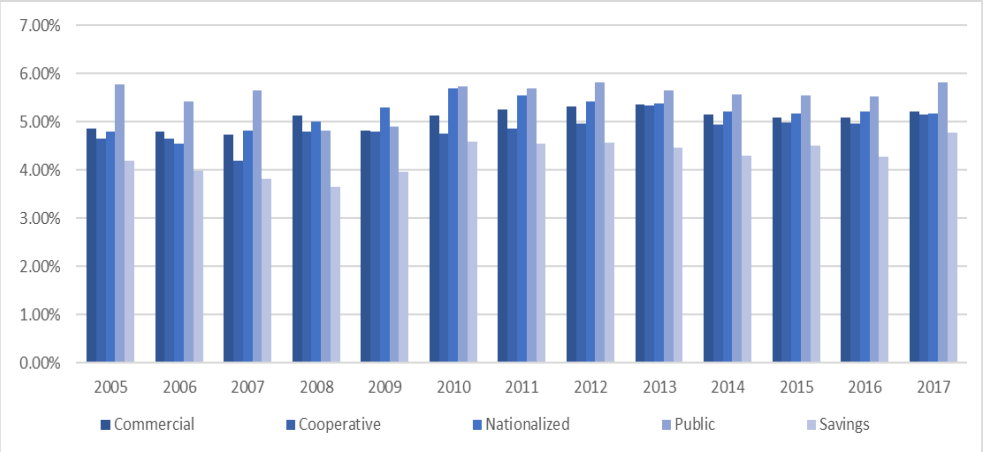
Figure 8.10 shows the minimum contribution of banks to potential resolution. The bail-in contribution of retail-oriented banks is significantly less than Wholesale and Investment banks, though Diversified retail (type 2) banks, that previously had the lowest bail-in contribution, converged in the aftermath of the economic crisis to Diversified retail (type 1) banks. Also, Diversified retail (type 2) banks converged to Wholesale and Investment banks after the financial crisis. Most of the differences across ownership structures are insignificant, except for public banks, which have a significantly higher bail-in capacity than all the other ownership structures. In fact, the bail-in contribution has a reverse relation with the average risk weight, shown above. Since the average risk weight is gradually increasing, the bail-in contribution capacity remained stable in recent years, which might mean that the resolution fund is likely to need more funds.

Figure 8.10 Bail-in contribution (share of total liabilities)

a) Business models



b) Ownership structures



Note: The bail-in contribution is the potential contributions of creditors to the recapitalisation of distressed banks, i.e. difference between the minimum bail-in and capital requirement as share of total liabilities. The minimum bail-in is 8% of total liabilities incl. own funds and the required recapitalisation level is equal to the total capital requirement of 8%.

Source: Authors

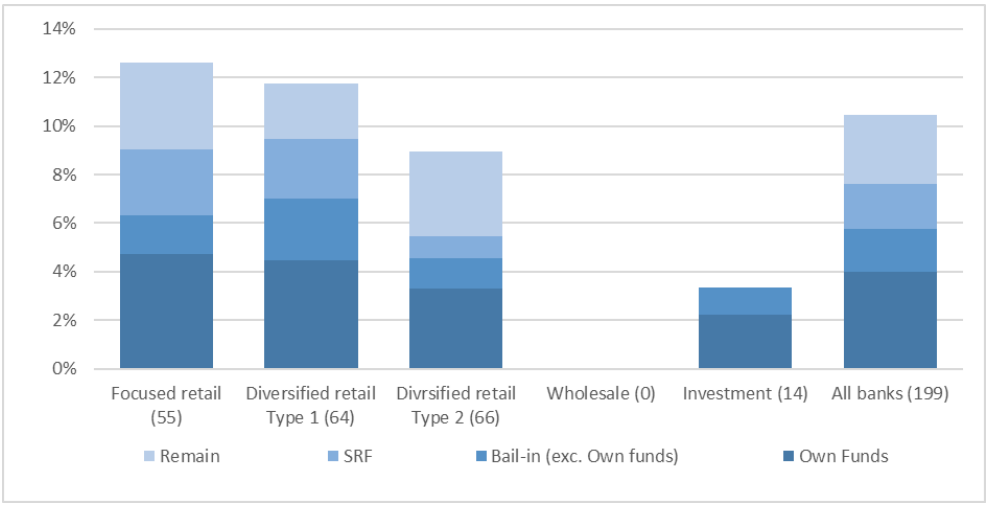
The **sixth and seventh indicators** are the **size and distribution of peak losses of Aided banks and** are estimates of the losses and the share of the losses that the Single Resolution Fund might have covered, in the event that the resolution mechanism would already have been fully implemented during the sample period. The estimates for cumulative losses, as well as the distribution across resolution tools, are based on the methodology of De Groen & Gros (2015).

The Focussed retail banks that received capital support during the past crises reported the highest cumulative peak losses as a share of total liabilities (See Figure 8.11). The losses are, however, only significantly higher than the Investment and Wholesale banks, amongst which there are no banks that receive capital support. Due to the limited bail-in contribution, a large share of the losses might have been covered through the Single Resolution Fund and an additional bail-in of other creditors. In turn, the investment bank losses would all have been absorbed through bail-in.

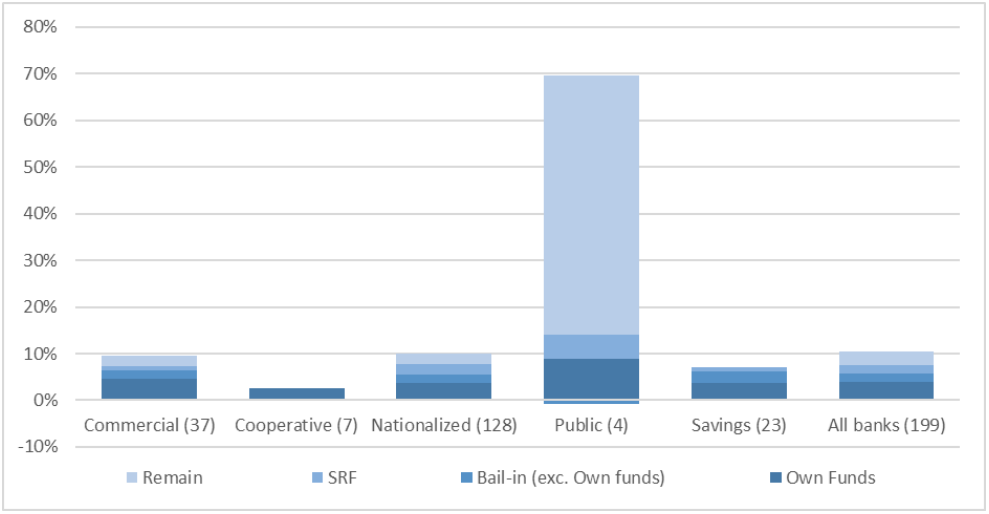
Public banks recorded the highest losses amongst the ownership structures, whilst the other types of banks recorded substantially lower losses. In the case of public banks, most losses are covered with additional bail-in of other creditors. For the other four types, the share of losses that might have been covered through the resolution fund are not significantly different.

Figure 8.11 Distribution of peak losses of Aided banks (share of total liabilities, included own funds)

a) Business models



b) Ownership structures



Notes: The figure above shows the distribution amongst creditors of cumulative peak losses of Euro-area banks that received capital support between 2007 and 2017, would require a minimum bail-in of 8% and maximum SRF of 5% of total liabilities (incl. own funds), as foreseen under the new resolution mechanism, and recapitalisation up to 8% of risk-weighted would already have been applied during the sample-period. The ownership structures in this figure are based on the structure before the intervention. The numbers between the brackets express the number of observations.

Source: De Groen and Gros (2015)

A new loss-absorption requirement asked banks to ensure the proper functioning of the bail-in mechanism. The main indicator to ensure that banks have sufficient bail-inable debt is the **Minimum Requirement for Own Funds and Eligible Liabilities (MREL)**[27]. It is a requirement introduced by the Bank Recovery and Resolution Directive (BRRD), the objective of which is to increase the presence of instruments with a high loss absorbing capacity in bank liabilities. The increase of the loss absorbing capacity should allow failing banks to be liquidated without jeopardising financial stability and without the need to use public funds. Unlike the TLAC indicator, defined by the Financial Stability Board (FSB), which pursues the same purposes as the MREL but will be applied from 1 January 2019 only to global systemically important banks (G-SIB), the MREL is applied to all banks of the European Union.[28]

Using this method, we assume that the MREL is computed based on the TLAC standard applied to the entire banking sector in Europe. The computation uses the formula max (18% RWA, 6.75% LRE) as a percentage of total liability and own funds.

The results are reported for the first component (18% RWA) and for the second component (6.75% LRE) and for the max between the two. All results are reported unweighted. This method compares the calculations of the MREL requirements using the RWA, the LRE and the max of the two (See Appendix VIII for more details).

Table 8.5 shows that Focussed retail and Investment banks have the highest maximum requirements, followed by the Diversified retail (type 2) banks. In contrast, Diversified retail (type 1) and Wholesale banks have the lowest requirements. Conversely, using the RWA formula, the highest requirements are shown by retail-oriented banks, whilst banks with more market-oriented business models show the lowest RWA requirement. In turn, LRE, mean and median requirements converge to values slightly lower than 6.75% for all business models. Thus, the LRE-based requirements do not backstop those based on RWA, since the latter are much higher.

As regards to ownership structures, average requirements based on RWA are particularly low for public banks, lower than the LRE ratio. The LRE-based requirements correct slightly for this low average level, pushing it from 6.64% to 8.63% in the combined maximum requirements. As well, mean requirements for nationalised, commercial and cooperative banks noticeably increase between their RWA estimate and the combined RWA and LRE maximum requirements.

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[27] MREL is measured using the methodology proposed by Ayadi et al. (2016) "Total Assets" versus" Risk Weighted Assets": does it matter for MREL requirements?"

[28] The description of the methodological approach is reported in Appendix ?.

Table 8.5 MREL estimations (averages, share of total liabilities plus own funds)

a) Business models

Business Models	18% RWAs	6.75% LRE	Max (18% RWA, 6.75% LRE)
Focussed retail	9.71%	6.74%	10.72%
Diversified retail (type 1)	9.10%	6.74%	10.06%
Diversified retail (type 2)	9.90%	6.73%	10.68%
Wholesale	7.17%	6.73%	9.46%
Investment	8.03%	6.70%	11.01%
All models	**9.23%**	**6.74%**	**10.38%**

b) Ownership structures

Ownership	18% RWAs	6.75% LRE	Max (18% RWA, 6.75% LRE)
Commercial	9.56%	6.72%	11.47%
Cooperative	9.59%	6.75%	10.33%
Nationalised	7.90%	6.72%	9.44%
Public	6.64%	6.74%	8.63%
Savings	8.40%	6.75%	9.62%
All	**9.23%**	**6.74%**	**10.40%**

In line with the European Banking Authority (EBA) and the Financial Stability Board (FSB), we distinguish between global systematically important banks (G-SIBs), other systematically important banks or domestic systematically important banks (D-SIBs) and finally, the other non-systematically important banks (No-SIB).

Looking at D-SIBs, the RWA-based requirements are very low for Wholesale and Investments banks, but the LRE-based requirements correct slightly for this low RWA average level, pushing the combined average ratio to 7.82% and 6.86% for D-SIBs respectively. With regard to the G-SIBs, the RWA based requirement is, on average, below the LRE requirement for Investment, Wholesale banks and Focussed retail banks. Moreover, referring to No-SIBs, retail-oriented banks show the highest average RWA requirements. However, when we observe the combined average ratio, Investment banks show the highest level of requirement.

Considering the ownership structure, cooperative and commercial banks show the highest average combined ratio, both for No-SIBs. Amongst D-SIBs, nationalised banks reveal the highest average combined ratio, followed by commercial and cooperative banks.

The LRE-based requirements act as an effective floor or backstop, raising the average value from RWA-based requirements. On average, No-SIBs are those banks that show the highest loss-absorption requirement based on the TLAC requirements. In practice, however, the resolution authorities can set the MREL requirements for these non-systemically important banks at 0%, which brings the loss absorption requirement below those of G-SIBs and D-SIBs, as one would expect.

Table 8.6 MREL estimations for G-SIB, D-SIB, No-SIB, unweighted

a) Business models

Business Models	G-SIBs			D-SIBs			No-SIBs		
	18% RWAs	**6.75% LRE**	**Max (18% RWA, 6.75% LRE)**	**18% RWAs**	**6.75% LRE**	**Max (18% RWA, 6.75% LRE)**	**18% RWAs**	**6.75% LRE**	**Max (18% RWA, 6.75% LRE)**
Focussed retail	5.72%	6.74%	6.74%	10.06%	6.69%	10.76%	9.71%	6.74%	10.72%
Diversified retail (type 1)	7.71%	6.68%	8.00%	8.50%	6.71%	9.17%	9.13%	6.74%	10.09%
Diversified retail (type 2)	7.43%	6.66%	7.85%	8.04%	6.71%	9.02%	10.18%	6.74%	10.94%
Wholesale	6.20%	6.75%	6.75%	5.62%	6.69%	7.82%	7.22%	6.73%	9.51%
Investment	4.82%	6.71%	6.83%	3.48%	6.74%	6.87%	8.57%	6.70%	11.58%
All models	6.11%	6.69%	7.34%	8.01%	6.71%	9.14%	9.30%	6.74%	10.47%

b) Ownership structures

Ownership	**G-SIBs**			**D-SIBs**			**No-SIBs**		
	18% RWAs	**6.75% LRE**	**Max (18% RWA, 6.75% LRE)**	**18% RWAs**	**6.75% LRE**	**Max (18% RWA, 6.75% LRE)**	**18% RWAs**	**6.75% LRE**	**Max (18% RWA, 6.75% LRE)**
Commercial	6.19%	6.69%	7.42%	8.28%	6.70%	9.39%	9.74%	6.72%	11.72%
Cooperative	5.56%	6.69%	6.79%	7.91%	6.71%	8.91%	9.62%	6.75%	10.35%
Nationalised	-	-	-	9.41%	6.71%	10.08%	6.86%	6.73%	9.00%
Public	-	-	-	4.91%	6.74%	7.85%	6.88%	6.74%	8.74%
Savings	-	-	-	7.88%	6.72%	8.66%	8.42%	6.75%	9.65%

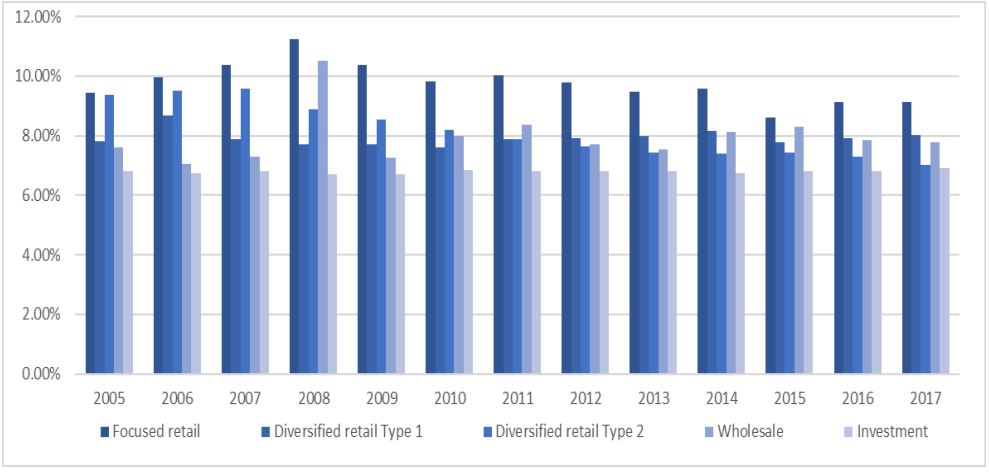
All	6.11%	6.69 %	7.34%	8.01%	6.71%	9.14%	9.30%	6.74%	10.47 %

Figure 8.12 shows the evolution of MREL during the period under investigation[29] and, in this case, the formula adopted to measure MREL is that described in the Appendix, emphasising that Focussed retail banks are those banks with the highest MREL requirement during the whole period, whilst Investment banks show the lowest. This is not surprising, as they also have higher average risk-weights. However, during the financial crises, the MREL of banks that adopt different business models has decreased indistinctly. It is only after the financial crisis that the indicator starts to rise.

Considering ownership structures, savings banks have the highest MREL. However, the gap between these banks and the others drops during the financial crisis. In fact, while the other ownership structures have shown a stable indicator during the whole period, savings banks have converged to the other ownership structures. The average MREL requirement decreased from 9.06% to 7.87% over the sample period.

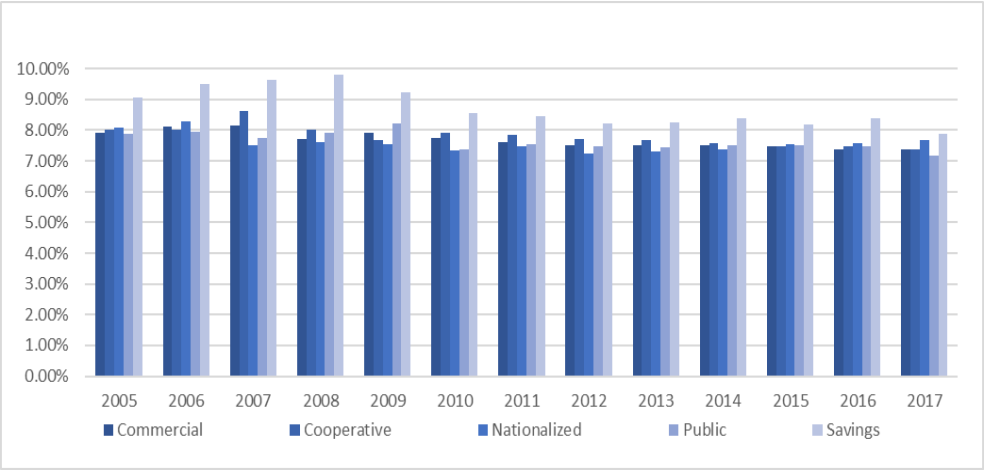
Figure 8.12 Evolution of MREL indicator

a) Business model



b) Ownership structure

[29] We know that the MREL was introduced in 2016, but in this section, we observe the amount of the capital requirement on own funds for the whole period investigated, in order to observe the evolution of this indicator.



Notes: The figure above shows the evolution of the MREL indicator both with regards to the different bank business models and the ownership structure.

Source: Authors' elaborations

To conclude, this section assessed the response of banks to prudential requirements across the different business models and ownership structures. In the aftermath of the financial and economic crises, the legislative and supervisory framework has been renewed. In short, the capital requirements have been strengthened and complemented with a non-binding leverage requirement and liquidity requirements, as well as the introduction of a recovery and resolution framework to deal with banks that have problems meeting the capital requirements.

Some of the indicators are distinct, while others fail to distinguish between business models and ownership structures. This is the case for the binding regulatory capital ratio (Tier-1), with which most banks keep a similar margin. These results provide some justification for imposing stricter regulatory requirements on both Wholesale and Investment banks, for which the regulatory risk measure does not seem to capture the underlying risks. Thus, more research and monitoring is required to continue estimating effective ratios.

The liquidity ratios are still under construction. The existing public reporting falls largely short on information about maturity of both assets and liabilities, to enable exact estimates to be made for the liquidity ratios. The rough estimates for this Monitor showed that the median values have increased in the most recent years and are, in 2014, all above the future 100% requirement.

Lastly, based on a preliminary assessment of the bail-ins and losses, the capital legislation and resolution framework might, to some extent, work against one another. Hence, the most risk-prone banks should have a

higher average risk-weight and thus capital requirement, whilst banks with the highest risk-weights have the lowest minimum bail-in contribution. More research is required to assess how the resolution mechanism works out in practice.

9. CONCLUSIONS

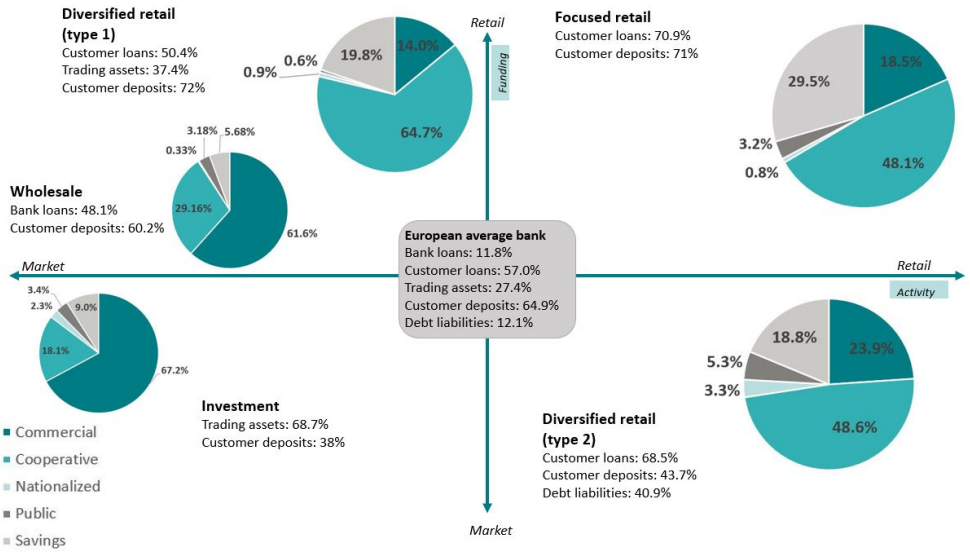
The Bank Business Model (BBM) Monitor of the European banking sector, using data from 2005 to 2017, assesses the banking sector structure in light of the changing economic, legislative and supervisory environment. It also attempts to gain better insights into the impact of different types of corporate structures. In particular, it analyses the interaction between business models and ownership structures as well as the internationalisation, migration, financial performance, contribution to the real economy, risk, and response to banking regulation and supervision through five broad clusters and five ownership structures.

With the objective of covering the entire European banking sector, the BBM Monitor includes 3,287 banking groups and subsidiaries of non-European banks that account for more than 95% of EEA and Swiss banking assets, and uses a unique definition and clustering model involving SAS programming.

For the analysis, 25,402 bank-year observations were clustered into five broad categories: Focussed retail, Diversified retail (type 1), Diversified retail (type 2), Wholesale and Investment banks.

The results of the business model identification are summarised in Figure 9.1 with the key findings per bank business model in Table 9.1.

Figure 9.1 Business models and ownership structures in European banking



Note: The shares of banks across ownership structures are based on the share of bank-year observations.

Source: Authors

Focussed retail banks have an ownership structure that is slightly skewed towards stakeholder value banks. In fact, about 64% of Focussed retail banks are cooperative and 20% savings banks. Most institutions provide traditional services, such as customer loans funded by customer deposits. This is also reflected in the income, which consists mostly of net interest income and commission and fees, whilst trading income and other income are only minor components. The share of the banks that were identified as Focussed retail remained fairly similar during the period investigated.

Focussed retail banks have performed quite well, compared to their peers between 2005 and 2017. Looking at the whole period, Focussed retail banks show the median highest return on assets. With the exception of the economic crisis of 2011 and 2012, in which they show negative profitability, they reported amongst the highest return on assets. Albeit, in terms of return on equity, Focussed retail banks show the second highest RoE, second only to Investment banks. Focussed retail banks also reported the second most operational efficiency in terms of cost-to-income ratio, second only to Diversified retail (type 2) banks . Interestingly, Focussed retail banks suffered significantly lower loan losses than the diversified retail banks and reported the most stable loan growth, confirming their undeniable role in the real economy, however Focussed retail banks show a moderate non-performing loans ratio. Focussed retail banks are least leveraged and amongst the business models that are most distant from

default, i.e. high Z-score, and they seem more resilient to extreme stress conditions, compared to other business models; this is confirmed by the low level of SRISK. Conversely, the regulatory (i.e. Tier 1) and market risk measures suggest that Focussed retail banks are significantly at greater risk than most of the other business models. The CDS-spreads on subordinated debt of Focussed retail banks are substantially higher and the risk-weights are the highest of the entire sample. This leads to the view that market perception is more aligned to the regulatory viewpoint.

Diversified retail (type 1) banks are modest in size. The ownership structure is slightly skewed towards stakeholder value banks, with the exception of public banks. In particular, Diversified retail banks (type 1) combine lending to customers with a moderate percentage of trading activities (i.e. 37% on average), primarily using customer deposits.

This seems to be the closest model to the focussed retail model, with the highest level of interchange between all models. More precisely, many Wholesale, Investment and Diversified retail (type 2) banks shifted to Diversified retail (type 1), but only a few banks made the reverse shift. Most of the banks that received state aid have, for example, reoriented towards Diversified retail (type 1) which was, in many cases, supported by conditions for obtaining capital support.

The other activities are barely reflected in the income, with the largest share of income being obtained from net interest. The commission and fees income is in line with those for Focussed retail banks and trading income is only slightly higher than for Focussed retail banks. Moreover, the trading income of retail-oriented banks is more stable than for Investment banks, which have the most trading activities. The contribution of the Diversified retail (type 1) banks to system risk seems moderate, based on various reporting and market risk indicators. Although the banks have the largest median distance to default (Z-score), the CDS spreads are similar to the other retail-oriented business models, but above the Wholesale and Investment banks. In turn, the diversified retail banks score relatively high on regulatory risk indicators, compared to the other retail models, i.e. relatively lower average risk-weights and higher regulatory Tier-1 ratios as well as the highest MREL indicator.

The returns of Diversified retail (type 1) banks deteriorated during the financial and economic crises. The returns on assets and equity have been amongst the highest pre-crisis, but marginalised during the financial crisis and turned negative during 2009 and 2012. The Diversified retail (type 1) banks suffered higher loan losses and non-performing loans than Focussed retail banks. The banks, nevertheless, reported the highest customer loan growth during the pre-crises period and positive growth throughout, except for 2009.

Diversified retail (type 2) banks are relatively large in size as compared to the other retail-oriented banks. These banks include nationalised, cooperative and public banks. It has, nevertheless, the highest share of listed banks, which might be explained by the average size of the banks. Although Diversified retail (type 2) is the smallest amongst the retail-oriented models based on number of banks, these banks possess the highest assets. The activities of the second type of diversified retail banks consist primarily of lending to customers using mainly debt liabilities and customer deposits. Diversified retail (type 2) banks are relatively risk-prone, based on various reporting indicators. The banks have the lowest median distance to default amongst retail-oriented banks. In turn, the Diversified retail (type 2) banks gradually scored higher on the regulatory risk indicators than the Diversified (type 1) business model, i.e. banks that adopt this business model show a level of risk-weighted assets in the middle, between Focussed retail and Diversified retail (type 1), whilst the Tier-1 ratio is comparable to Focussed retail banks. Also, Diversified retail (type 2) banks, together with Focussed retail banks, show the highest MREL/TLAC.

Diversified retail (type 2) bank returns have been the most stable. It has been the only model where the returns on assets and equity have not turned negative in any single year, despite the high provisions of customer loans, with moderate non-performing loans, closer to Investment and Wholesale banks than to other retail-oriented banks. Moreover, in the post-crises period, this business model shows higher return on assets than the other retail-oriented business models. The returns were not funnelled through to the real economy in the form of higher customer loans but, instead, to improve the capital position. The banks posted slightly positive customer loan growth during the financial crisis which returns to growth in the post-crisis period.

Wholesale banks are amongst the smallest group. These banks primarily engage in interbank lending and borrowing and are primarily categorised as shareholder value banks. This model has the highest percentage of shareholder-value banks (71%). However, these also include the central institutions of cooperative and savings banks that provide liquidity and other services to local banks as well as public banks. Hence, the Wholesale banks include the lowest share of savings and nationalised banks. Moreover, the model contains the least listed and the largest shares of block-ownership. The bank-to-bank intermediation model depends mostly on net interest income, as well as commission and fees income. Wholesale banks are traditionally characterised by low loan losses. Despite the extraordinary losses during the financial crisis, Wholesale banks still had both the lowest loan loss provisions and the lowest non-performing

loans – in line with Focussed retail banks. In addition, Wholesale banks show the highest operational efficiency.

Wholesale bank returns have been reasonably stable, except during the financial crisis. The gap between the return on equity was smaller than the gap between the return on assets in the early years due to a higher leverage. Unlike Investment banks, the capital improvement of Wholesale banks was not accompanied by consecutive years of decline in loans. In fact, the growth of customer loans for Wholesale banks only shows negative in 2012; during the other years, although growth is modest, it is positive.

Table 9.1 Results across business models, 2005-17

	Ownership	Migration	Financial performance & operational efficiency	Contribution to the real economy	Risk	Response to regulation and resolution
Model 1 - Focussed retail (9,736 obs.)	Skewed towards stakeholder value types (e.g. cooperative, savings banks)	Most stable business model (90%); migration	Relative high returns, except for econ. crisis and high operational efficiency	High stable customer loan growth	The second highest distance to default; lowest loan loss provisions amongst retail banks, but the highest NPL ratio; highest CDS spread of subordinated bonds. The median of SRISK is negative.	The highest risk weights; moderate Tier-1 cap. and high tangible equity; low bail-in contribution. The second highest MREL amongst BM.
Model 2 – Diversified retail (Type 1) (8,752 obs.)	Skewed towards stakeholder value banks (i.e. small cooperatives, savings and	Highly stable business model (87%); largest migration to Focussed retail and main	Returns as well as operational efficiency deteriorated during the fin. and econ crises	High customer loan growth (but lower than Focussed retail during and after the crises)	The highest distance to default; moderate loan loss provisions but high level of NPL ratio;	Amongst highest risk weights; the highest Tier-1 cap. Amongst retail-oriented banks; and

	public)	receiver from other models			the highest stock returns volatility. The median of SRisk is negative but close to zero.	moderate tan. eq.; moderate bail-in contribution and the highest MREL.
Model 3 – Diversified retail (Type 2) (3,424 obs.)	Cooperative and savings banks	Highly stable business model (77%); migration to other retail oriented models	Returns most stable and only model not posting a loss in a single year	Low customer loan growth during fin. crisis and negative during/after econ. crisis	Low distance to default; the lowest loan loss provisions and moderate NPL ratio. It is the only BM that shows a positive median of SRisk.	High risk weights; the lowest Tier-1 cap. and low tan. eq.; low bail-in contr.; least liquid. Moderate level of MREL.
Model 4 – Wholesale (2,110 obs.)	Predominantly commercial banks, but largest share of public banks amongst all BMs, which have the largest share of the assets	Highly stable business model (80%); migration to Diversified retail (type 1) and exchange with investment	Returns stable, although the reduction during fin. crisis, and the worse cost-efficiency	Relatively high customer loan growth during crises but with some years with negative sign	Low distance to default; lowest loan loss provisions and low NPL ratio; the lowest CDS spread of subordinated bonds. The median of SRISK is	Low risk weights; sharply increasing Tier- 1 cap. and tan. eq.; high bail-in contribution. Moderate MREL.

					negative but close to zero.	
Model 5 – Investment (1,370 obs.)	Predominantly commercial banks, but substantial share of cooperative banks	Stable business models (80%); migration to Diversified retail (type 1) and exchange with wholesale	Returns rather stable, except for fin. crisis, and low cost efficiency	The loan growth deteriorated relatively more during the fin. and econ. crises	The lowest distance to default; moderate loan loss provisions and low NPL ratio. The median of SRisk is the lowest.	The lowest risk weights; high Tier-1 cap. and the lowest tan. eq.; the highest bail-in contribution. Lowest MREL.

Source: Authors

Amongst the five models, the banks identified as i**nvestment-oriented** are relatively small in number, but the largest in size. Investment banks primarily engage in trading activities, whilst relying on debt securities and derivatives for funding. Investment banks, with Wholesale banks, include the largest share of profit-maximising banks in terms of assets, i.e. the highest share of shareholder value banks. Yet, it is together with Wholesale banks the only model that relies on net interest income for less than half of its income. Commissions and fees form the largest share of the remaining income. Investment banks also have the highest level of trading income amongst business models.

Like Wholesale banks, Investment banks primarily suffered during the financial crisis. The return on assets was below that of the retail-oriented models. During the financial and economic crises, the banks suffered from high risk-costs that put pressure on returns. The operational efficiency has been similar to that of Wholesale banks and they show the highest level of cost-to-income ratio, i.e. the cost efficiency is lower than retail-oriented banks. The deleveraging that was used by Investment banks to improve their capital position and address their less stable funding was funnelled through to the real economy in the form of lower customer loans. In fact, from the beginning of the financial crisis (2009), on average, the growth of customer loans shows a negative indicator. Despite deleveraging, the leverage of Investment banks is still relatively high, which is likely to reflect in a higher bail-in contribution under the new resolution regime. Moreover, Investment banks show the lowest risk-weighted assets and a high Tier-1 ratio (second only to Wholesale banks). Looking at the distribution across quartiles, Investment banks usually appear most in both the top and bottom quartiles of the performance measures, whilst more retail-oriented banks usually are distributed in the second and third quartiles. This suggest that the performance of investment banks is more volatile.

Turning to the results across ownership structures, c**ommercial banks** account for more than half of all the banking assets, whilst only representing about 25% of the number of institutions. Commercial banks conduct relatively more lending and trading activities. This is also reflected in their income structure, which consists substantially of net interests and commission and fees income. The profits of commercial banks deteriorated after the onset of the crisis. Nevertheless, the banks were, on average, able to report relatively stable and high returns and in the final years, after the economic turmoil, commercial banks have returned to produce some of the highest profits.

Commercial banks suffered moderate loan losses, but have the lowest non-performing loans and reported stable loan growth. Commercial banks

had, especially during the first years of the sample period (i.e. from 2005 to 2008), relatively low capital ratios and high SRISK. Over time, these low capital ratios have substantially increased, similar to what happened for the other ownership structures. The MREL/TLAC indicator is moderate over time. In turn, the regulatory and market risk measures suggest that commercial banks are moderate, looking at both the CDS spreads and the risk-weights.

The c**ooperative banks** account for about 50% of the observations, but only 17% of assets. The activities of cooperative banks are, on average, retail-oriented. Hence, the operational income consists primarily of net interest revenues. Cooperative banks reported stable returns, which were amongst the highest in terms of return on assets and rather moderate in terms of return on equity, due to a lower leverage.

Cooperative banks suffered moderate loan losses and non-performing loans, and reported stable loan growth. Cooperative banks were relatively moderately leveraged which, combined with low volatility in earnings, reflected in being a considerable distance to default. In turn, the regulatory and market risk measures suggest that cooperative banks are at more risk than commercial banks, looking at their higher CDS spreads, the risk-weights and total SRISK compared to commercial banks.

The n**ationalised banks** are the smallest group of banks representing about 1% of total observations, but with moderate average size (10% of total assets). These banks, on average, depend most on market activities, with relatively high trading assets and debt liabilities. Despite the trading assets, the income of nationalised banks consists, for the largest part, of net interest. Nationalised banks reported the worst performance during both the financial and economic crisis, with losses between 2008 and 2013. These were partially due to trading losses at the height of both crises, as well as loan losses during both crises (especially the economic crisis). They show the highest level of NPL during the period observed. The negative returns were funnelled through in the form of a decline in customer loans between 2011 and 2016. The volatility and bad performance of the banks was also reflected in being the shortest distance to default amongst bank ownership structures. The poor performance, based on the reporting measures, was mimicked by market risk measures. Hence, the CDS-spreads and share volatility was significantly higher than any of the other ownership structures. In turn, the regulatory measures were slightly worse than for the other ownership structures, looking at Tier-1 capital ratios and leverage ratio. In terms of SRISK, nationalised banks show the most negative total systemic risk.

The **public banks** form only a small part of the sample both in terms of number and in terms of total assets. Public banks are mainly involved in

retail activities. Public banks primarily depend on net interest income. The operational efficiency of public banks, measured through cost-to-income ratio, is higher than all the other structures.

Public banks suffered both the least loan losses and low NPL and reported the highest loan growth, particularly at the height of both the financial and economic crises. The larger capital levels also led to the relative furthest distance to default based on the reporting measure, i.e. a moderate Z-score. This was supported by the regulatory and market risk measures, because the CDS spreads and average risk-weights were the lowest amongst the ownership structures. Hence, this also means that public banks are likely to need to contribute the most in case of resolution, before resolution funds can be tapped.

The **savings banks** are responsible for only 12% of the assets in the sample, but about a fifth of the institutions (22%). The activities of these predominantly domestically active banks are skewed towards retail. This is also reflected in the income structure, which consists primarily of interest revenues. The returns of the savings banks have been continuously lower than the other ownership structures, with the exception of nationalised banks – despite slightly lower loan loss provisions than those of cooperative and public banks.

The lower returns and higher loan losses and non-performing loans of savings banks during the crises were reflected in the relatively low loan growth figures. Despite all this, these banks show the longest distance to default, as well as moderate regulatory capital and market volatility.

The findings provide new evidence about the role of different business models and ownership structures in European banking, in terms of financial performance, operational efficiency, contribution to the real economy, contribution to systemic risk and impact on financial (in)stability. It is clear that shareholder value banks, which are more of an investment and wholesale nature, are more oriented towards financial performance, whilst tending to accelerate the accumulation of risk at a system level and being less resilient to extreme stress conditions. In turn, retail-oriented banks, which are more stakeholder-oriented institutions, are more inclined to contribute to the real economy, whilst maintaining equivalent levels of financial performance, contributing less to the accumulation of risk at a system level and being more resilient to extreme stress conditions.

APPENDIX I.
LIST OF VARIABLES

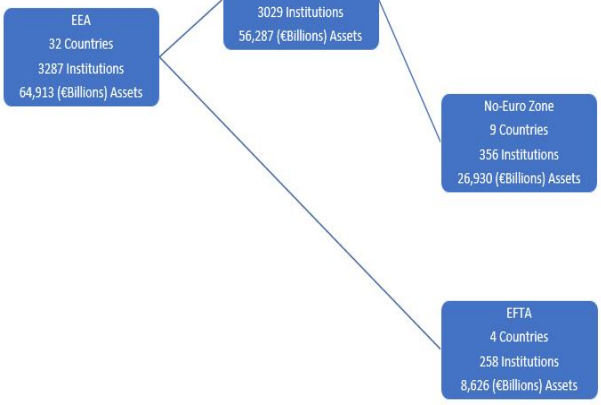
No.	Variable	Coverage	No.	Variable	Coverage
1	Country (headquarter location)	100%	26	Income (interest - net)	99%
2	Reporting currency	100%	27	Income (commissions - net)	99%
3	Ownership (SHV/STV)	100%	28	Income (trading - net)	97%
4	Ownership (cooperative, savings, etc.)	100%	29	Income (other)	97%
5	Listed (YES/NO)	100%	30	Expenses (operating - total)	99%
6	Internationalisation (total – no. of countries)	98%	31	Expenses (operating - personal)	98%
7	Internationalisation (subsidiaries – no. of countries)	98%	32	Expenses (operating – risk costs)	98%
8	Internationalisation (branches – no. of countries)	98%	33	Expenses (operating – loan loss provisions)	97%
9	Assets (total)	100%	34	Profit (before tax)	99%
10	Assets (% of GDP)	100%	35	Income tax	99%
11	Cash (and balances with central banks)	99%	36	Profit (after tax)	99%
12	Loans to banks (total)	99%	37	Risk-weighted assets (total)	86%
13	Loans to customers (gross)	85%	38	Capital (regulatory capital)	87%
14	Loans to customers (net)	100%	39	Capital (Tier I - total)	82%
15	Intangible assets	99%	40	Capital (core Tier I - total)	21%
16	Liabilities (total)	100%	41	Applicable Basel Standards (I/II)	92%
17	Deposits (banks)	99%	42	Basel approach (SA/IRB)	73%
18	Deposits (central banks)	17%	43	State aid (Received - YES/NO)	87%
19	Deposits (customers)	100%	44	CDS spread (senior, average, local currency)	3%
20	Repurchase agreements (liabilities)	5%	45	CDS spread (senior, volatility, local currency)	3%
21	Derivatives (total - fair value - negative)	95%	46	CDS spread (senior, average, USD)	3%
22	Capital (equity - total)	100%	47	CDS spread (senior, volatility, USD)	3%
23	Capital (tangible common equity)	99%	48	CDS spread (subordinated, average, local currency)	3%
24	Capital (common equity)	99%	49	CDS spread (subordinated, volatility, local currency)	3%
25	Income (total)	99%	50	CDS spread (subordinated, average, USD)	3%

No.	Variable	Coverage	No.	Variable	Coverage
51	CDS spread (subordinated, volatility,	3%	58	Supervisor (Single Supervisory	100%

	USD)			Mechanism - YES/NO)	
52	Share price (year-end)	11%	59	Supervisor (Financial Stability Board - YES/NO)	100%
53	Share price (average)	11%	60	Cumulative peak losses aided banks (% of total liabilities)	5%
54	Share price (volatility)	11%	61	MREL	100%
55	Share price (observations)	12%	62	Non-performing loans (% of customer gross loans)	82%
56	Share price (volume)	10%	62	SRISK	100%
57	Supervisor (European Banking Authority - YES/NO)	100%			

APPENDIX II. DISTRIBUTION OF BANKS ACROSS COUNTRIES

Distribution of banks across countries



Country	Institutions	Assets
AT	247	703,536
BE	22	814,012
CY	14	410,646
DE	1573	7,070,816
EE	6	3,255
ES	99	4,712,030
FI	24	801,328
FR	75	7,715,193
GR	19	319,373
IE	14	398,554
IT	440	3,312,274
LT	5	6,836
LU	36	268,607
LV	14	14,274
MT	10	22,112
NL	33	2,417,291
PT	26	333,718
SI	11	24,295
SK	5	8,518

Country	Institutions	Assets
BG	9	23,034
CZ	8	495,607
DK	76	6,382,590
GB	164	9,559,244
HR	14	44,982
HU	9	20,176
PL	13	535,700
RO	7	106,760
SE	56	9,762,415

Country	Institutions	Assets
CH	143	3,216,984
LI	7	61,265
IS	6	3,566
NO	102	5,344,487

Note: The figure above shows the distribution of banks across the EEA countries and the aggregates for the different sub-agglomerations within the EEA. Total assets data used is for 2017 or the latest available year.
Source: Authors

APPENDIX III. DEFINITION OF BANK BUSINESS MODELS AND DISTRIBUTION ACROSS YEARS AND COUNTRIES

The business models' definition used in this Monitor distinguishes primarily between the key banking activities (i.e. retail versus market or mixed) and the funding strategies (i.e. retail versus market or mixed) (in Ayadi, 2019) [30]. Allowance is made for financial and risk exposures. To account for these factors collectively, without over-representing any particular factor, five instruments, which constitute the defining activity/funding features of a business model in banks from an asset and liability stand point, were used to form the clusters.[31] These were:

1. *Loans to banks (as % of assets).* This indicator measures the scale of wholesale and interbank activities, which proxy for exposures to risks arising from interconnectedness in the banking sector.
2. *Customer loans (as % of assets).* This indicator identifies the share of customer loans to non-bank customers, indicating a reliance on more traditional banking activities.
3. *Trading assets (as % of assets).* These are defined as non-cash assets other than loans; a greater value would indicate the prevalence of investment activities that are prone to market and liquidity risks.
4. *Debt liabilities (as % of assets).* These are defined as non-equity liabilities other than deposits and derivatives. Although bank liabilities are comprised of short-term interbank debt, the broader debt liabilities indicator provides a general insight into the bank's exposure to market funding.

[30] This methodology builds on previous editions of the Bank Business Model Monitor (Ayadi et al, 2011; Ayadi et al, 2012; Ayadi & De Groen, 2014; Ayadi et al, 2016; and, Ayadi et al, 2017).

[31] Alternative instrument combinations were also considered. In many cases, using a different set of instruments led to an unrealistically large number of clusters, with many comprising a single bank/year. Removing any one of the five indicators from the clustering exercise also led to indistinct clustering. In turn, using a larger set of instruments did not change the results substantially, as long as the defined indicators were included.

5. *Derivative exposures (as % of assets).*[32] This measure aggregates the carrying value of all negative derivative exposures of a bank, which are often identified as one of the key (and most risk prone) financial exposures of banks with heavy investment and trading activities.

[32] Total derivative exposures are defined as the summation of positive and negative fair values of all derivative transactions, including interest, currency, equity, OTC, hedge and trading derivatives.

Evolution of sizes across Business models

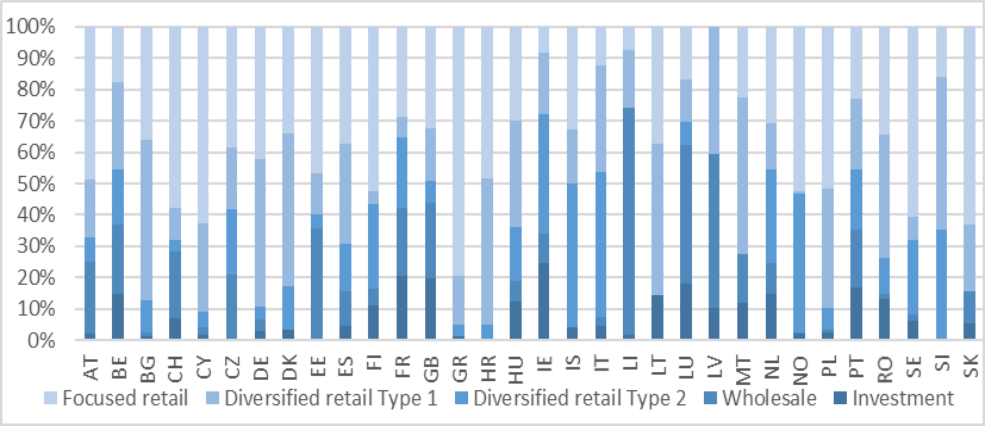
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
							Total assets (€ billion)						
Focussed retail	747	1,184	1,442	2,168	2,152	3,249	3,827	3,839	4,284	3,923	5,572	4,750	7,467
Diversified retail (type 1)	1,360	2,394	5,049	4,401	8,219	8,847	8,859	9,498	8,733	10,614	13,432	8,797	11,576
Diversified retail (type 2)	10,087	12,020	13,237	13,248	14,999	17,285	15,997	14,397	15,489	13,366	12,115	15,103	30,727
Wholesale	1,344	991	996	247	411	611	630	688	770	628	694	687	1,477
Investment	10,140	10,724	12,009	15,257	8,840	12,202	14,694	14,884	10,949	14,115	10,451	11,006	9,319
All banks	23,679	27,313	32,733	35,321	34,621	42,195	44,007	43,307	40,226	42,647	42,265	40,343	60,567
							Number of institutions						
Focussed retail	72	94	127	143	135	1,082	1,221	1,195	1,255	1,226	1,188	895	1,103
Diversified retail (type 1)	32	36	34	41	56	1,065	1,002	1,104	1,110	1,182	1,102	1,013	975
Diversified retail (type 2)	97	108	129	116	119	435	427	390	358	305	351	448	151
Wholesale	12	14	18	17	14	284	291	266	277	250	221	159	287
Investment	19	19	25	23	19	156	154	192	179	179	169	137	99
All banks	**232**	**271**	**333**	**340**	**343**	**3,022**	**3,095**	**3,147**	**3,179**	**3,142**	**3,031**	**2,652**	**2,615**
							Median total assets (€ billion)						
Focussed retail	6.4	7.9	7.7	9.3	9.4	0.5	0.5	0.6	0.6	0.6	0.6	0.8	1.3
Diversified retail (type 1)	6.9	8.1	7.5	9.3	8.9	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.9
Diversified retail (type 2)	21.5	24.7	21.3	18.9	24.9	1.0	0.9	0.9	1.1	1.4	1.1	1.5	1.5
Wholesale	7.5	9.2	8.3	7.6	9.7	0.2	0.3	0.4	0.3	0.3	0.4	0.6	0.4
Investment	175.3	285.2	88.6	111.9	95.6	1.7	1.2	1.0	1.1	1.2	1.1	1.2	2.1
All banks	10.3	11.5	10.7	10.9	11.9	0.5	0.5	0.6	0.6	0.	0.7	0.8	1.1

Evolution of sizes across Ownership structures

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
						Sum of total assets (€ billion)							
Commercial	14,299	16,440	18,920	20,826	19,524	23,722	24,957	24,658	22,976	25,127	25,257	23,559	34.374
Cooperative	3,435	4,082	4,766	4,983	5,943	7,058	7,590	7,735	7,500	7,839	7,808	7,866	8,070
Nationalised	2,959	3,380	5,004	5,151	4,757	5,095	4,983	4,346	3,464	3,685	3,242	2,927	2,607
Public	387	427	534	611	648	1,312	1,420	1,560	1,501	1,587	1,676	1,716	2,718
Savings	2,599	2,985	3,510	3,749	3,749	5,008	5,057	5,008	4,786	4,409	4,282	4,275	12,798
All banks	23,679	27,313	32,733	35,321	34,621	42,195	44,007	43,307	40,226	42,647	42,265	40,343	60,567
						Number of institutions							
Commercial	114	129	157	160	161	676	708	730	738	720	698	634	623
Cooperative	27	39	47	47	47	1,588	1,625	1,653	1,682	1,673	1,608	1,316	1,305
Nationalised	18	20	20	21	22	29	28	27	26	28	26	26	26
Public	13	16	23	25	25	67	69	73	72	73	72	71	68
Savings	60	67	86	87	88	662	665	664	661	648	627	605	593
All banks	**232**	**271**	**333**	**340**	**343**	**3022**	**3095**	**3147**	**3179**	**3142**	**3031**	**2652**	**2615**
						Median total assets (€ billion)							
Commercial	6.2	7.5	7.4	8.1	8.6	1.3	1.0	1.1	1.1	1.2	1.3	1.4	2.0
Cooperative	29.6	18.9	19.9	10.1	24.8	0.3	0.3	0.3	0.4	0.3	0.4	0.5	0.5
Nationalised	56.7	65.9	69.4	74.3	8.0	75.6	74.5	70.4	74.1	70.5	65.9	11.9	56.0
Public	12.2	10.0	9.4	11.2	11.6	6.7	6.5	7.0	6.7	6.1	6.6	8.1	10.4
Savings	8.8	7.4	9.7	10.9	10.8	1.3	1.3	1.3	1.3	1.4	1.4	1.6	2.6
All banks	**10.3**	**11.5**	**10.7**	**10.9**	**11.9**	**0.5**	**0.5**	**0.6**	**0.6**	**0.**	**0.7**	**0.8**	**1.1**

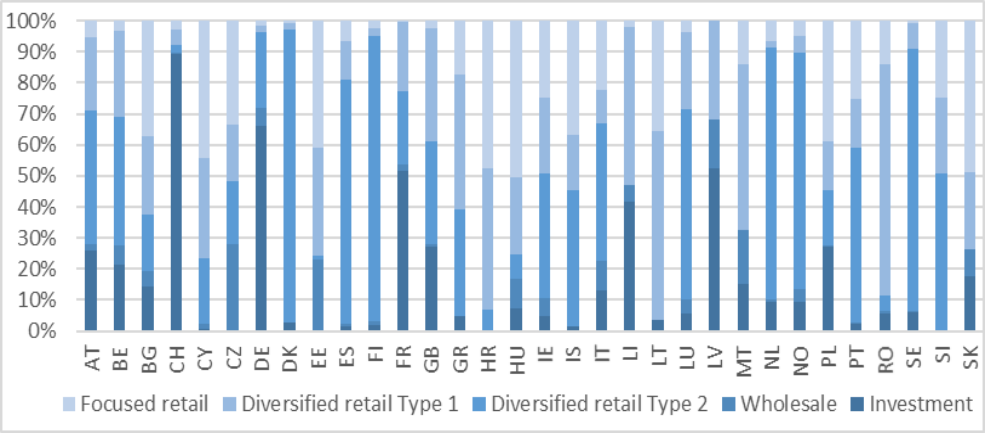
Note: All figures correspond to the year-end observations for the relevant sub-sample.
Source: Authors

Distribution of banks across business models and countries (% of institutions)



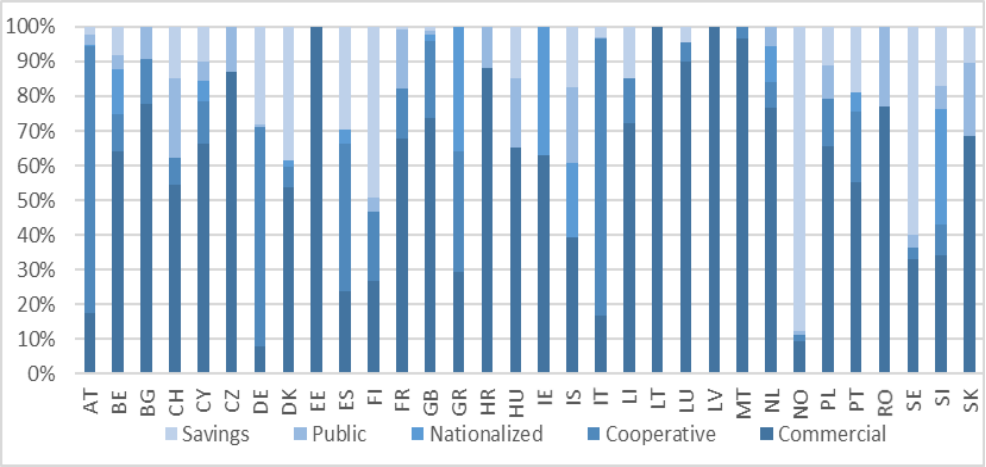
Note: The figure above shows the distribution of banks across business models based on share of observations for the entire sample period in the EEA countries and Switzerland.
Source: Authors

Distribution of banks across business models and countries (% of assets)



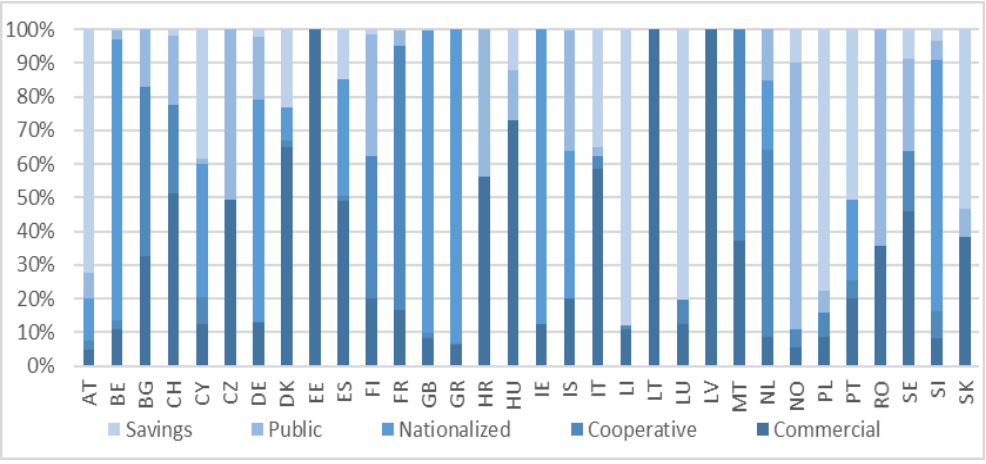
Note: The figure above shows the distribution of banks across business models, based on share of assets for the entire sample period in the EEA countries and Switzerland.
Source: Authors

Distribution of banks across ownership structures and countries (% of institutions)



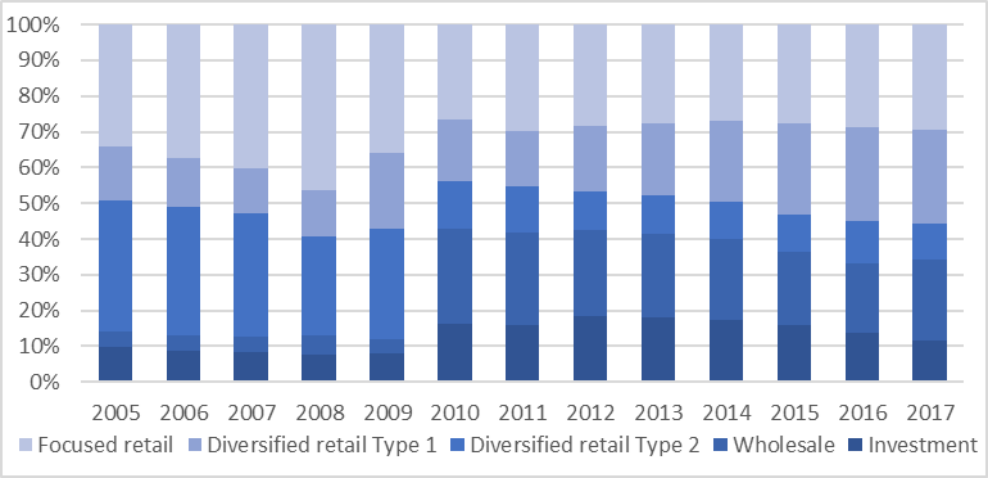
Note: The figure above shows the distribution of banks across ownership structures, based on share of observations and assets for the entire sample period in the EEA countries and Switzerland.
Source: Authors

Distribution of banks across ownership structures and countries (% of assets)



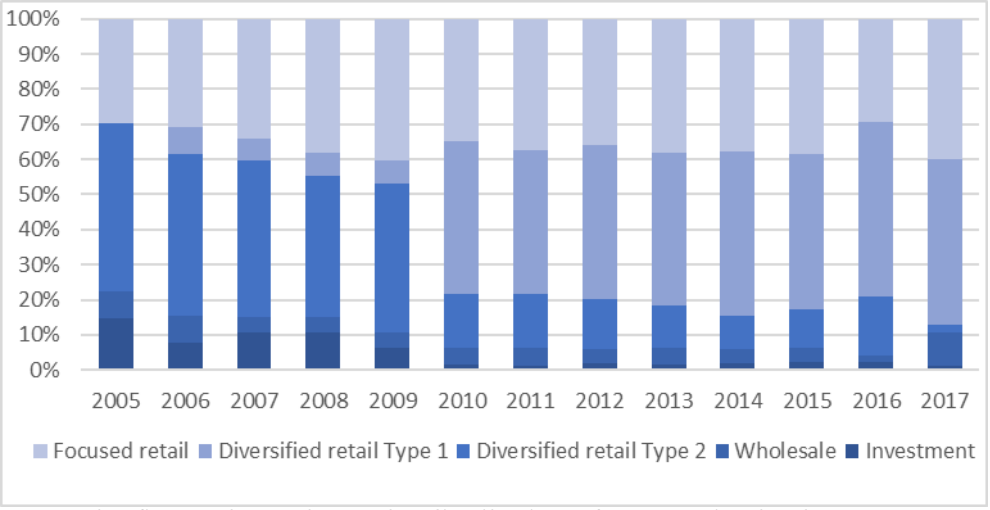
Note: The figure above shows the distribution of banks across ownership structures, based on share of assets for the entire sample period in the EEA countries and Switzerland.
Source: Authors

Distribution of commercial banks across business models and years (% of institutions)



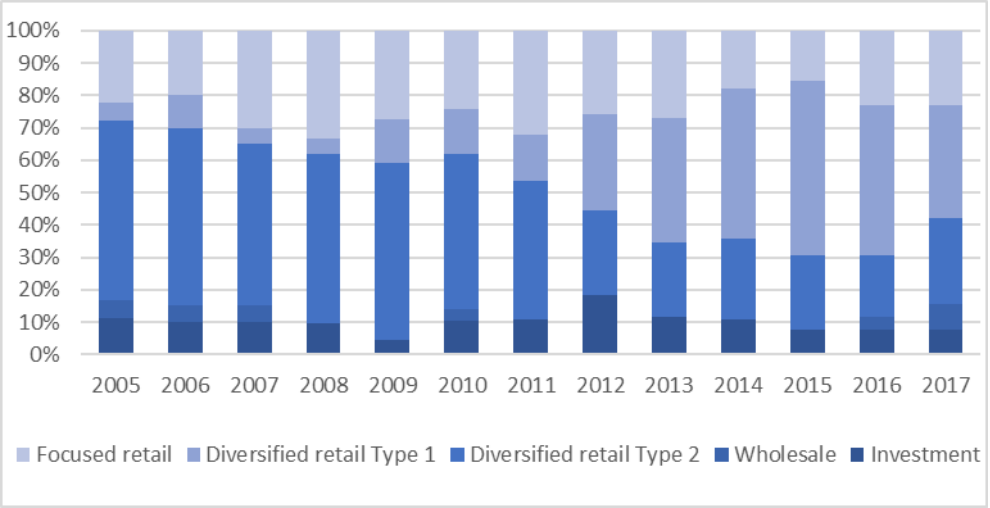
Note: The figure above shows the distribution of commercial banks across years and business models, based on share in number of institutions for the entire sample period in the EEA countries and Switzerland.
Source: Authors

Distribution of cooperative banks across business models and years (% of institutions)



Note: The figure above shows the distribution of cooperative banks across years and business models, based on share in number of institutions for the entire sample period in the EEA countries and Switzerland.
Source: Authors

Distribution of nationalised banks across business models and years (% of institutions)

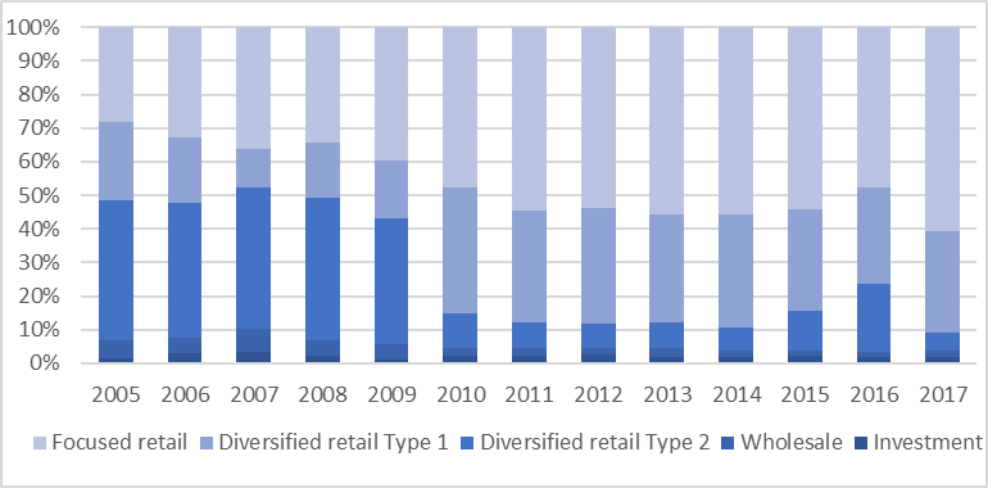


Note: The figure above shows the distribution of nationalised banks across years and business models, based on share in number of institutions for the entire sample period in the EEA countries and Switzerland.
Source: Authors

Distribution of public banks across business models and years (% of institutions)

Note: The figure above shows the distribution of public banks across years and business models, based on share in number of institutions for the entire sample period in the EEA countries and Switzerland.
Source: Authors

Distribution of savings banks across business models and years (% of institutions)



Note: The figure above shows the distribution of savings banks across years and business models, based on share in number of institutions for the entire sample period in the EEA countries and Switzerland.
Source: Authors

APPENDIX IV. DETERMINING THE OPTIMAL NUMBER OF CLUSTERS

To form the clusters, Ward's (1963) procedure for calculating the distance between clusters was used. The procedure forms partitions in a hierarchical manner, starting from the largest number of clusters possible (i.e. all banks/years in a separate cluster) and merging clusters by minimising the within-cluster sum-of-squared-errors for any given number of clusters. Several studies found that the Ward clustering methodology performs better than other clustering procedures for instruments that involve few outliers and in the presence of overlaps.[33]

One of the key problems often encountered in clustering is the presence of missing values. When a particular observation has one or more missing instrument values, it has to be dropped from the cluster analysis, since the similarity to other bank-year observations cannot be determined. The sample used in the Monitor contains such cases, despite efforts to choose indicators with high coverage ratios. In order to accommodate the entire sample of observations, when the 'intangible assets' and 'negative carrying values of derivative exposures' were not reported, they were assumed to be zero in the calculation of 'Trading assets', 'Debt liabilities' and 'Derivative exposures,' since banks are not required to report both balance sheet items unless significant.

All the clustering procedures were conducted using SAS's built-in and user-contributed functions.

To diagnose the appropriate number of clusters, Calinski & Harabasz's (1974) pseudo-F index was used as the primary 'stopping rule'. The index is a sample estimate of the ratio of between-cluster variance to within-cluster variance.[34] The configuration with the greatest pseudo-F value was chosen as the most distinct clustering. The results show that the pseudo-F indices attain a single maximum, pointing to the five-cluster configuration as the most distinct one. The number of clusters is confirmed

[33] See Milligan (1981) and references therein for an assessment of different clustering methods.

[34] Evaluating a variety of cluster stopping rules, Milligan & Cooper (1985) single out the Calinski and Harabasz index as the best and most consistent rule, identifying the sought configurations correctly in over 90% of all cases in simulations.

by alternative stopping rules, namely the Semi Partial R-Squared measure, the Cubic Clustering Criterion and the Sum of Squares Between.

Pseudo-F indices for clustering configurations for banks in Europe

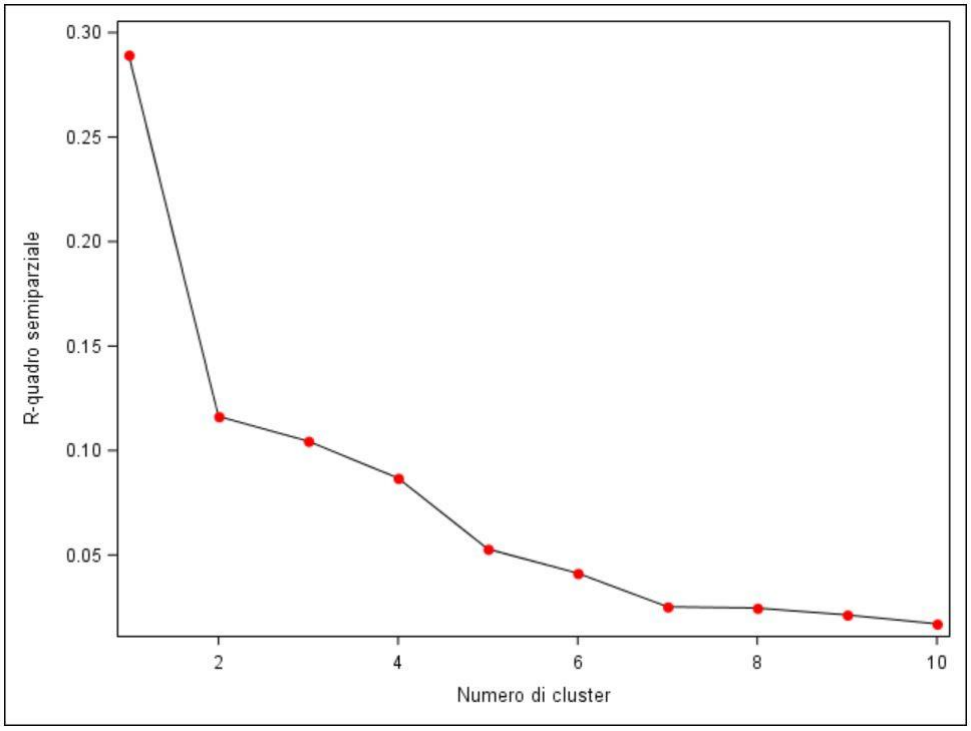
Number of clusters	Pseudo-F index (Calinski & Harabasz)	Number of clusters	Pseudo-F index (Calinski & Harabasz)
1	...	6	7,875
2	7,925	7	7,653
3	7,578	8	7,649
4	7,677	9	7,757
5	**8,196**	10	7,610

Note: The Calinski & Harabasz (1974) pseudo-F index is an estimate of the between-cluster variance divided by within-cluster variance.

Source: Authors

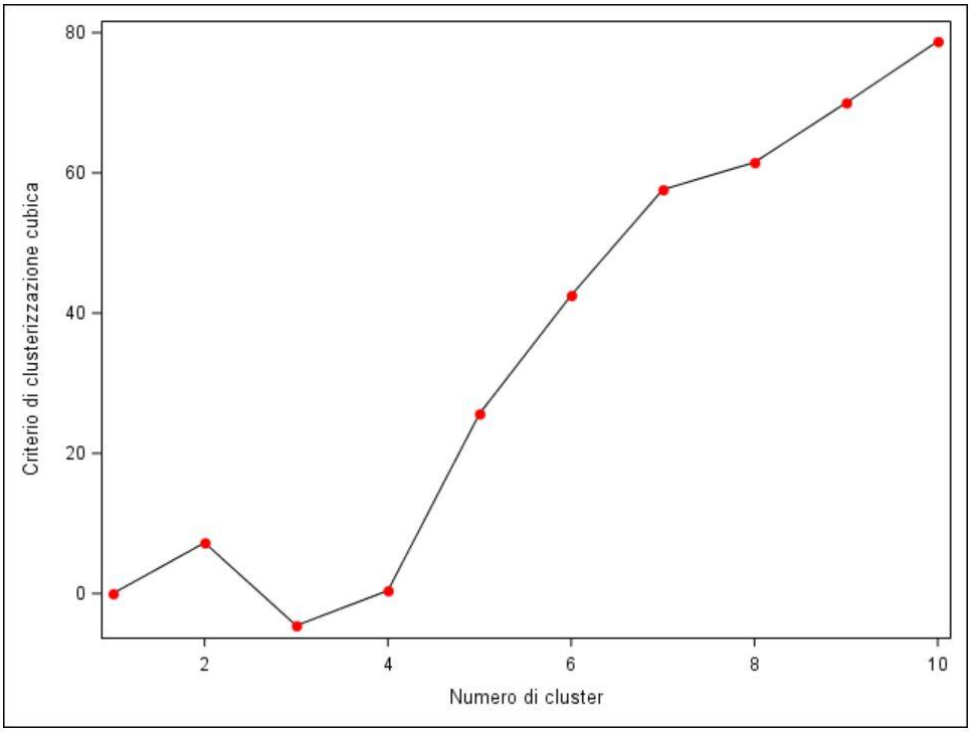
The pseudo-F statistics of Calinski & Harabasz confirm 5 clusters as the optimal solution. We present here three other popular selection criteria; Semi Partial R-Squared, Cubic Clustering Criterion and Sum of Squares Between. They all support the five-cluster configuration.

Semi Partial R-Squared (SPRSQ) across clusters



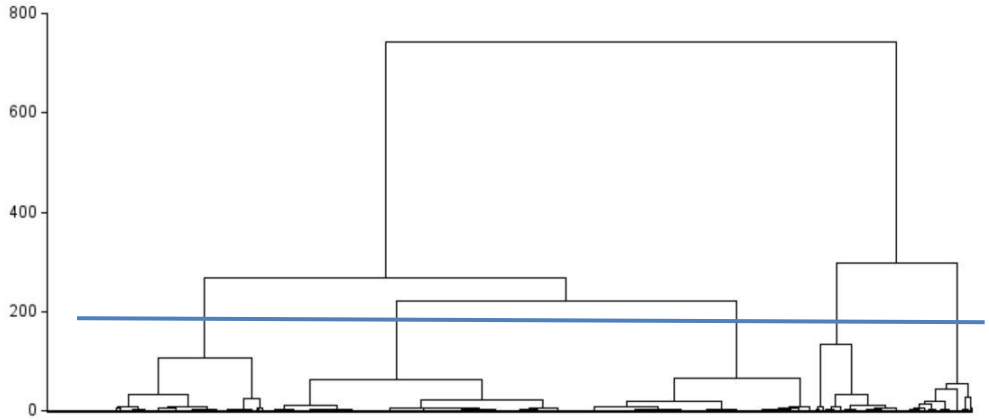
Note: The Semi Partial R-Squared measures the loss of homogeneity when a new group is created. Since we are seeking homogeneous groups, it must be small enough. Also, the number of clusters must be parsimonious. It is clear from the figure that 5 is a break point for the number of clusters, where the curve has started to level off and most of the drop in the semi-partial R-squared has been achieved.
Source: Authors

Cubic Clustering Criterion (CCC)



Note: The higher the Cubic Clustering Criterion (CCC), the more homogeneous the clusters are. The figure shows the jump in CCC obtained from increasing the number of clusters from 4 to 5, which is also a clear break point. The requirement of a parsimonious number of clusters supports a number of 5 clusters as one of the best choices
Source: Authors

Sum of Squares Between

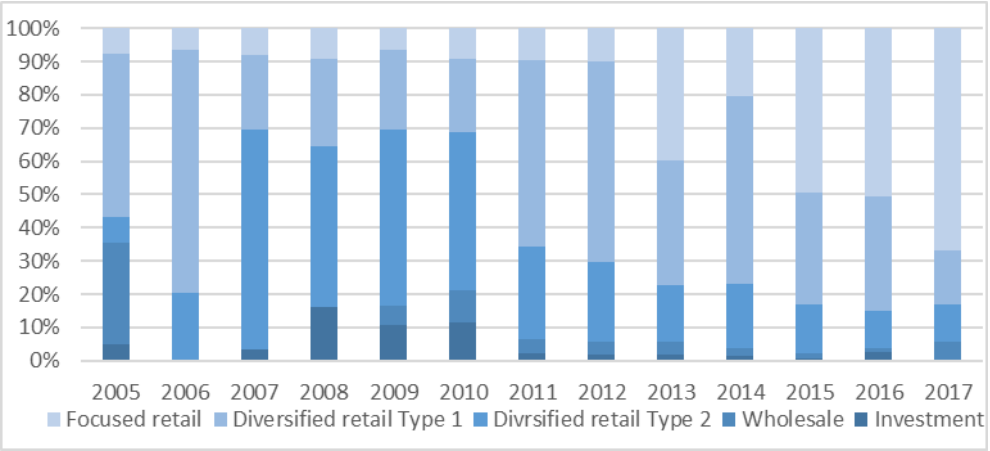


Note: On the Dendrogram, new clusters are formed in a hierarchical way by partitioning existing clusters. The Y-axis represents the distance between datasets according to the measure Sum of Square Between (SSB). More precisely, one reads for each horizontal line, the distance between two clusters. The cut off line for 5 clusters can even drop below 100, whilst keeping the number of clusters at 5. It is clear again that by selecting 5 clusters, a substantial reduction in SSB is achieved.

Sources: Authors

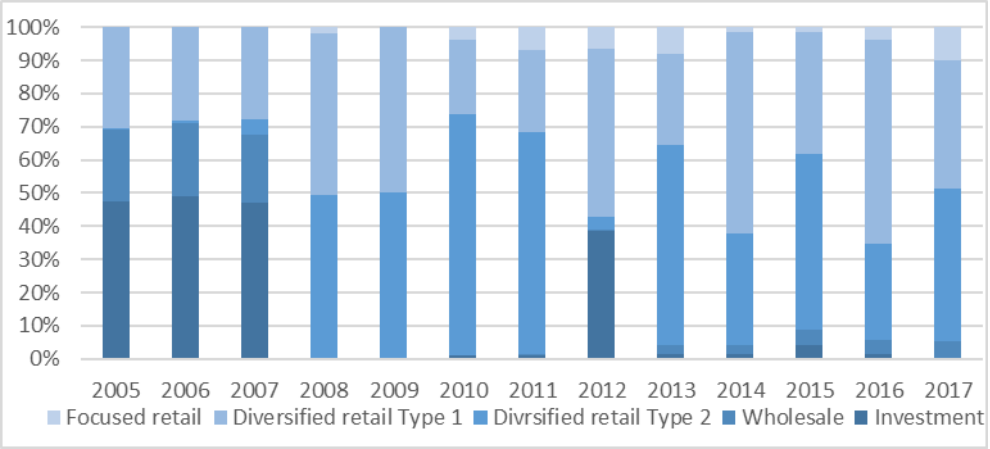
APPENDIX V.
BUSINESS MODELS ACROSS YEARS FOR SELECTED COUNTRIES

Banking business models in Austria (% of assets)



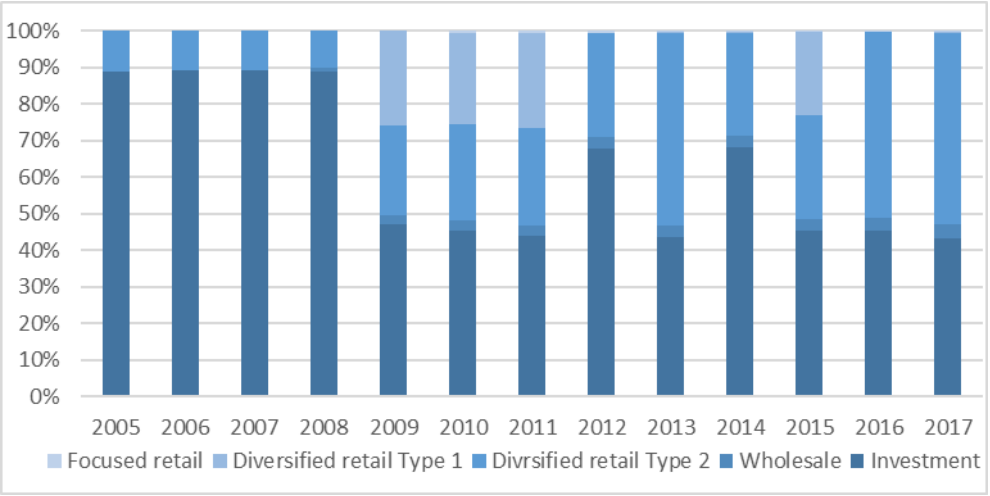
Source: Authors

Banking business models in Belgium (% of assets)



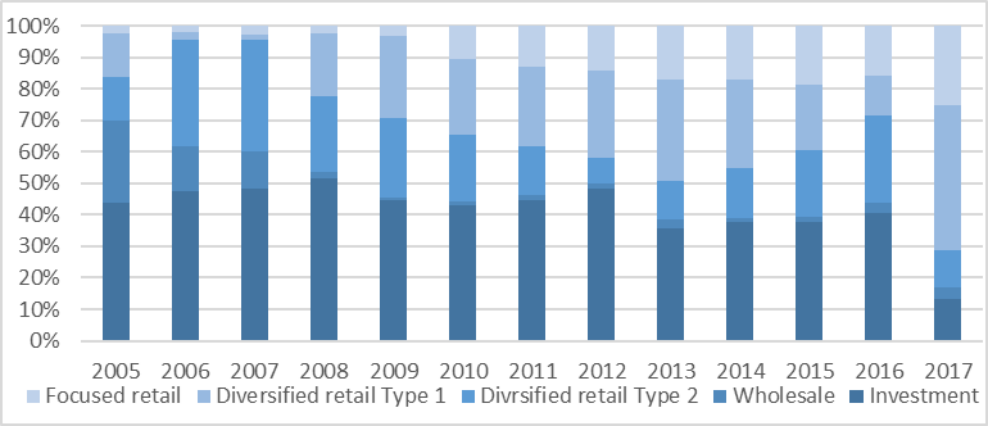
Source: Authors

Banking business models in France (% of assets)



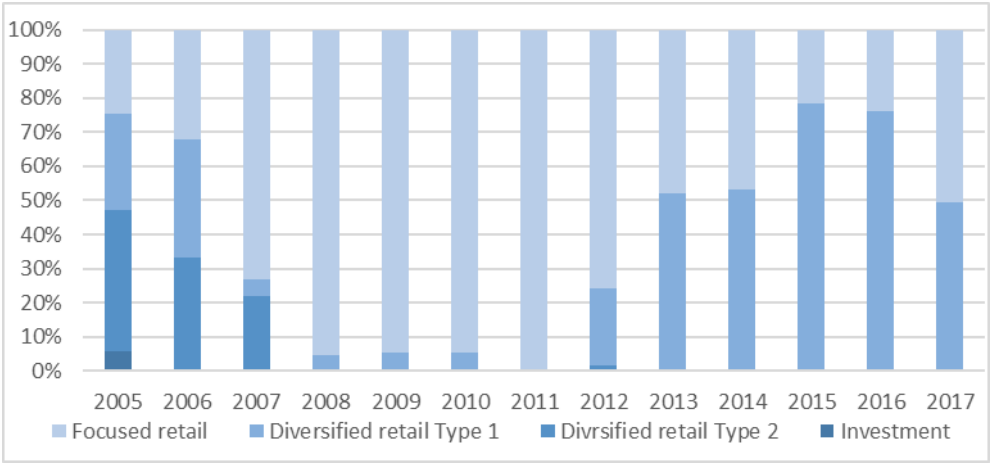
Source: Authors

Banking business models in Germany (% of assets)



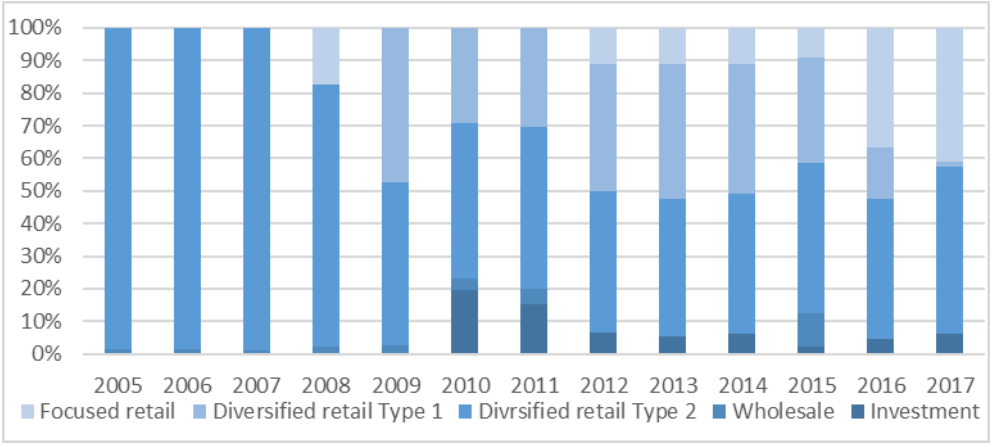
Source: Authors

Banking business models in Greece (% of assets)



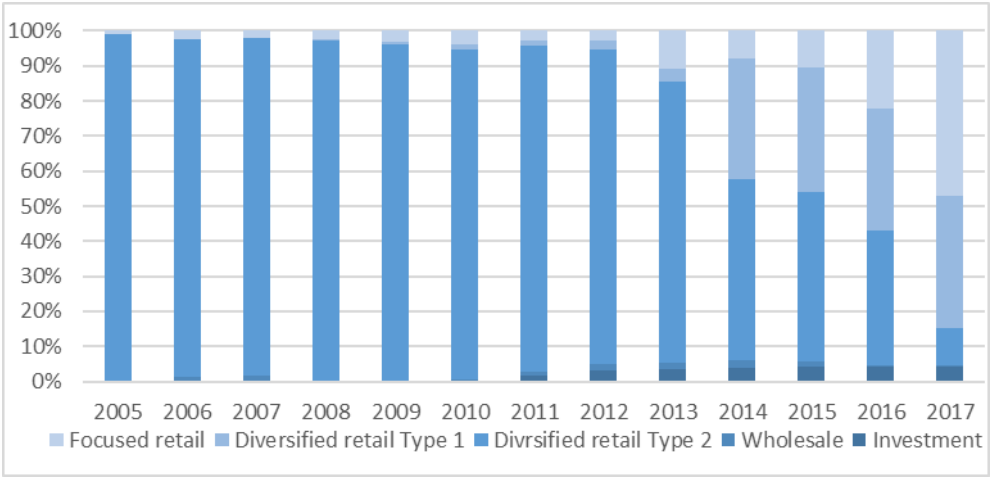
Source: Authors

Banking business models in Ireland (% of assets)



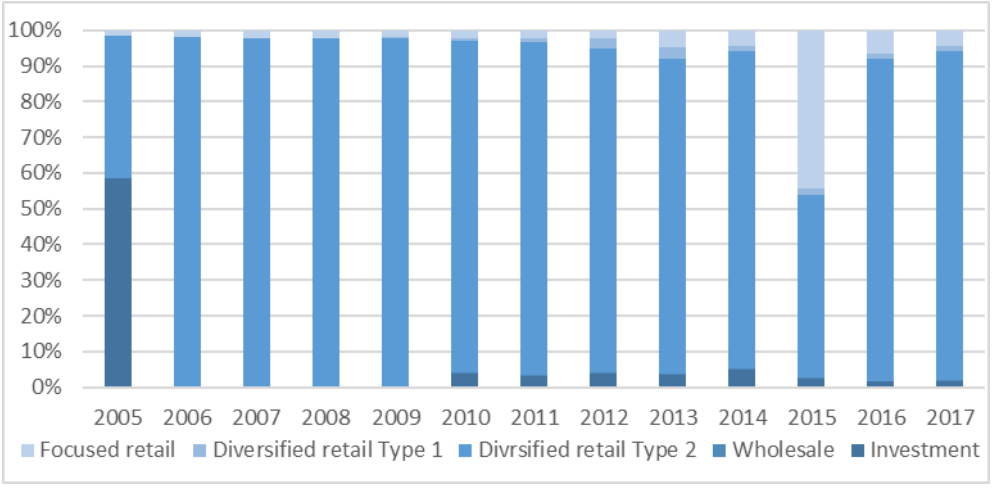
Source: Authors

Banking business models in Italy (% of assets)



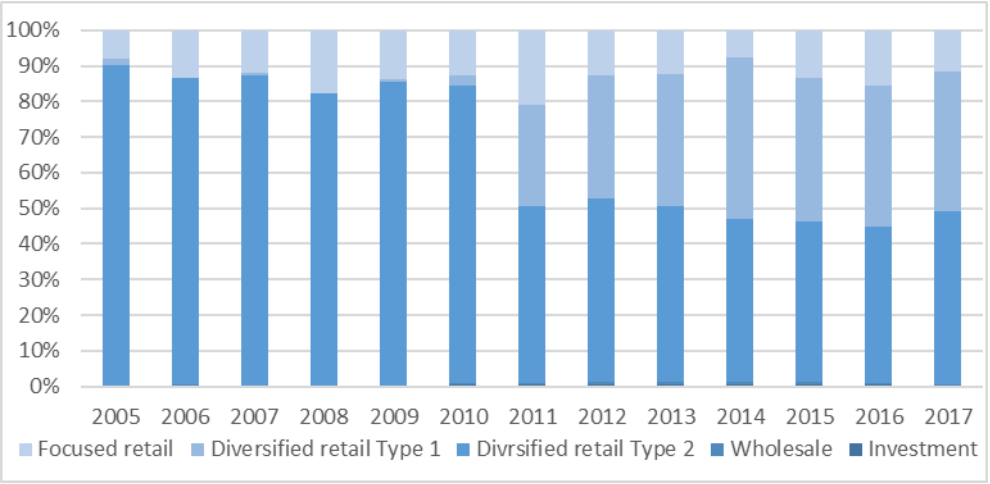
Source: Authors

Banking business models in the Netherlands (% of assets)



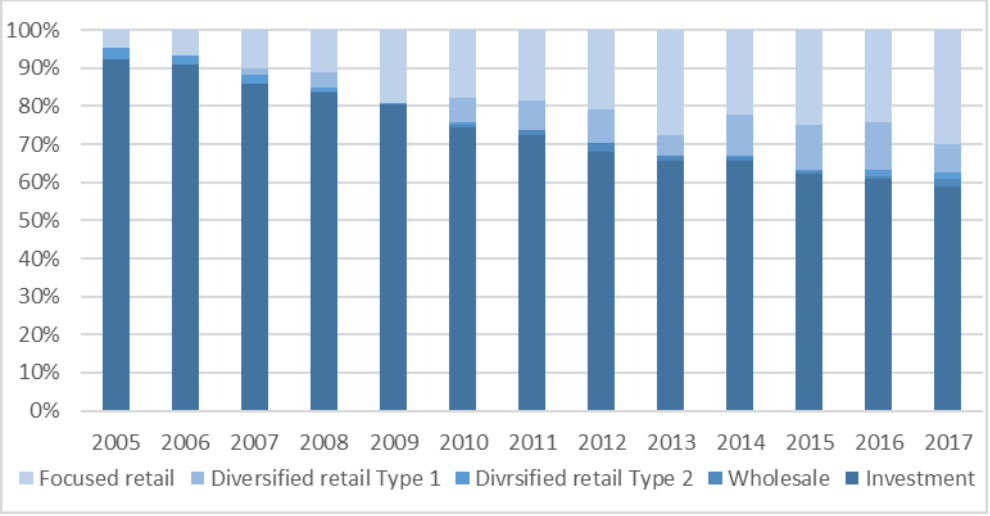
Source: Authors

Banking business models in Spain (% of assets)



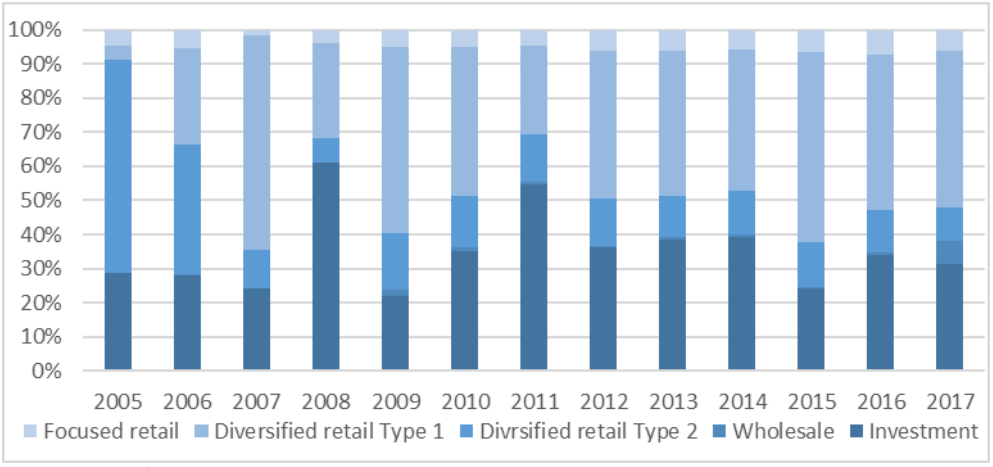
Source: Authors

Banking business models in Switzerland (% of assets)



Source: Authors

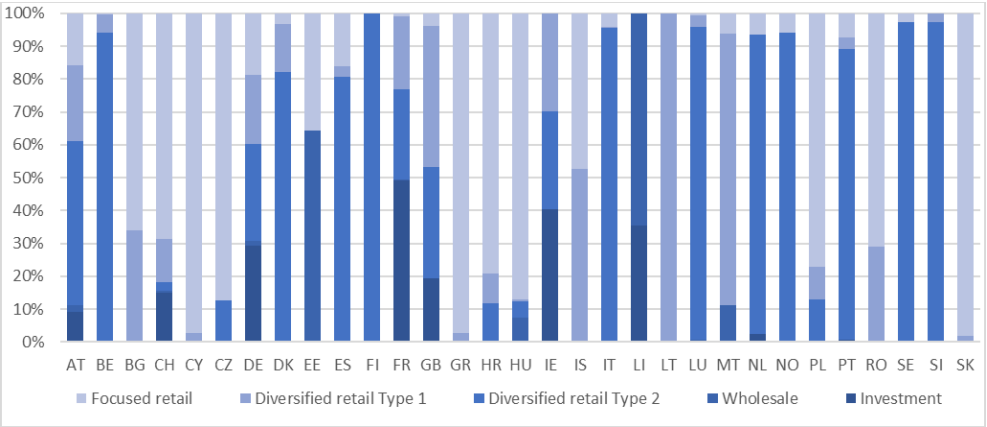
Banking business models in United Kingdom (% of assets)



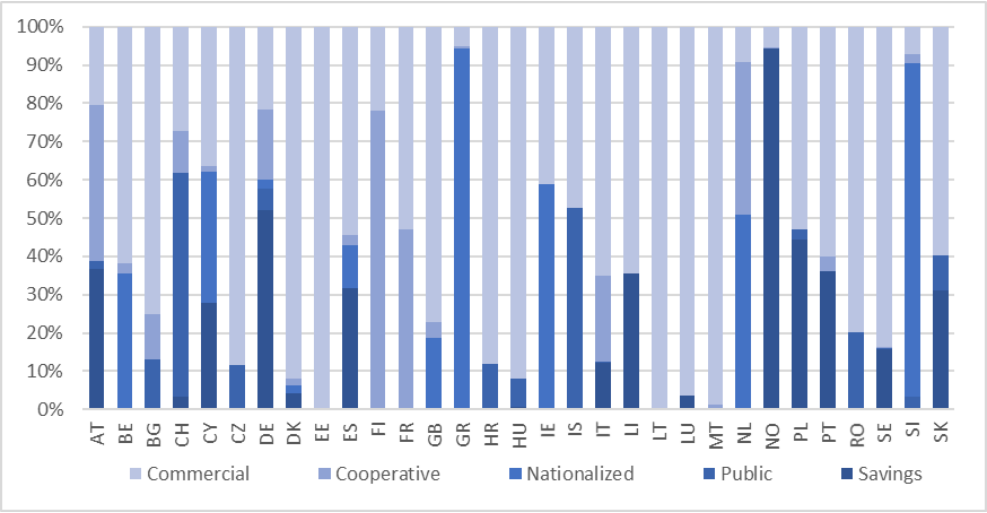
Source: Authors

Distribution of Non-performing loans 2010

a) *Business models*



b) Ownership structure

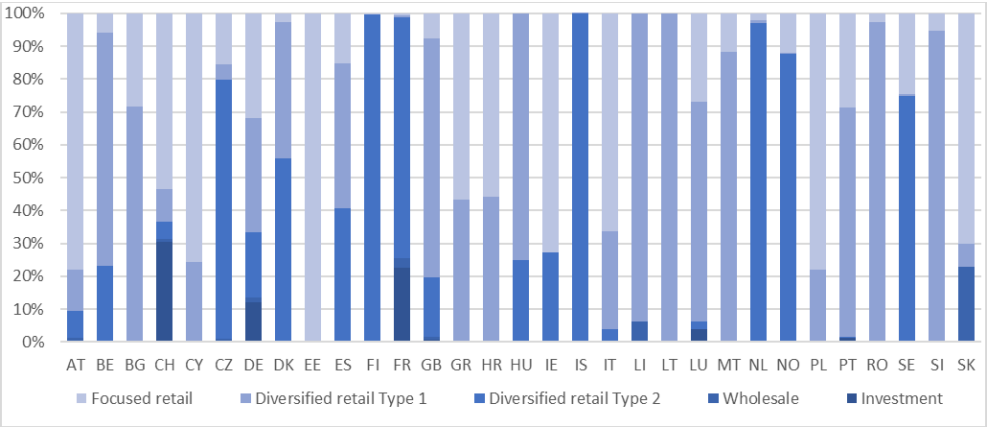


Note: The figure shows the distribution of the non-performing loans across countries in 2010.

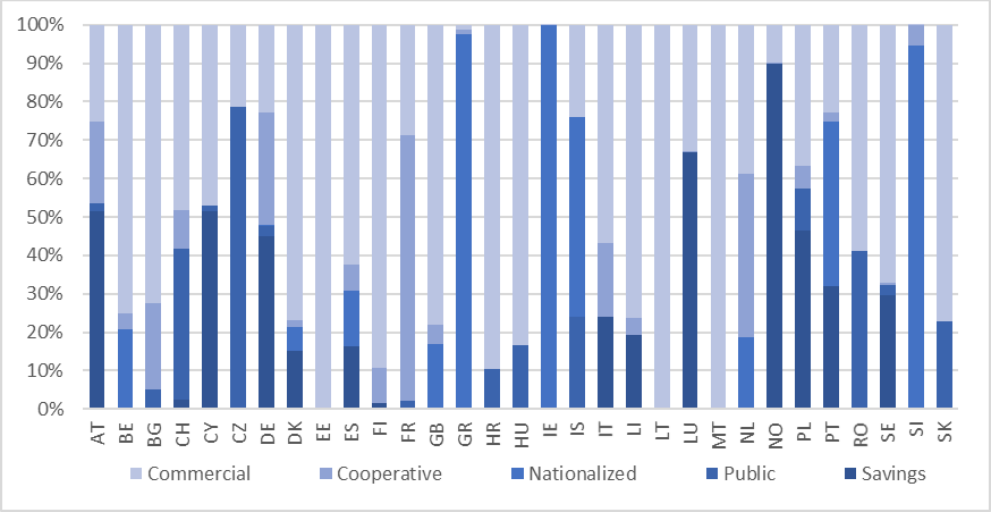
Source: Authors

Distribution of Non-performing loans 2017

a) Business models



b) Ownership structure



Note: The figure shows the distribution of non-performing loans across countries in 2017.
Source: Authors

APPENDIX VI. CALCULATION OF Z-SCORE

The Z-score used in the study is the one derived in Boyd & Runkle (1993), which is a simple indicator of the risk of failure or the distance to default. To derive the measure, it is assumed that default occurs when the one-time losses of bank *j* in year *t* exceed its equity, or when

$$\pi_{jt} + E_{jt} < 0 \quad . \tag{A1}$$

Then, assuming that the bank's return on total assets (RoA), or π_{jt} / TA_{jt}, is normally distributed around the mean μ_j, and standard deviation σ_j, the probability of failure is given as

$$pr(\pi_{jt} < -E_{jt}) = pr(\pi_{jt} / TA_{jt} < -E_{jt} / TA_{jt}) = \int_{-\infty}^{D_{jt}} \phi(r)dr \quad , \tag{A2}$$

where ϕ represents the standard normal distribution, r is the standardised return on assets and D is the default boundary that separates a healthy bank from an unhealthy one, described as the normalised equity ratio:

$$D_{jt} = \frac{-(E_{jt} / TA_{jt}) - \mu_j}{\sigma_j} \quad , \tag{A3}$$

Note that a greater D implies a greater probability of default and, therefore, a greater risk for the bank. The average and standard deviation calculations were obtained using available data for the years 2005-2014.

Since D admits negative values in most cases, the Z-score is set to be represented as a positive number, or as

$$Z_{jt} = -D_{jt} . \tag{A4}$$

This implies that a greater Z-value implies a lower probability of default.

APPENDIX VII. ASSUMPTIONS ON NSFR

The assumptions for the net stable funding ratio (NSFR) are similar to those put forward in IMF (2011). Introduced by the Basel Committee on Banking Supervision (BCBS, 2010a), the NSFR aims to restrict banks from having an excessive reliance on short-term funding, in an attempt to promote more balanced mid to long-term financial resources, in order to support the assets through stable funding sources. More specifically, the measure requires the available stable funding to exceed the required stable funding.

Available stable funding sources include total Tier-1 and Tier-2 capital, as well as reserves that count as part of equity. Stable forms of funding, including customer deposits and other liabilities with more than one-year maturities, are also included. Lower maturity liabilities, including term deposits and retail deposits from non-financial institutions, enter as available funding after the application of various haircuts. Short-term liabilities to financial institutions and secured wholesale funding are generally not included as available, due to substantial rollover risks and potential margin calls that may materialise in times of market stress.

Required stable funding includes assets that cannot be quickly sold off without substantial costs during adverse market conditions, lasting up to one year. Most customer loans are assumed to have long-term maturities and will, thus, face liquidation costs. All encumbered securities that are posted as collateral enter directly into the calculation of required stable funding, as they cannot be sold off without changing the original contract. Shorter maturity retail loans are also treated as required funding, albeit with an appropriate haircut. In turn, more liquid unencumbered assets, such as cash or marketable securities, receive lower factors, as they are, typically, readily available for sale without substantial potential losses.

Since the available data is quite restricted in nature, assumptions regarding many specific items were made. The following table provides the assumptions and the relevant multiplicative factors that were used to build the NSFR measure present in the study. Although comparable to the measure developed by IMF (2011), the validity of the results is likely to depend on the assumptions on certain factors more than others. This is particularly the case for debt liabilities and trading assets, which make up more than one-third of the balance sheets of most banks, especially the investment and wholesale banking models.

Balance sheet items	**Factors**
AVAILABLE STABLE FUNDING	
Customer deposits	85%
Deposits from banks	0%
Derivative liabilities (negative, fair-value)	0%
Repurchase agreements	0%
Debt liabilities	50%
Equity & reserves	100%
REQUIRED STABLE FUNDING	
Cash	0%
Customer loans	80%
Loans to banks	0%
Derivative assets (positive, fair-value)	90%
Trading assets	50%

Source: Ayadi et al. (2012)

APPENDIX VIII. ASSUMPTION ON MREL AND TLAC

To estimate the MREL, we use the TLAC formula as proxy.

From the FSB term sheet, a formula for the TLAC according to the requirements of 2022, can be cast as: TLAC=Max (18% RWA, 6.75% LRE), where LRE is the Leverage Ratio Exposure. It is the denominator of the leverage ratio as per Basel III. The leverage ratio exposure of the Basel III agreement is the sum of Total assets on the balance sheet and a number of (potentially substantial) off-balance sheet adjustments. It is important to note that the leverage ratio framework is not yet implemented in most European countries and the LRE is estimated in our study by subtracting intangible assets from total assets. The estimations are done separately for component 1 and component 2 of the formulae.

To summarise, we assume that the MREL are computed based on the TLAC standard applied to the entire banking sector in Europe. The computation uses the formula max (18% RWA, 6.75% LRE) as a percentage of total liability and own funds.

APPENDIX IX. ASSUMPTION ON SRISK

Brownlees and Engle (2017) introduce SRISK to measure the systemic risk contribution of a financial firm to the whole financial system. SRISK is a measure of capital shortfall of a firm conditional on a severe market decline and is a function of its size, leverage and risk.

Equation (1) in the paper of Gehrig and Iannino (2017) has been adapted. The capital shortfall for every bank-year observation is calculated as:

SRISK=Capital shortfall=k*(risk-weighted assets)-equity, (1)

With k being the prudential ratio of capital. Usually, k indicator is computed as k=8% the minimum capital requirement asked by the Authorities.

The relative exposure of each bank to the aggregate SRISK of the financial sector is the ratio of the SRISK of the bank-year to the sum of the SRISKs that are positive. In conclusion, the aggregate SRISK provides early warning signals of distress in indicators of real activity.

$$SRISK\%_{it} = \frac{SRISK_{it}}{SRISK_t}, where\ i = firms\ with\ SRISK > 0 \qquad (2)$$

APPENDIX X. LIST OF SYSTEMIC BANKS EXAMINED (GLOBAL AND DOMESTIC)

Rank	Name	Country	Total assets (€ million, last year)	Type of ownership (as of year-end, last year)	Coverage (period, first-last year)	Change in assets (%, first-last year)	Business Model(s)
1	Danske Bank A/S	DK	3,539,528	Commercial	2005-2017	986%	D2
2	Svenska Handelsbanken AB (publ)	SE	2,766,977	Savings	2005-2017	1544%	D2
3	DNB ASA	NO	2,698,268	Savings	2005-2017	1894%	D2
4	HSBC Holdings Plc	GB	2,521,771	Commercial	2005-2017	99%	D1, D2
5	Swedbank AB (publ)	SE	2,212,636	Commercial	2005-2017	1639%	D2
6	BNP Paribas SA	FR	1,960,252	Commercial	2005-2017	56%	I
7	Crédit Agricole Group	FR	1,763,169	Cooperative	2005-2017	51%	D1, D2, I
8	Deutsche Bank AG	DE	1,474,732	Commercial	2005-2017	49%	D1, I
9	Banco Santander, SA	ES	1,444,305	Commercial	2005-2017	79%	D2
10	Société Générale SA	FR	1,275,128	Commercial	2010-2017	53%	I
11	Groupe BPCE	FR	1,259,850	Cooperative	2009-2017	22%	D2
12	Barclays Plc	GB	1,133,248	Commercial	2005-2017	-16%	D2, I
13	UBS Group AG	CH	915,642	Commercial	2005-2017	-31%	D1, D2
14	ING Groep N.V.	NL	846,216	Commercial	2005-2017	1%	F, D2, I
15	UniCredit SpA	IT	836,790	Commercial	2005-2017	6%	D2

16	Crédit Mutuel Group	FR	813,198	Cooperative	2005-2017	86%	D2
17	Lloyds Banking Group Plc	GB	812,109	Commercial	2005-2017	80%	D2
18	Intesa Sanpaolo SpA	IT	797,292	Commercial	2005-2017	191%	F, D2
19	Credit Suisse Group AG	CH	796,289	Commercial	2005-2017	-7%	I
20	Royal Bank of Scotland Group Plc	GB	738,056	Nationalised	2005-2017	-35%	D1, D2, I
21	Banco Bilbao Vizcaya Argentaria, SA	ES	690,059	Commercial	2005-2017	76%	D1, D2
22	Coöperatieve Rabobank U.A.	NL	602,991	Cooperative	2005-2017	19%	D2
23	Jyske Bank A/S	DK	597,440	Commercial	2005-2017	3048%	D1, D2
24	Nordea Bank AB (publ)	SE	581,612	Commercial	2005-2017	79%	D1, D2
25	Commerzbank AG	DE	452,513	Commercial	2005-2017	2%	D1, D2
26	Deutsche Zentral-Genossenschaftsbank AG	DE	401,604	Cooperative	2005-2015	2%	I
27	ABN AMRO Group NV	NL	393,171	Nationalised	2009-2017	2%	D2
28	KBC Group NV	BE	292,342	Commercial	2005-2017	-10%	D1, D2
29	Landesbank Baden-Württemberg	DE	237,713	Savings	2005-2017	-41%	D1, D2, I, W
30	La Banque Postale, SA	FR	231,477	Public	2005-2017	116%	W, I
31	Raiffeisen Gruppe Switzerland	CH	227,728	Cooperative	2007-2017	207%	F

32	Banco de Sabadell, SA	ES	221,348	Savings	2005-2017	323%	F, D2
33	Erste Group Bank AG	AT	220,659	Savings	2005-2017	45%	F, D1, D2
34	Bayerische Landesbank	DE	214,521	Savings	2005-2017	-37%	D1, D2, W
35	Skandinaviska Enskilda Banken AB (publ.)	SE	200,880	Commercial	2005-2016	36%	D2
36	Dexia SA	BE	180,938	Nationalised	2005-2017	-64%	D2, W
37	Fundación Bancaria Caixa d'Estalvis i Pensions de Barcelona, "la Caixa"	ES	180,352	Savings	2005-2013	95%	D2
38	Nykredit Holding A/S	DK	175,900	Savings	2005-2016	7%	D2
39	Belfius Banque SA	BE	167,959	Nationalised	2005-2017	-27%	D1, D2, W
40	NORD/LB Norddeutsche Landesbank Girozentrale	DE	163,838	Savings	2005-2017	-17%	D2
41	Banca Monte dei Paschi di Siena SpA	IT	153,767	Savings	2005-2017	0%	F, D2
42	Hypo Real Estate Holding AG	DE	152,339	Nationalised	2005-2014	-50%	D2, I
43	NRW.BANK	DE	147,584	Public	2010-2017	-6%	D2
44	NV Bank Nederlandse Gemeenten	NL	140,025	Public	2010-2016	18%	D2
45	Sydbank A/S	DK	138,494	Commercial	2005-2017	944%	D1, D2
46	Unione di Banche Italiane SpA	IT	127,376	Cooperative	2005-2017	85%	F, D2

47	Governor and Company of the Bank of Ireland	IE	122,587	Nationalised	2005-2017	-4%	D2
48	Julius Bär Gruppe AG	CH	97,918	Commercial	2007-2017	245%	D1, I
49	PostFinance AG	CH	95,185	Commercial	2013-2016	18%	I
50	Raiffeisen Zentralbank Österreich AG	AT	93,864	Cooperative	2006-2016	44%	F, D1, W
51	DekaBank Deutsche Girozentrale	DE	93,740	Savings	2005-2017	-18%	W, I
52	Allied Irish Banks, Plc	IE	90,061	Nationalised	2005-2017	-32%	DF, D1, D2
53	Nederlandse Waterschapsbank NV	NL	87,123	Public	2010-2017	52%	D2
54	Caixa Geral de Depósitos SA	PT	86,461	Savings	2005-2015	17%	D2
55	Banco Popular Español SA	ES	77,698	Commercial	2005-2015	104%	F, D2
56	Landwirtschaftliche Rentenbank	DE	76,979	Public	2005-2016	23%	W, I
57	Westdeutsche Genossenschafts-Zentralbank AG	DE	73,584	Cooperative	2005-2015	22%	F, W
58	Banco Comercial Português, SA	PT	71,939	Commercial	2005-2017	-6%	F, D2
59	Bankinter SA	ES	71,333	Savings	2005-2017	75%	F, D2

60	Landeskreditbank Baden-Württemberg–Förderbank	DE	70,670	Public	2005-2017	42%	D1, D2, W
61	Alior Bank SA	PL	69,494	Commercial	2009-2017	4452%	F, D1
62	Banco Popolare Società Cooperativa	IT	68,695	Cooperative	2006-2016	71%	D2
63	Piraeus Bank SA	GR	67,417	Nationalised	2005-2017	186%	F, D1, D2
64	Banco Mare Nostrum, SA	ES	67,201	Nationalised	2011-2016	-42%	F, D1
65	Powszechna Kasa Oszczednosci Bank Polski SA	PL	64,851	#N/D	2005-2017	1146%	F
66	Alpha Bank AE	GR	60,813	Nationalised	2005-2017	38%	F, D2
67	National Bank of Greece SA	GR	60,427	Nationalised	2005-2016	30%	F, D1
68	Eurobank Ergasias SA	GR	60,029	Nationalised	2005-2017	35%	F, D1, D2
69	Zürcher Kantonalbank	CH	54,844	Public	2005-2017	169%	F, D1
70	SNS Bank NV	NL	53,098	Nationalised	2005-2017	28%	F, D2
71	OP Financial Group	FI	52,845	Cooperative	2005-2017	153%	D2
72	Novo Banco, SA	PT	52,055	Nationalised	2010-2017	-20%	D1, D2
73	ABANCA Corporación Bancaria, SA	ES	50,784	Nationalised	2011-2017	-30%	F,D1
74	Banque et Caisse d'Epargne de l'Etat, Luxembourg	LU	45,509	Savings	2006-2017	10%	D1

75	Argenta Bank- en Verzekeringsgroep SA	BE	44,068	Commercial	2007-2017	50%	F, D1, D2
76	Banca popolare dell'Emilia Romagna SC	IT	43,324	Cooperative	2005-2015	41%	D2
77	Migros Bank AG	CH	43,294	Cooperative	2005-2017	144%	F
78	Bank Handlowy w Warszawie SA	PL	43,038	Commercial	2005-2017	403%	D1
79	Caisse de Refinancement de l'Habitat SA	FR	42,486	Commercial	2010-2016	-7%	I
80	Aareal Bank AG	DE	41,908	Commercial	2005-2017	7%	D1,D2
81	Banca Popolare di Sondrio SCpA	IT	41,625	Commercial	2005-2017	192%	F, D1
82	Deutsche Apotheker- und Ärztebank eG	DE	41,369	Cooperative	2005-2017	40%	F, D1
83	HASPA Finanzholding	DE	40,552	Savings	2011-2015	14%	F
84	Grupo Cooperativo Cajamar	ES	40,507	Cooperative	2006-2017	109%	F
85	Raiffeisenlandesbank Oberösterreich AG	AT	40,319	Cooperative	2007-2017	82%	D1, D2
86	Volkswagen Financial Services AG	DE	39,757	Commercial	2005-2016	227%	F, D1, W
87	Münchener Hypothekenbank eG	DE	38,905	Cooperative	2005-2017	14%	F, D2

88	Mediobanca - Banca di Credito Finanziario SpA	IT	38,225	Commercial	2005-2016	83%	D2
89	Banca Popolare di Milano Scarl	IT	37,901	Cooperative	2005-2016	35%	F, D2
90	Pictet & Cie Group SCA	CH	37,288	Commercial	2005-2017	16%	D1, I
91	Bank of New York Mellon SA/NV	BE	36,670	Commercial	2010-2017	-7%	F, D1
92	Liberbank, SA	ES	35,462	Savings	2011-2017	-30%	F, D1
93	Precision Capital SA	LU	35,296	Commercial	2006-2017	>10000%	D1, W
94	Banco BPI SA	PT	30,159	Commercial	2005-2016	27%	D1, D2
95	Fundación Bancaria Unicaja	ES	28,268	Savings	2006-2010	21%	F
96	Volksbanken-Verbund	AT	25,323	Cooperative	2007-2017	-73%	D2
97	Banca Carige SpA - Cassa di Risparmio di Genova e Imperia	IT	24,920	Commercial	2005-2017	8%	F, D2
98	Bank of Cyprus Public Company Limited	CY	24,897	Savings	2006-2015	-7%	F
99	Banca Popolare di Vicenza SpA	IT	23,750	Cooperative	2006-2017	45%	F, D1, D2
100	Permanent TSB Group Holdings Plc	IE	22,773	Nationalised	2014-2017	-63%	F, D2
101	Banque Cantonale Vaudoise	CH	21,524	Public	2005-2016	91%	F, D2
102	AXA Bank Europe SA	BE	21,328	Commercial	2007-2015	45%	F, D2

103	Bank Ochrony Srodowiska SA	PL	19,677	Public	2007-2017	675%	F, D1
104	Etablissement Public à caractère Industriel et Commercial Bpifrance	FR	17,337	Public	2010-2017	-28%	D2, I
105	RBC Investor Services Bank SA	LU	15,755	Commercial	2010-2017	25%	W, I
106	Banque Degroof Petercam SA	BE	15,544	Commercial	2007-2016	70%	D1
107	Basler Kantonalbank	CH	15,544	Public	2005-2016	131%	F, D2, I
108	Nova Ljubljanska Banka d.d.	SI	14,409	Nationalised	2014-2017	-18%	F, D1, D2
109	Iccrea Holding SpA	IT	14,184	Cooperative	2005-2015	243%	F, D2, W
110	OTP Bank Nyrt.	HU	13,190	Commercial	2005-2017	-36%	F, D1
111	Sberbank Europe AG	AT	12,581	Commercial	2005-2017	185%	F
112	Bank of Valletta Plc	MT	11,821	Commercial	2007-2017	108%	D1
113	Veneto Banca SpA	IT	10,856	Cooperative	2006-2016	159%	F, D2, I
114	RCB Bank Ltd.	CY	9,154	Commercial	2011-2017	-14%	F
115	Bank BPH SA	PL	8,840	Commercial	2008-2015	-17%	D2
116	VTB Bank (Austria) AG	AT	7,511	Public	2010-2016	9%	D2
117	Hellenic Bank Public Company Ltd.	CY	6,847	Commercial	2005-2017	29%	F, D1
118	Cooperative Central Bank Ltd.	CY	4,507	Cooperative	2010-2015	217%	F, D1

119	Nova Kreditna banka Maribor d.d.	SI	4,259	Nationalised	2006-2015	13%	F, D1, D2
120	ABLV Bank, AS	LV	3,824	Commercial	2010-2017	98%	I, W
121	State Street Bank Luxembourg S.C.A.	LU	764	Commercial	2005-2017	-96%	W, I
122	Getin Noble Bank SA	PL	129	Commercial	2006-2011	9172%	F, W
123	BFA, Sociedad Tenedora de Acciones, SAU	ES	269,159	Nationalised	-17%	2010-13	D1, D2, I
124	Landesbank Hessen-Thüringen Girozentrale	DE	163,838	Savings	-8%	2005-17	D2
125	HSH Nordbank AG	DE	110,082	Savings	-8%	2005-16	D2
126	Landesbank Berlin Holding AG	DE	102,437	Savings	-29%	2005-13	I
127	Société de Financement Local SA	FR	88,002	Public	43%	2006-14	D2
128	Fundación Bancaria Ibercaja	ES	63,118	Savings	106%	2005-13	F, D1, D2
129	Kutxabank, SA	ES	59,413	Savings	213%	2006-14	F
130	Bank für Arbeit und Wirtschaft und Österreichische Postsparkasse AG	AT	34,651	Nationalised	-32%	2006-14	D1, D2

131	Raiffeisenlandesbank Niederösterreich-Wien AG	AT	29,514	Cooperative	105%	2005-14	D1, W, I

Note: The systemic banks included in this list are the banks directly supervised by the ECB, non-Euro area EBA stress tested and Swiss banks with more than € 30 billion (i.e. similar to the main criteria for direct supervision of banks inside the euro area). The business models to which the banks belong for different years are indicated in the column on the right-hand side. The business models are expressed with the first letter of the business models: Focussed retail (F), Diversified retail – Type 1 (D1), Diversified retail – Type 2 (D2), Wholesale (W), and Investment (I). When the bank is assigned to two or more business models this means that the bank has migrated from one business model to the other over time.

Source: Authors

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LIST OF ABBREVIATIONS

ABCP	Asset-backed commercial paper
AQR	Asset quality review
BBM	Bank business model
BCBS	Basel Committee on Banking Supervision
CCC	Cubic clustering criterion
CDS	Credit default swap
CET1	Common equity Tier-1
CIR	Cost-to-income ratio
D-SIBs	Domestic systemically important banks
EBA	European Banking Authority
ECB	European Central Bank
EEA	European Economic Area
EFTA	European Free Trade Association
EU	European Union
EUR	Euro
FSB	Financial Stability Board
GDP	Gross domestic product
GFC	Great Financial Crisis
G-SIBs	Global systemically important banks
IOFSC	International Observatory of Financial Services Cooperatives
IRB	Internal rating-based
LRE	Leverage Ratio Exposure
MREL	Minimum Requirement for own funds and Eligible Liabilities
No-SIB	Non- Systemically Important Banks
NPL	Non-Performing Loans
NSFR	Net stable funding ratio
PSI	Private sector involvement
RoA	Return on assets
RoE	Return on equity
RoRWA	Return on risk-weighted assets
RWA	Risk-weighted assets
SHV	Shareholder-value
SIBs	Systemically Important Banks

SRF	Single Resolution Fund
SRISK	Measure of Systemic risk contribution
SSB	Sum of square between
ST	Stress Test
STV	Stakeholder-value
SPRSQ	Semi partial R-squared
TCE	Tangible common equity
TCR	Total capital requirement
TLAC	Total-Loss Absorbing Capacity
USD	United States Dollar
XBRL	eXtensible Business reporting language

BBM BANK BUSINESS MODELS

The Banking Business Models (BBM) Monitor 2019 Europe is the European edition of the bank business models analysis, which is part of the Global Monitor of banks and credit unions business models. The Global Monitor covers Europe, United States of America and Canada. More countries will be added subject to data availability.

The BBM Monitor 2019 for Europe identifies the business models of 3,287 banks covering more than 95% of assets of the European Union plus EFTA countries from 2005 to 2017, which accounts for 25,402 bank-year observations. Using a unique definition and a careful selection of multi-dimensional attributes and the development of state-of-the-art clustering methodologies, the BBM Monitor provides a coherent approach to analyse banks and to monitor their behaviour over time. The Monitor covers issues such as interaction with ownership structures, size, internationalisation, migration, financial performance and operational efficiency, contribution to the real economy, risk, resilience, robustness and resolution.

The BBM Monitor is geared towards bank practitioners, policy makers, regulators, supervisors and academics who are interested in independent research, analysis and expert views on the banking sector in Europe.

The BBM Monitor and Results will be updated annually and potentially extended, subject to data availability. The business model identification results of the BBM Monitor 2019 for Europe are available for all the bank-year observations upon request.

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