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Abstract

In response to the post-crisis regulatory reforms, the European banking sector has undergone major changes that have led banks to reconsider their strategies, structures, and operations. Based on a sample of over 3,000 banks from 32 European countries during the period 2010-2017, we identify banks' business models based on cluster analysis and track their evolution. We then apply a binomial logistic regression and find that banks with higher risk and lower profitability are more likely to change their business model. Employing a propensity score matching approach, we investigate the effect of migration on bank performance and find that changing the business model affects banks positively, i.e. migrating banks increase their profitability, stability, and cost-efficiency. The effect of migration differs depending on the target business model. When switches are a consequence of being acquired or motivated by regulatory compliance, the positive effect remains.

Keywords: *banks; business models; banking strategy; propensity score matching;*

JEL codes: G21; G28; L21; L25

1. Introduction

Since the global financial crisis, the European banking sector has undergone fundamental changes that have led banks to reconsider their business models. To remain profitable in a landscape characterised by increased regulatory pressure and intensifying competition by non-bank financial intermediaries, banks have had to prioritise their activities as well as their funding sources. Boards' strategic choices will be reflected in changes in balance sheet composition and will ultimately influence bank performance and shareholders' value.

This paper investigates the impact of these strategic decisions on the European banking landscape by analysing the determinants of bank business model migrations and their effects on bank performance. The analysis of business models fosters the understanding of banks' activities, including their customers, distribution channels, and sources of profits, thereby overcoming the traditional approach to prudential supervision which is mainly focused on the adequacy of bank capital and the management of liquidity risk (Cavelaars and Passenier, 2012).

The literature on business models (BM hereafter) has a long tradition (see Zott and Amit, 2011, for a comprehensive survey). In general, a business model is a strategic choice that translates into balance sheet and income statement results. Studies on business models with specific reference to the banking industry are more recent. Except for the early work of Amel and Rhoades (1988), only in the last two decades have both regulators and academics focused their attention on the definition of banks' BM and their contribution to systemic risk (De Meo et al., 2018; Cernov and Urbano, 2018).

As currently there are no clear and common definitions of business models, this task is considered particularly challenging and welcome given that BMs: i) determine the types of risks banks are exposed to, and their interconnection with financial stability; ii) are useful tools to assess the impact of, and the strategic reaction to, new pieces of regulation across different

groups of banks; iii) can be used as a benchmarking tool for micro-supervision goals (Vaillant and Cernov, 2018).

There is a growing stream of the literature which focuses on the identification of bank business models, defined with respect to the activities that a bank undertakes (Ayadi et al., 2011; Ayadi and de Groen, 2014; Roengipitya et al., 2014; Farnè and Vouldis, 2017; Flori et al., 2019). In addition to the definition of bank business models, it is crucial to understand how these evolve, as changes in business strategies may generate changes in market structure, possibly resulting in a less diversified industry with a higher concentration of risk. Some contributions speculate on the possible drivers that may push banks to revise their business strategy. Gambacorta et al. (2017) underline that banks might have changed their strategic focus in response to the financial crisis and the re-regulation that ensued, as it forced banks to revise the composition of their funding mix. Ayadi et al. (2016) identify the most important reasons leading banks to change their business models: a) to respond to market forces and competitive pressures; b) to respond to other strategic drivers, such as reducing costs, improving efficiency and curbing excessive risk-taking activities; c) to respond to regulatory and government led-decisions. The first two can be considered strategic (or endogenously-driven) reasons aiming at improving performance; the latter the consequence of institutional changes (i.e. exogenously-driven decision) that force banks to adapt to new and uncertain environments. While it might be difficult to distinguish between truly exogenous and endogenous drivers of the decision to migrate from one business model to another, we attempt to disentangle the impact of strategic choices (for example corporate restructuring and mergers and acquisitions (M&A) operations) from business model changes driven by exogenous circumstances (be they regulatory or environmental).

Our study contributes to the literature by first identifying European bank business models and map their evolution. We then focus on the analysis of the decision to migrate from

one business model to another; finally, we assess the outcomes of these changes. More specifically, our study addresses the following research questions: *i*) what are the determinants of a bank's decision to change the business model?; *ii*) what are the effects of such a decision on the bank performance (i.e. profitability, risk and cost efficiency) in subsequent years? (iii) are the outcomes of strategic migrations different from those of migrations driven by exogenous circumstances?

To answer these questions, we collect balance sheet data for a large sample banks from 32 European Economic Area (EEA) countries and Switzerland during the period 2010-2017. The starting point of our empirical analysis is the identification of bank business models, using cluster analysis (Ayadi et al., 2016). We then track each bank over its lifetime in the sample to assess whether it changes the business model. We find that, in general, banks' business models are stable. Interestingly, we do not reveal a specific pattern of migrations, as switches cannot be attributed to bank size, ownership structure or geographical dimension.

The next step in our empirical analysis involves the analysis of the drivers of business model migrations. We apply binomial logistic regressions to the entire sample and find that smaller, less profitable banks are more likely to change the business model, perhaps in search for profitability. Riskier banks are also more likely to switch, possibly to diversify and reduce risk. Finally, we find that ownership structure matters, with cooperative banks less likely to switch compared to other ownership types.

The main aim of our analysis involves evaluating the performance effect of migrations. However, comparing migrating and non-migrating banks might yield biased estimates, as the performance of these two groups might have been systematically different before the decision to migrate. To overcome this issue, we use a propensity score matching (PSM) approach and use it to evaluate the effect of switching business models on bank performance, with the switch

considered as the treatment, the switchers as the treated sample and the non-switcher the untreated sample.

Our results on the effects of migrations suggest an improvement in bank performance (i.e. higher profitability and lower cost efficiency) in the years following the migration. Finally, we attempt to disentangle the performance effect of strategic migrations (via M&As) from those migrations that are exogenously driven. We find that banks that change BM following an acquisition increase cost efficiency and profitability. When the BM switch is exogenously-driven, as in the case of banks receiving state aid, migrations reduce insolvency risk thereby providing evidence supporting the interventions in the EU banking sector during the crisis period. Our results are robust to different model specifications, different time windows, and different matching procedures.

The contributions of our paper are manifold. First, we present a detailed analysis of the business models of a large and representative sample of European banks during an extended period, which includes the years during and after the sovereign debt crisis. This allows us to develop an understanding of the changing banking sector landscape post-crisis. Second, we evaluate all business model migrations over the sample period and present a detailed analysis of migrating banks' characteristics. Third, departing from the previous literature that focused on the definition of business models and the analysis of the relationship between business models and some accounting measures, such as performance or risk, we focus on the determinants of migration. This is a novel contribution that improves our understanding of the drivers of banks' strategic choices. Finally, we investigate the effects of migrations on bank performance. This allows us to provide policy recommendations regarding the impact of the changing regulatory and institutional landscape on banks' business model decisions, and the effect of these strategic changes on banks' profitability, efficiency, and risk profile.

The remainder of the paper is organised as follows: Section 2 reviews the literature; Section 3 describes our dataset and the results of the univariate analysis; Section 4 presents the results of our empirical analysis. Sections 5 and 6 report additional analyses and robustness tests. Section 7 concludes.

2. Literature review

The academic literature on bank business models has grown substantially in recent years, as the exogenous shocks of the financial and economic crises, and the related re-regulation process that questioned the pre-crisis models of doing business, drove banks to reassess their choices and strategies.

Two main issues have been investigated so far: the definition and identification of specific business models in the banking industry and the link between types of business models and bank characteristics. An emerging stream of literature tries to identify patterns across the changes in BM and to measure the effects of the transition from one model to another.

Bank business models' identification

The literature on bank business models' identification builds upon the stream of the management literature that rests on the idea that business models are defined with respect to the activities that a firm (bank) undertakes (Parmigiani and Mitchell, 2009; Vidal and Mitchell, 2013; Zott and Amit, 2007, 2011; Zott et al, 2011). Accordingly, studies that follow this general approach have tried to offer an acceptable classification of bank business models using balance sheet data (Ayadi et al., 2011; Ayadi and de Groen, 2014; Roengipitya et al., 2014; Hryckiewicz and Kozlowski, 2017; Flori et al., 2019). As balance sheet composition can be linked more directly and stably to banks' strategic choices compared to income composition, income statement variables are not used to define business models. Instead, as financial and economic

results depend upon the strategy adopted, they are mainly used *ex-post* to gauge the existence of differential performance among different business models.

Although the allocation of banks to business clusters is mainly data-driven, it incorporates judgment elements, since researchers a priori select the balance sheet dimensions over which to perform hierarchical clustering. The two more recent studies by Farnè and Vouldis (2017) and Roengipitya et al. (2017) try to minimise subjective views and expert judgment in the choice of clustering variables. Taking a completely different approach, a recent study by Cernov and Urbano (2018) proposes a mixed methodology to business models classification, combining both qualitative and quantitative components. Although leveraging on different methodologies, all studies tend to identify four/five different clusters that distinguish between retail-oriented and market-oriented business models. On the one hand banks that remain closer to the traditional intermediation role, relying more on retail funding and customer loans; on the other hand, banks that engage in less stable funding and trading activities, such as wholesale and investment banks.

The relationship between business models and bank characteristics

A further strand of literature investigates the relationship between bank business models and bank characteristics, such as size, capitalisation, risk, performance, operating efficiency, and ownership (Altunbas et al., 2011; Ayadi et al., 2014; Köhler, 2015; Mergaerts and Vander Vennet, 2016; Hryckiewicz and Kozlowski, 2017; De Meo et al., 2018) or market features, such as changes in yield curve factors, in a zero-interest rate environment or the major global distress events starting from the global financial crisis (Lucas et al., 2019; Flori et al., 2019).

The main findings of this literature suggest that market-oriented business models (investment and wholesale banks) delivered higher financial performance before the financial crisis, although at the expense of a greater accumulation of risk, while retail-oriented banks

contributed to the real economy significantly more than other BMs. Retail banks also appeared to perform better in the long run (during and after the financial and economic crises) as they exhibited higher profitability in terms of ROA, ROE and net interest margins in addition to lower vulnerability to distress (Mergaerts and Vander Vennet, 2016).

The evolution of bank business models

In most studies, business models are considered static and are identified once over the sample period. Given the profound structural changes in banking markets post-crisis, this assumption might be limiting. To the best of our knowledge, only the recent study by Roengpitya et al. (2017) considers how business models have evolved and to what extent the transition impacts on relative performance, measured by ROE, around the time of the switch. Somewhat surprisingly, they find no evidence that underperformers are inclined to switch.

Given the impact of the global financial crisis, the European sovereign debt crisis, and ensuing regulatory reforms, have had on the banking industry, our analysis also focuses on potential differences in outcomes between strategic/endogenously-driven (for example, M&A operations) and exogenously-driven (for example, fostered by regulation or state interventions) changes of business models. We argue that the positive impact of business model change reinforces the strategic M&A decisions and improves the outcome of state interventions. On the other hand, banks that are involved in M&A operations and undertake additional strategic changes via business model migration might be faced with higher costs and lower profitability. Similarly, troubled banks receiving state aid might waste time and limited financial resources pursuing business model changes, resulting in a negative impact on performance.

3. Data and univariate analysis

3.1 Data

Our initial sample is composed of 3,287 banks from 32 European Economic Area (EEA) countries and Switzerland during the period 2010-2017.[1] More specifically, we include 2,672 Eurozone banks, 372 EU (non-Eurozone) banks and 258 banks from the four European Free Trade Association (EFTA) countries (Switzerland, Iceland, Norway, and Liechtenstein).[2] The sample covers more than 95% of the total banking assets in the European Economic Area (EEA). The sample includes 23,883 bank-year observations, covering the period of the European sovereign debt crisis (2010-2013), along with the recovery period (2014-2017). In terms of specialisation, our sample includes 815 commercial banks, 692 savings banks, 1,702 cooperative banks, 78 public banks and 32 banks that were nationalised during the crisis period.

Data are collected from several data sources: bank-specific variables from SNL (S&P Global Market Intelligence); macroeconomic variables from the World Bank; state aid information from the European Central Bank and the European Commission databases; and corporate operations data (M&A) are collected from the Zephyr database (Bureau Van Dijk).

3.2 Identification of business models

Our starting point is the identification of bank business models, by means of cluster analysis. We build upon the work of Ayadi and de Groen (2014) and adopt the Ward's method, which is a criterion applied in hierarchical cluster analysis with the aim of grouping together entities with similar characteristics. Assuming that banks choose their business model, the instrumental variables adopted to define the BMs are based on the balance sheet variables over which we posit that banks have full control and can manage. Specifically, five instruments were used to form the clusters: loans to banks, customer loans, trading assets, debt liabilities,

[1] The distribution of banks by country and year is reported in the Appendix (Table A).
[2] The Eurozone is an economic and monetary union of 19 of the 28 European Union member states (as of 2019). The original 11 eurozone countries are: Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain. Since then other countries also joined: Greece (2001); Cyprus (2008); Estonia (2011); Latvia (2014); Lithuania (2015); Malta (2008); Slovakia (2009) and Slovenia (2017). We consider non-Eurozone banks from EU member states which have not adopted the euro as their national currency.

derivative exposures, all considered as a percentage of total assets. More specific information about the methodology and the variables are included in Appendix 1.

Our cluster analysis results confirm the existence of five business models in the European banking industry, as identified by Ayadi et al. (2016):

i) focused retail, i.e., banks that use customer deposits as the primary means for funding loans and maintain relatively high levels of loss-absorbing capital; these institutions follow the traditional financial intermediation model;

ii) diversified retail, i.e. banks that are still retail-oriented, and yet more diversified than focused retail banks, either on the asset side (type 1) or the liability side (type 2). More specifically, type 1 BM groups retail-oriented banks, whose asset side, along with loans, also present more trading assets than focused retail banks; type 2 BM includes banks that have significantly more trading assets than focused retail banks, also are more reliant on debt and short term market funding.

iii) wholesale, which groups together banks that are heavily wholesale oriented and largely active in the interbank markets;

iv) investment, banks that have substantial trading activities; this includes large universal banks with a significant investment banking division as well as pure investment banks.

Figure 1 shows the differences, in terms of assets and liabilities, for the five business models identified. The items with the asterisk are those used in the cluster analysis to define five business models.

[Figure 1 approximatly here]

Figure 2 shows the percentage of banks in each business model (by the number of banks and by total assets) over the sample period.

[Figure 2 approximatly here]

3.3 Identifying business model migrations

Given that we are interested in business model changes, we track each bank over its lifetime in the sample to assess whether it switches BM. To make sure we do not identify anomalous migrations (i.e. driven by one-off extraordinary balance sheet operations), we consider a bank as having changed the business model only if the bank does not return to the previous BM in the following year.[3] More specifically, we are interested in '*stable migrations*', that is when: a) the bank maintains the same business model for at least two years after migration; or b) the yearly change in BM refers to a continuous evolution of business models.

Table 1 shows the results of our initial analysis of the distribution of migrating banks, considering the timing of the migration. From a total of 23,883 observations in the period under investigation (2010–2017), we identify 2,058 migrations, corresponding to about 8.6% of the sample. This means that, in general, bank business models are stable. From a total of 3,287 banks, 1,472 banks changed their BM at least once. On average, migrating banks switch 1.4 times during the period under investigation, thus implying that some banks move more than once. To account for the possible crisis-induced changes in business models, we divide the sample period into two sub-periods: the sovereign debt crisis (2010–2013), and recovery (2014–2017). Looking at the migrations that occurred during these two periods, we observe that, both in terms of the number of banks and of asset size, more migrations took place in the post-crisis period, providing supporting evidence of the deep restructuring of the industry experienced in recent years.

[3]As the cluster analysis is carried out on year-end annual balance sheet data, we want to avoid treating as migration those temporary (1 year) switches that might simply depend on the yearly change of the distance between clusters. As a consequence, we do not consider a migration if the bank reverts to the previous BM within one year.

[Table 1 approximately here]

Next, we analyse migrations by bank size, by ownership and distinguishing between Eurozone and non-Eurozone countries. Concerning bank size, following the European Central Bank, we identify three groups using a threshold based on the total assets of the banking sector according to data collected in the preceding year. Large banks are banks with total assets greater than 0.5% of the overall sector; medium banks are banks with total assets between 0.5% and 0.005% and finally, small banks are banks with total assets less than 0.005% of the total. Table 2 shows that the migrations are distributed in a similar way across medium and small banks, while a lower percentage of migrations is detectable in the group of large banks.

Regarding the banks' ownership structure, we see that migrations are evenly distributed; nonetheless, a higher percentage of migrations is present among nationalised and commercial banks – 12.96% and 11.09%, respectively.

Finally, we investigate the distribution of migrations by the country of origin of the parent bank. First, we distinguish between Euro- and non-Eurozone banks: the last row of Table 2 shows a similar distribution of migrating banks in the two geographic areas (8-9% of the total). Next, we distinguish between Mediterranean countries, Eastern European countries, and Continental/Nordic European countries. We find that migrations are more frequent in the first two groups, a fact that could be ascribed to their greater exposure to extreme institutional environments, such as the sovereign debt crisis and the aggressive reduction in lending by foreign-owned banks in Eastern European countries in response to the difficulties faced by parent banks in their home countries after the financial crisis (Iwanicz-Drozdowska et al., 2018).

The analysis of migrations indicates that, by and large, business models are stable over time; however, transitions do occur. Interestingly, we were unable to uncover a specific pattern as switches cannot be traced back to bank size, ownership structure or geographical dimension.

[Table 2 approximately here]

In the next step, we link the migrations to the different types of business models identified for our sample of banks. Figure 3 illustrates the transition matrix (in terms of the number of banks) for the five models, during the sample period. Banks allocated to the focused retail model show the highest persistence in their chosen business model: 90% of these banks remain within the same business model throughout the entire period. Similarly, the majority of diversified retail (type 1) banks maintains the same business model (87.7%), whereas the percentage is slightly lower for the other three business models: less than 80% in the case of diversified retail (type 2) and investment banks; even lower (80%) for wholesale banks. Considering both inflows and outflows from one business model to another, focused retail banks are net acquires (+13.27%) along with diversified retail (type 1) (+25.64%). By contrast, all other models lose more banks than they acquire. Our results show a general tendency to move towards more retail-oriented business models (i.e. focused retail and diversified type 1).

However, when we consider migrations in terms of total assets (Table 3), diversified retail (type 2) and investment banks show the highest persistence within the same cluster (92.27% and 92.53%, respectively).

[Figure 3 approximately here]

Table 3, Panel A reports transitions across models over the sample period: we highlight which BMs are stable and which BMs are the most attractive (net acquirers). Banks that moved

to the focused retail business model represent less than 10% of total bank assets. The highest percentage of assets migrated to the diversified retail (type 1) BM, suggesting that banks refocused their activity towards the retail business, yet without losing the diversification of their funding sources. Table 3, Panel B and Panel C, report the transition matrix focusing on the two sub-periods considered, i.e. sovereign debt crisis period (2010- 2013) and the recovery (2014- 2017). During the crisis period we observe that banks tended to switch to the diversified retail (type 1) and investment business models, while during the recovery period, larger banks moved to the diversified retail (type 1 and type 2) BM.

In Table 4 we show a cross-sectional analysis of the full sample comparing the characteristics of banks that migrate with those that do not. These characteristics pertain to balance-sheet structure, income statement ratios, and ownership structure. We also test the hypothesis that migrating and non-migrating banks are independent samples from a population with the same distribution (t-test). Our findings emphasise that, on average, migrating banks have lower profitability and lower cost-efficiency. These banks also display a lower credit portfolio quality, a higher loan loss provision ratio than non-migrating banks, even if the difference in means is not significant. Referring to the balance-sheet structure, migrating banks are smaller, better capitalised, have a higher risk appetite and lower financial stability. Moreover, our findings suggest that migrating banks have in their balance sheet less loans to customers and more trading activities. Concerning their funding strategy, migrating banks show a lower weight of customer deposits over total assets, suggesting a more diversified funding structure. Finally, commercial banks are more likely to change their business model.

[Table 4 approximately here]

4. Empirical analysis

4.1 The determinants of business model migration

To answer our first question, that is what are the determinants of a bank's decision to change the business model, we apply a binomial logistic regression to the entire sample model to assess the determinants of migrations:

$$P\ (w_{it} = 1) \approx P\ (\alpha_0 + \sum_{k=1}^{K} \alpha_k X_{kit-1} + S_{ki} + Y_{kt} + \varepsilon_{it} > 0), \quad (1)$$

where α_0 is a constant, K denotes the number of explanatory variables $X_{k,it-1}$ in the selection equation, S_i are country dummies, Y_t are year dummies, and ε_{it} is an identically and independently distributed error term. On the left-hand side, the dependent variable w_{it} is set to 1 in the year t in which bank *i* migrates, measuring the probability of switching, and 0 otherwise. Variable descriptions are reported in Appendix 3.

We consider three sets of bank-specific variables. The first set reflects the size, risk profile, efficiency, stability and profitability of our sample banks plus their ownership structure. Size is proxied by the natural logarithm of total assets; the risk profile is captured by leverage (the ratio of equity over total assets, E_TA) and by a measure of risk appetite, i.e., the ratio of risk-weighted assets (RWA) over total assets. To define operating efficiency and profitability we use, respectively, the cost to income ratio (C_I) and the return on average assets (ROA). Bank stability is proxied by Z-score, measured as the sum of total equity over total assets and the average return on total assets over the standard deviation of total assets (Z-SCORE).

We also add a proxy for investments in financial technologies, measured by the ratio of intangible assets over total assets (INTANGIBLE_TA), to control for the possibility that the change in business model is driven by the strategic choice of positively increasing investment in new technology to embrace the fintech revolution and the related changes in demand for banking services. Finally, we add three different dummies to control for the ownership form of our sample banks: a dummy COMMERCIAL, equal to 1 if the bank is a commercial bank and

0 otherwise; a dummy COOPERATIVE, equal to 1 if the bank is a cooperative and 0 otherwise; and a dummy SAVINGS, equal to 1 if the bank is a savings and loan institution and 0 otherwise.[4]

Next, to check whether there are different probability of migrations according to the specific business model initially adopted, we include the business models adopted by the banks in the period before the year observed (t-1). Therefore, we include four dummy variables: i) FOCUSED_BM equals 1 if the bank adopted the focused retail business model in the year before the migration and 0 otherwise; ii) TYPE1_BM equals 1 if the bank was a diversified retail (type 1) banks in the year before the migration and 0 otherwise; iii) TYPE2_BM equals 1 if the bank is a diversified retail (type 2) bank in the year before the migration and 0 otherwise; iv) WHOLESALE_BM equals 1 if the bank adopted the wholesale business model in the year before the migration and 0 otherwise. All bank-specific variables are lagged one period at time t-1. Finally, we also include time fixed effect and country fixed effect to control for other institutional differences among countries and years not captured by other variables.[5]

The results of the logistic regressions are reported in Table 5. The second column reports the estimates of Model 1, that includes financial statement and ownership information, the third column shows the results of Model 2, which also controls for the business models adopted by banks in the year before the migration.

We find that the smaller the bank size, the lower its profitability and the higher its risk appetite, the higher its probability of migration. Taken together, these results seem to suggest that those banks with a higher propensity for risky activities are more likely to change their business model, possibly in search of profitability.

[4] When the four variables are 0 in all cases, the bank is a public or a nationalized bank.
[5] We do not control for differences in the regulatory framework. Since we focus on European countries, we assume a level of harmonisation of the regulatory framework. Country-specific regulations that may affect banks' decision to change business models (or discourage banks from switching) should be controlled for by country fixed effects.

With regard to the ownership structure, our findings underscore a negative and significant relationship between migration and cooperative banks. Cooperative banks are less likely to change their business models during the period under investigation than banks under other ownership forms. As cooperative banks are typically not profit maximisers, they are less likely to respond quickly to changes in the competitive environment and might need more time to implement changes. Looking at the business model adopted before the migration, our findings suggest that more retail-oriented banks – those that adopt the focused retail and diversified retail (type 1) business models – are less likely to change their business model than investment banks – (in our analysis is the reference category), conversely, diversified retail (type 2) banks show a higher propensity to change their business model than investment banks.

In sum, in the last decade, migrations among the different bank business models have been mainly determined by bank-specific variables, such as profitability and riskiness, but also by the ownership structure and the initial business model. The next step of our analysis is to check whether these changes have been beneficial to migrating banks, to support the bank's strategy.

[Table 5. approximately here]

4.2. The effects of business model migration on bank performance

To answer our second research question, we need to determine the effects of migration on bank performance. This evaluation gives rise to several methodological issues, particularly self-selection concerns with regard to the endogeneity of the strategic decision itself, i.e., the migration.[6] First, the comparison of migrating banks to non-migrating banks might yield biased

[6] These methodological issues are present in any study aimed at estimating the effect of a specific strategic decision on bank performance. Casu et al. (2013) and Barba Navaretti and Castellani (2008) discuss similar issues.

estimates of the migration effects because the performance of non-migrating banks may differ systematically from the performance of migrating banks, even in the absence of migration. Therefore, if migrating banks are found to perform better, on average, than non-migrating banks, we may not be able to disentangle whether this difference could be ascribed to the change of business model or differences in the banks' characteristics prior the migration. Second, considering only migrating banks eliminates the possibility of benchmarking the hypothetical performance that the bank would have had, had it not changed its business model.

To ensure that the comparison between migrating and non-migrating banks does not suffer from the endogeneity issues, we employ a propensity score matching approach (PSM). Matching is a popular non-parametric approach; it is largely adopted in policy impact analysis (Essama-Nssah, 2006) and has been recently adopted in the finance literature to gauge the impact of diverse strategic choices (Villalonga, 2004; Casu et al., 2013; Palvia et al., 2015).

The implementation of propensity score matching, can be broken down into three different phases: i) estimating the propensity score; ii) matching migrating banks with non-migrating banks, and iii) estimating the effect of migration on the bank's performance. The propensity score is estimated starting with the full model presented in Table 5 (Model 2). This was made possible because we included in the first step of the analysis all variables that do not depend on the treatment, i.e., the migration (Caliendo and Kopeinig, 2008).

Once the propensity scores are estimated, we proceed to match migrating banks with banks that never migrated during the period under investigation. The restriction allows to check that migrating banks are not matched with banks that have migrated in the previous years. We employ nearest neighbour matching with replacement and we impose a caliper of 1% to minimise the risk of bad matches and increase the matching quality (Caliendo and Kopeinig, 2008).

To verify the matching quality, we plot the distribution of the two samples: the pre-matching sample and the post-matching sample. Figure 4A, Panel A (in Appendix 4) shows the percentage bias for each explanatory variable both in the unmatched and matched samples, while Figure 4A, Panel B (in Appendix 4) depicts the distribution of the propensity scores for the migrating and non-migrating banks, revealing that post-matching these two groups of banks greatly overlap. As a robustness check, we also plot the distribution of the propensity score before and after the matching procedure, observing that in the unmatched sample, the propensity score distribution of non-migrating (untreated) banks is skewed to the left, whereas in the matched sample it is very close to that of the migrating (treated) banks (Figure 4B in Appendix 4), giving us confidence in the matching procedure. Finally, to check whether the two samples are balanced, we compare the differences in the means of the covariates of migrating and non-migrating banks, before and after the matching. The results of the test are reported in Table 6 and demonstrate that before the matching there were significant differences, whereas after the matching the significance of the differences drastically decreases in all covariates and becomes not statistically significant. Thus, we observe that the covariates are balanced in both groups, suggesting successful matching.

[Table 6 approximately here]

We now use the matched samples to estimate the effects of migration on a set of bank performance measures: profitability, proxied by ROA; bank soundness, proxied by its distance to default (Z-score)[7]; cost efficiency (measured by the cost to income ratio); and finally, risk appetite (measured by RWA density).

[7] The Z-score (defined as the number of standard deviations by which bank returns have to fall to exhaust bank equity) is considered a proxy for bank soundness (see, among others, Laeven and Levine, 2009; Anginer et al, 2014).

To detect the treatment effect on different years, for each outcome we consider three different time-windows: i) the year of treatment; ii) the year after migration; and iii) the longer-term, with a two-year window around the time of migration.

Table 7 reports the results of different windows and outcomes. Our findings suggest that the migration has a negative (but not significant) effect on bank profitability only in the year of migration, when we expect the higher incidence of the costs of migration to materialise, whereas in the subsequent years [t; t+1] and [t+1; t+2], migrating banks perform better than non-migrating banks. Looking at the coefficients of the Z-score, we observe a positive and significant relationship between Z-score and migration in the first and second years after migration. Finally, after an increase in the year of migration, we find a negative relationship between the cost-to-income ratio and the migration, indicating that migrating banks improve their cost-efficiency after the migration more than non-migrating banks.

To summarise, our results indicate an improvement in bank performance following migration (i.e. higher profitability, higher cost efficiency and higher stability) that is enjoyed in the years following the migration. This supports our hypothesis that banks that change their business model improve their performance post-migration more than non-switching banks.

[Table 7. approximately here]

5. Strategic and exogenously-driven migrations

To answer to our third research question, we now differentiate between strategic (endogenously-driven) migrations from those of migrations driven by exogenous circumstances. We expect that different reasons behind the decision to migration might have a diverse impact on performance outcomes. Therefore, we concentrate on three different sub-samples: *i*) banks that are involved in M&A operations; *ii*) banks that are involved in M&A

operations as target banks; *iii*) banks that received a state aid during the financial crisis. Several studies analyse the effects of M&A operations on bank performance (Focarelli et al. 2002; Cornett et al., 2003; Zollo and Sigh, 2004), on cost-efficiency (Berger and Humhrey, 1992; Pilloff and Santomero, 1998; Asimakopoulos and Athanasoglou, 2013), and on bank lending to small business borrowers (Berger et al. 1998; Sapienza, 2002). We add to this literature by identifying the effect of bank business model migrations resulting from M&A operations. To this end, we compare: a) migrating banks and non-migrating banks that have been involved in M&A operations; b) migrating banks and non-migrating banks that have been acquired in M&As operations.

In the first set of estimations, we identify a sub-sample of banks that were involved in M&A operations and compare those that change the business model as a consequence with those that do not. In the second set of estimations, we identify a sub-sample of banks that were acquired and compare those that change the business model as a consequence of the acquisition with those that do not. In this way, we are able to isolate the effects of migrations from the effects of M&As on bank performance. We isolate the impact on target banks: these are often smaller institutions acquired by larger groups and therefore more likely to undergo substantial corporate restructuring initiated by the bidder banks post-M&A. This can be seen as an exogenously driven migration and not as the consequence of an internal, managerial decision.

Table 8, Panel A reports the estimates of the effects of migrations controlling for the effects of M&As. We find no differences between migrating and non-migrating banks post-M&A in terms of stability and risk appetite. However, we observe a difference in cost-efficiency and profitability. After an initial deterioration of cost-efficiency in the year of migration, in the subsequent years, the cost-to-income ratio improves, with also beneficial effects on profitability (ROA). It seems that banks involved in an M&A operation and simultaneously changing their business model improve their cost efficiency and profitability

more than those banks that only face one extraordinary operation (M&A). Vander Vennet and Gropp (2003) and Al-Sharkas et al. (2008) provide evidence that mergers and acquisitions have a positive effect on bank cost efficiency. We add to these findings by showing that the positive effect on cost efficiency post-merger is driven by changes in the business model.

Table 8, Panel B reports the estimates of the effects of migrations for only target banks. Focusing on the sub-sample of acquired banks, our results suggest that, besides the positive effect on cost efficiency and profitability, acquired banks that change BM improve their stability more than acquired banks that do not (the coefficient of Z-score is positive and significant in all the time windows). These results are in line with Piloff (1996) and Hannan and Pilloff (2009), who underline that cost-efficient banks tend to acquire their more inefficient counterparties, suggesting the existence of potential post-merger performance gains. Taken together, our evidence suggests that different drivers of BM changes are associated with different outcomes post-migration.

Table 8, Panel C reports the estimates of the effects of migrations for banks that received state aid. During the Eurozone crisis, a restructuring of the bank business model was often a pre-requisite to accessing government funding. Therefore, we consider it another example of exogenously-driven BM switches, i.e. crisis-related changes in business models.

Looking at the results in Panel C, we find that, in the year of migration and subsequent years, troubled banks that also changed BM experience a positive increase in their Z-score. These results are in line with the aims of governments which, during the financial crisis, supported their problem banks in exchange for a significant restructuring of the banks' activities deemed necessary to foster financial stability.

In sum, even those changes in BMs that were exogenously imposed are beneficial to the switching bank; however, the effects are more concentrated on stability issues whereas improvements in cost-efficiency or profitability are evident for strategic BM changes.

[Table 8 approximately here]

6. Additional analysis and robustness checks

6.1 Migration effects and specific business models

The performance effect of migrations may differ depending on the business model toward which the bank moves. To test the implication of switches to specific BMs, we re-run our analysis considering only migrating banks and identify differences in relative performance.

[Table 9 approximately here]

Table 9 shows that migration outcomes differ according to the specific business model in which banks move. Banks that move to the focused retail BM improve their cost efficiency at the expense of profitability more than other migrating banks. Migrating banks in both diversified retail (type 1) and investment BM increase their stability more than other migrating banks; banks that move to diversified retail (type 2) increase profitability more than others and finally, banks that migrate to wholesale BM reduce their risk profile more than other migrating banks. In sum, business model migrations positively affect bank performance and, on average, migrating banks perform better than non-migrating banks. However, we show that the potential benefits depend on the choice of the new business model, as some switches improve performance (in terms of profitability, stability, cost-efficiency, and risk) more than others. This emphasises that not all migrations are equal and deliver the same results. The choice of business model in which to move can depend on (or is closely connected with) the final goal of this change (being either increasing profitability, improving efficiency or decreasing risk).

The sample size of migrating banks does not allow us to investigate the effects of migration considering both the starting business model and the business model after migration.

To overcome this problem, we categorize BMs in two main clusters: *i*) diversified, including the diversified retail (type 1) and the diversified retail (type 2); *ii*) specialised, comprising those business models that are oriented towards a more specialized activity (i.e., focused retail, investment, and wholesale business models). Similarly, we categorize BM switching into: (1) banks that become more diversified vs. (2) banks that become more focused. In this way, we can analyse the effects of migrations from a more diversified business model towards a more specialised one and vice versa. Results are reported in Table 10 and, not surprisingly, indicate that migrating banks that move to a more specialised business model reduce their costs more than banks that move in more diversified business models.

[Table 10 approximately here]

6.2 Subsamples without small banks or cooperative banks

We re-run our analysis excluding small cooperatives banks that the cluster analysis included in the investment bank business model. Recall that according to the BM definition we adopt, investment banks are those that have the greatest share of trading assets in their balance sheet. With this definition, some cooperative banks happened to be clusterised as investment banks although one could consider quite unusual that the strategy of non-profit-maximisers, as cooperative banks are, could be described by a business model expected to take on (market) risks in exchange for higher returns. It is important to note that this happens to a small portion of our sample of cooperatives: on a total of 1,699 cooperative banks, only 100 small institutions are defined as investment banks (for at least one year observed). To ensure that our results are not driven by this anomaly, we re-run the analysis excluding from our sample those cooperative banks that are small and that in our analysis are clusterised as investment banks in at least one

year of our sample period. The findings of this analysis are reported in tables 11 and 12 and are in line with those obtained in the main analysis.

[Table 11 approximately here]

[Table 12 approximately here]

These robustness tests confirm that our main findings are robust and are consistent both in term of methodology and in term of sample compositions.

6.3 Robustness checks

We carry out three robustness tests to challenge specific features of the adopted methodology, i.e. the definition of time windows; the identification of matches, and the assumption that all observable variables capture the entire pre-migration variation between migrating and non-migrating banks.

Alternative time windows

We consider the following alternative time windows to evaluate the effects of the migration on bank performance: *i*) three years after migration; *ii*) two years after migration; and *iii*) the year before and the year after migration. The results are reported in Table 13 and confirm the previous main findings.

[Table 13 approximately here]

Nearest neighbour match

As a second robustness check, we run the propensity score matching estimator using a different nearest neighbour match, as suggested by Abadie and Imbens (2002). We use the

nearest neighbour with three matches and the results are reported in Table 14. Our findings confirm those obtained in the main analysis. In general, migrating banks are more profitable and stable than non-migrating banks starting in the years following the migration.

[Table 14. approximately here]

Sensitivity test

One of the limitations of the propensity score matching methodology is that it is not robust when unobserved factors can potentially drive migration decisions. When some important variables (confounders) are excluded from the PSM model, hidden bias may affect the estimated treatment effect (DiPrete and Gangl, 2004). We run the Rosenbaum (2002) bounding approach as sensitivity test to measure how strong the unobserved covariate must be to be able to influence the decision to migrate (treated group). Table 15 reports the results of the sensitivity test and suggests that our findings are robust to hidden bias.

[Table 15 approximately here]

7. Discussion and Conclusions

This study evaluates the effects of business model migrations in the European banking industry during a period characterised by profound economic, technological and regulatory changes. In the aftermath of the global financial crisis, regulatory changes and the increased pace of innovation forced banks to reconsider their strategies to improve performance. These trends were compounded by the sovereign debt crisis, which left many banks in several EU counties in need of government bailouts. Against this background, we collected data for a large sample of banks of different sizes and ownership structures during the period 2010-2017. Our

analysis offers important insights and contributes to the current debate on structural reform of the EU banking sector. Based on a unique definition of business models and a robust clustering method, we identify the five business models EU banks operate with and track their evolution over the sample period. We find that business models are generally stable, but an important part of the sector changed strategic orientation during the sample period. We then extended the analysis to the determinants of business model migrations. Our results show that larger, less profitable and riskier banks are more likely to change the business model.

Is this migration useful, in terms of the supervisory ultimate goals of a more profitable and more stable banking system? We answer this question employing a propensity score matching approach, that allows us to evaluate the effects of migration on bank performance. Our findings suggest that in the years after migration, banks' performance improves - in terms of profitability, stability and cost efficiency - compared to non-migrating banks. Thus the answer to the question is positive: migrating banks enjoy lower costs that help improve their ROA in the long run and higher stability (Z-Score). The improvement in performance seems to be driven by cost reduction (i.e., an improvement in cost to income ratios). Our findings also indicate that the effect of migration differs depending on the business model to which the bank move. We show that switches to some business models improve performance more than others, suggesting that banks may choose a specific business model in which to migrate based on their short term objectives as well as their long term plans.

We also conjectured that migrations strategically adopted by bank management or exogenously imposed on bank management could lead to different results (vis-à-vis non-switchers). For this reason, we further investigated the ex-post outcomes of migrations following an M&A operation or a state aid, as examples of strategically and exogenously-driven migrations. We find that the performance effect of strategic decisions is in the form of improvements in profitability and cost-efficiency, while "imposed" switches improve stability.

We provide further evidence to the empirical literature on M&As by showing that the acknowledged post-merger positive effect on cost-efficiency is driven by changes in the business model, as only switchers experience an improvement in profitability and cost-efficiency. Our results also provide support to government decisions to grant public aid in exchange for a thorough corporate restructuring: banks that changed their business model post bailouts improved their stability more compared to those which did not change.

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List of Tables

Table 1 Distribution of Migrating and Non-migrating banks

	Number of banks		Total Assets	
	Non-migrating banks	**Migrating banks**	**Non-migrating banks**	**Migrating banks**
Crisis	93.49%	6.51%	96.21%	3.79%
Recovery	89.09%	10.91%	94.98%	5.02%
Total	91.38%	8.62%	95.57%	4.43%

Note: Table 1 shows the distribution of migrating and non-migrating banks in three different subperiods: crisis (2010-2013) and recovery (2014-2017) both in terms of number and in terms of total assets.

Table 2 Distribution of migrating and non-migrating banks by size, ownership structure and geographical area

	Non-migrating banks		Migrating banks	
	Number	*Percentage*	*Number*	*Percentage*
Panel A: Bank size				
Large	310	96.27%	12	3.73%
Medium	4,972	91.67%	452	8.33%
Small	16,543	91.21%	1,594	8.79%
Panel B: Bank Ownership				
Commercial	4,914	88.91%	613	11.09%
Cooperative	11,423	91.75%	1,027	8.25%
Nationalised	188	87.04%	28	12.96%
Public	533	94.34%	32	5.66%
Savings	4,767	93.01%	358	6.99%
Panel C: Eurozone				
Eurozone	17,480	91.22%	1,683	8.78%
Non-Eurozone	4,345	92.06%	375	7.94%
Panel D: Geographic distribution				
Mediterranean	4,160	88.21%	556	11.79%
Eastern Europe	446	85.44%	76	14.56%
Continental/Nordic Europe	17,219	92.35%	1,426	7.65%
Total	**21,825**	**91.38%**	**2058**	**8.62%**

Note: Panel A shows the distribution of migrating and non-migrating among banks of different size: large, medium and small. The size buckets are identified using the ECB threshold based on the total assets of the banking sector according to data collected in the preceding year. Large banks are banks with total assets greater than 0.5% than the overall sector; medium banks are banks with total assets between 0.5% and 0.005% and finally, small banks are banks with total assets of less than 0.005% of the total. Panel B shows the distribution of migrating and non-migrating banks considering the bank ownership: cooperative, commercial, savings, public and nationalized banks. Panel C shows the distribution of migrating and non-migrating banks in the Euro and Non-Euro zone. Finally, Panel D shows the distribution of migrating and non-migrating banks in the Mediterranean, Eastern and Continental/Nordic European countries. We consider Continental/Nordic European countries: AT, BE, CH, DE, DK, FI, GB, IE, IS, LI, LU, NL, SE. We consider Eastern European Countries: BG, CZ, EE, HU, LT, LV, PL, RO, SK. We include in the group of Mediterranean countries: CY, ES, FR, GR, HR, IT, MT, PT, SI.

Table 3. Distribution of migrations among different business models (% of total assets)

	Panel A: Full Sample Period (2010 – 2017)					
	Business Models	**Focused retail**	**Diversified (type 1)**	**Diversified (type 2)**	**Wholesale**	**Investment**
Period t-1	Focused retail	88.27%	5.94%	5.25%	0.33%	0.21%
	Diversified (type 1)	2.91%	83.21%	5.20%	0.88%	7.80%
	Diversified (type 2)	3.21%	3.90%	92.27%	0.04%	0.58%
	Wholesale	1.85%	7.75%	0.10%	87.28%	3.03%
	Investment	0.08%	4.69%	2.03%	0.68%	92.53%
	Total	***3.94%***	***8.90%***	***4.62%***	***3.62%***	***3.35%***
	Panel B: Eurozone Crisis Period (2010 – 2013)					
Period t-1	Focused retail	90.42%	7.82%	0.86%	0.34%	0.55%
	Diversified (type 1)	3.34%	81.05%	2.67%	0.59%	12.35%
	Diversified (type 2)	1.46%	4.19%	93.01%	0.00%	1.34%
	Wholesale	3.59%	7.27%	0.23%	85.55%	3.35%
	Investment	0.02%	7.55%	0.95%	0.30%	91.18%
	Crisis	***10.73%***	***55.81%***	***8.39%***	***2.35%***	***22.72%***
	Panel C: Eurozone Recovery Period (2014 – 2017)					
Period t-1	Focused retail	87.03%	4.87%	7.77%	0.32%	0.01%
	Diversified (type 1)	2.68%	84.38%	6.56%	1.04%	5.34%
	Diversified (type 2)	4.34%	3.71%	91.80%	0.06%	0.09%
	Wholesale	0.63%	8.08%	0.00%	88.48%	2.80%
	Investment	0.12%	2.35%	2.91%	0.99%	93.63%
	Recovery	***23.23%***	***30.34%***	***30.21%***	***6.00%***	***10.22%***

Note: Panel A reports the distribution of migrations among different business models during the whole period investigated (2010 – 2017). The diagonal line (in grey) shows the percentage of total assets of banks that do not migrate. Panel B reports the distribution of bank migrations in terms of total assets (%) during the Eurozone crisis period (2010-2013) and Panel C refers to the recovery period (2014-2017). The lines in bold (Total %, Crisis %, and Recovery %) illustrate the percentage of total bank assets that migrate from other business models to the business model observed during the period.

Table 4 Summary statistics for all sample banks

	Total Sample			Non-Migrating Banks			Migrating Banks			Differences in means		
Variable	*Obs*	*Mean*	*Std. Dev.*	*Obs*	*Mean*	*Std. Dev.*	*Obs*	*Mean*	*Std. Dev.*	*Abs*	*%*	*P-value t-test*
Panel A Balance sheet structure												
Customer deposits over total assets	23,069	0.658	0.226	21,147	0.659	0.226	1,922	0.644	0.227	0.015	2.25%	0.000
Customer loans over total assets	23,075	0.566	0.205	21,150	0.568	0.206	1,925	0.545	0.187	0.023	4.08%	0.000
Trading assets over total assets	23,247	0.277	0.164	21,379	0.276	0.166	1,868	0.288	0.135	0.012	-4.24%	0.003
Size	23,883	6.720	1.864	21,825	6.732	1.869	2,058	6.595	1.809	0.137	2.04%	0.001
Intangible assets over total assets	23,642	0.002	0.009	21,610	0.002	0.009	2,032	0.002	0.009	0.000	-27.05%	0.044
Equity over total assets	23,718	0.106	0.097	21,748	0.105	0.094	1,970	0.118	0.128	0.013	-12.39%	0.000
RWA density	20,398	0.600	1.301	18,624	0.595	1.186	1,774	0.649	2.169	0.054	-9.15%	0.092
Z-score	23,774	60.381	70.537	21,722	61.858	71.527	2,052	44.745	56.747	17.113	27.66%	0.000
Panel B Income Statement												
Return on assets	23,556	0.005	0.054	21,627	0.005	0.049	1,929	0.000	0.095	0.006	106.73%	0.000
Return on equity	23,519	0.044	0.982	21,598	0.052	0.724	1,921	-0.044	2.430	0.096	184.01%	0.000
Net Interest Margin	23,464	0.674	1.526	21,565	0.677	1.580	1,899	0.647	0.655	0.030	4.37%	0.418
Cost to income	23,498	0.757	3.609	21,594	0.722	2.519	1,904	1.157	9.413	0.434	-60.13%	0.000
Loan loss provisions over gross loans	19,298	0.006	0.111	17,696	0.006	0.116	1,602	0.007	0.040	0.002	-32.17%	0.534
Panel C Ownership structure												
Commercial Banks	23,883	0.231	0.422	21,825	0.225	0.418	2,058	0.298	0.457	0.073	-32.29%	0.000
Cooperative banks	23,883	0.521	0.500	21,825	0.523	0.499	2,058	0.499	0.500	0.024	4.65%	0.019
Savings banks	23,883	0.215	0.411	21,825	0.218	0.413	2,058	0.174	0.379	0.044	20.36%	0.034
Public banks	23,883	0.024	0.152	21,825	0.024	0.154	2,058	0.016	0.124	0.009	36.33%	0.000

Note: The table shows the descriptive statistics (number of observations, mean and standard deviation) of the most important balance sheet and income statement ratios and the ownership form. The Table distinguishes between total sample, migrating banks and non-migrating ones. Finally, in the last three columns, we report the results of the statistic T-test to test differences in means.

Table 5. Determinants of banks' propensity to migrate (odds ratio)

VARIABLES	Model 1	Model 2
Constant	-0.269	0.536
	(0.560)	(0.573)
ETA_{t-1}	-0.241	.0.346
	(0.379)	(0.372)
$INTANGIBLE\_TA_{t-1}$	-3.848	-6.044
	(4.438)	(4.539)
SIZE	-0.097***	-0.129***
	(0.018)	(0.019)
ROA_{t-1}	-5.195***	-4.487***
	(1.138)	(1.113)
$COST\_INCOME_{t-1}$	-0.002	-0.003
	(0.009)	(0.010)
RWA_{t-1}	0.041***	0.043***
	(0.013)	(0.013)
Z_SCORE_{t-1}	-0.0007	-0.0003
	(0.0005)	(0.0004)
COMMERCIAL	0.068	0.155
	(0.170)	(0.172)
COOPERATIVE	-0.404**	-0.234
	(0.181)	(0.183)
SAVINGS	-0.109	0.143
	(0.182)	(0.183)
$BM\_FOCUSED_{t-1}$	-	-0.870***
		(0.113)
BM_TYPE1_{t-1}	-	-0.630***
		(0.108)
BM_TYPE2_{t-1}	-	0.408***
		(0.120)
$BM\_WHOLESALE_{t-1}$	-	-0.034
		(0.132)
YEAR FE	YES	YES
COUNTRY FE	YES	YES
Observations	17,137	17,137
R-squared	0.0317	0.0572
Log Likelihood	-5244.5875	-5106.1998

Note: The table reports the logit regression estimates of banks' propensity to migrate. The dependent variable is equal to 1 if a bank changes its business model and 0 otherwise. All explanatory variables, with exception of ownership structure, are lagged 1 year. ETA is the equity over total assets; FINTECH is the ratio between intangible assets and total assets; SIZE is the natural logarithm of total assets; ROA is the return over total assets; COST_INCOME is the cost over total income; RWA is the risk weighted assets over total assets; COMMERCIAL is a dummy variable equals 1 if bank is commercial and 0 otherwise; COOPERATIVE is a dummy variable equals 1 if bank is a cooperative bank and 0 otherwise; SAVINGS is a dummy variable equals 1 if bank is a saving bank and 0 otherwise; BM_FOCUSED is a dummy variable equals 1 if bank has a focused retail business model in the year before the migration and 0 otherwise; BM_TYPE1 is a dummy variable equals 1 if bank has a diversified retail (type 1) business model in the year before the migration and 0 otherwise; BM_TYPE2 is a dummy variable equals 1 if bank has a diversified retail (type 2) business model in the year before the migration and 0 otherwise; BM_WHOLESALE is a dummy variable equals 1 if bank has a wholesale business model in the year before the migration and 0 otherwise *, **, *** stand for statistical significance at the 10%, 5%, 1% levels, respectively.

Table 6 t-Test for equality of means of covariates before and after matching

Variable	Matched	Treated	Control	%bias	Reduct bias	t-test	p>t
EQ_TA_{t-1}	U	0.10575	0.09553	13.2		5.53	0.000
	M	0.10210	0.10588	-4.9	63	-1.27	0.203
$INTANGIBLE\_TA_{t-1}$	U	0.00154	0.00124	4.6		1.61	0.107
	M	0.00149	0.00169	-3.2	32	-0.9	0.370
$SIZE_{t-1}$	U	6.6646	6.8511	-10.1		-3.63	0.000
	M	6.6904	6.7053	-0.8	92	-0.22	0.823
ROA_{t-1}	U	0.00159	0.00597	-18.5		-8.84	0.000
	M	0.00354	0.00456	-4.3	76.7	-1.73	0.085
$COST\_INCOME_{t-1}$	U	0.78634	0.6762	15.3		8.24	0.000
	M	0.73651	0.72846	1.1	92.7	0.46	0.646
RWA_{t-1}	U	0.7849	0.57561	7.5		5.04	0.000
	M	0.59164	0.57589	0.6	92.5	1.52	0.129
$COMMERCIAL_{t-1}$	U	0.27049	0.18028	21.7		8.43	0.000
	M	0.26232	0.29185	-7.1	67.3	-1.85	0.065
$COOPERATIVE_{t-1}$	U	0.51828	0.54515	-5.4		-1.98	0.047
	M	0.52463	0.49989	5	7.9	1.38	0.167
$SAVINGS_{t-1}$	U	0.17907	0.24102	-15.3		-5.41	0.000
	M	0.18042	0.17258	1.9	87.4	0.57	0.566
$FOCUSED_{t-1}$	U	0.21438	0.39637	-40.3		-14	0.000
	M	0.21689	0.20793	2	95.1	0.61	0.541
$TYPE\ 1_{t-1}$	U	0.3367	0.4012	-13.4		-4.87	0.000
	M	0.33909	0.34821	-1.9	85.9	-0.54	0.592
$TYPE\ 2_{t-1}$	U	0.24905	0.09342	42.2		18.15	0.000
	M	0.25016	0.22473	6.9	83.7	1.67	0.095
$WHOLESALE_{t-1}$	U	0.11665	0.05988	20.1		8.32	0.000
	M	0.11516	0.12583	-3.8	81.2	-0.92	0.36
$INVESTMENT_{t-1}$	U	0.10575	0.09553	13.2		5.53	0.000
	M	0.10210	0.10588	-4.9	63	-1.27	0.203

Note: The Table reports the means of variables used in the logit regression and the differences in means in the two subsamples, before the matching and after the matching. U refers to unmatched sample and M to the matched sample. In the last four columns Table shows the T-test and the corresponding p-value. ETA is the equity over total assets; FINTECH is the ratio between intangible assets and total assets; SIZE is the natural logarithm of total assets; ROA is the return over total assets; COST_INCOME is the cost over total income; RWA is the risk weighted assets over total assets; COMMERCIAL is a dummy variable equals 1 if bank is commercial and 0 otherwise; COOPERATIVE is a dummy variable equals 1 if bank is a cooperative bank and 0 otherwise; SAVINGS is a dummy variable equals 1 if bank is a saving bank and 0 otherwise; FOCUSED is a dummy variable equals 1 if bank has a focused retail business model in the year before the migration and 0 otherwise; TYPE1 is a dummy variable equals 1 if bank has a diversified retail (type 1) business model in the year before the migration and 0 otherwise; TYPE2 is a dummy variable equals 1 if bank has a diversified retail (type 2) business model in the year before the migration and 0 otherwise; WHOLESALE is a dummy variable equals 1 if bank has a wholesale business model in the year before the migration and 0 otherwise; INVESTMENT is a dummy variable equals 1 if bank has an investment business model in the year before the migration and 0 otherwise.

Table 7. The effect of migration on bank performance

ATET	Coef.	Std. Err.	[95% Conf.	Interval]
ROA_t - ROA_{t-1}	-0.003	0.0034	-0.0074	0.0061
ROA_{t+1} - ROA_t	0.003	0.0029	-0.0016	0.01
ROA_{t+2} - ROA_t	0.005**	0.0024	0.001	0.0124
Z_t - Z_{t-1}	0.4512	1.202	-1.804	2.705
Z_{t+1} - Z_t	4.244***	1.515	-1.633	7.502
Z_{t+2} - Z_t	4.125***	1.576	1.238	7.421
$C\_I_t - C\_I_{t-1}$	0.0961*	0.0560	-0.0137	0.205
$C\_I_{t+1} - C\_I_t$	-0.165*	0.0921	.0.345	0.0152
$C\_I_{t+2} - C\_I_t$	-0.044	0.0779	-0.1969	0.1084
$RWA_t - RWA_{t-1}$	-0.062	0.0635	-0.1866	0.0622
$RWA_{t+1} - RWA_t$	0.0418	0.0490	-0.0532	0.1390
$RWA_{t+2} - RWA_t$	-0.0274	0.0228	-0.0721	0.0172

Note: Table reports the results of the average treatment effect on treated. The outputs are: ROA as a proxy of bank's profitability, Z-score as a proxy of risk of default, the cost-income ratio (C_I) as a proxy of bank's cost efficiency, RWA is the risk-weighted assets density and is a proxy of risk appetite. We test the effect on different time windows. The matching variables are those used in the main analysis to measure the propensity score. Number of matches is equal to 4. "***", "**" and "*" indicate 1%, 5%, and 10% significance levels, respectively.

Table 8. The effect of strategic and externally imposed migrations

ATET	Coef.	Std. Err.	[95% Conf.	Interval]
Panel A: Effects of migrations on banks involved in M&A operations				
ROA_t - ROA_{t-1}	-0.0099	0.0087	-0.027	0.0072
ROA_{t+1} - ROA_t	0.0029	0.00208	-0.0011	0.00705
ROA_{t+2}- ROA_t	0.0062**	0.0029	0.00049	0.01205
Z_t - Z_{t-1}	1.0785	1.4938	1,8493	4.0064
Z_{t+1} - Z_t	1.5655	1.5692	1.5101	4.6412
Z_{t+2} - Z_t	0.7557	1.6392	-2.457	3.9686
C_I_t – C_I_t	0.2948	0.1945	-0.0865	0.6762
C_I_{t+1} – C_I_t	-0.376**	0.1728	-0.7156	-0.03802
C_I_{t+2} – C_I_t	-0.4913**	0.1973	-0.8781	-0.1045
RWA_t – RWA_t	-0.0183	0.0187	-0.055	0.0184
RWA_{t+1} – RWA_t	-0.0081	0.0092	-0.0267	0.01003
RWA_{t+2} – RWA_t	-0.00312	0.01482	-0.0321	0.0259
Panel B: Effects of migrations on banks involved in M&A operations as targets				
ROA_t - ROA_t	-0.0188	0.0153	-0.0488	0.01122
ROA_{t+1} - ROA_t	0.0038*	0.00199	-0.0001	0.00778
ROA_{t+2}- ROA_t	0.00317	0.0031	-0.0029	0.0093
Z_t - Z_{t-1}	2.1854**	1.3198	-0.4013	4.7722
Z_{t+1} - Z_t	0.0176*	1.836	-3.581	3.617
Z_{t+2} - Z_t	0.9752*	1.3479	-1.6667	3.617
C_I_t – C_I_{t-1}	0.3761	0.4345	-0.4756	1.2279
C_I_{t+1} – C_I_t	-0.5519*	0.338	-1.2146	0.1106
C_I_{t+2} – C_I_t	0.6077**	0.3353	-1.2644	0.05024
RWA_t – RWA_{t-1}	-0.0287	0.03109	-0.0896	0.03221
RWA_{t+1} – RWA_t	0.0016	0.0114	-0.0208	0.02413
RWA_{t+2} – RWA_t	0.00326	0.01659	-0.0292	0.03579
Panel C: The effects on migration of banks that received state aid				
ROA_t - ROA_{t-1}	-0.001	0.0066	-0.01301	0.01295
ROA_{t+1} - ROA_t	0.0045	0.0173	-0.0294	0.0284
ROA_{t+2}- ROA_t	0.01503	0.01715	-0.0185	0.04865
Z_t - Z_{t-1}	0.8493**	0.9201	-0.9541	2.6529
Z_{t+1} - Z_t	0.1958*	1.0205	-1.8043	2.196
Z_{t+2} - Z_t	0.2791	1.4273	-2.518	3.0767
C_I_t – C_I_{t-1}	-0.1351	0.7645	-0.6336	1.3633
C_I_{t+1} – C_I_t	-0.9143	0.6831	-2.253	0.4245
C_I_{t+2} – C_I_t	-0.9143	0.8159	-2.513	0.6849
RWA_t – RWA_{t-1}	0.002	0.158	-0.0307	0.0313
RWA_{t+1} – RWA_t	-0.011	0.0132	-0.037	0.015002
RWA_{t+2} – RWA_t	0.006	0.0242	-0.0417	0.0535

Note: Table reports the results of the average treatment effect on treated. The outputs are: ROA as a proxy of bank's profitability, Z-score as a proxy of risk of default, the cost-income ratio (C_I) as a proxy of bank's cost efficiency, RWA is the risk-weighted assets density and is a proxy of risk appetite. We test the effect on different time windows. The matching variables are those used in the main analysis to measure the propensity score. Number of matches is equal to 4. "***", "**" and "*" indicate 1%, 5%, and 10% significance levels, respectively.

Table 9. The effect of migration to specific business models

ATET	Focused retail	Type 1	Type 2	Wholesale	Investment
ROA_t - ROA_{t-1}	0.001	-0.001	-0.012	0.021	-0.046
ROA_{t+1} - ROA_t	-0.002***	0.002	0.002**	-0.014	0.052
ROA_{t+2} - ROA_t	-0.001	0.002	0.003	-0.002	0.056
Z_t - Z_{t-1}	-0.302	-1.154	-7.697	-3.036	4.998
Z_{t+1} - Z_t	-0.641	2.227**	-3.678	1.423	8.365***
Z_{t+2} - Z_t	-1.792	1.969	-9.522	1.995	5.596
$C\_I_t - C\_I_{t-1}$	-0.048	-0.004	-0.010	0.108	0.267
$C\_I_{t+1} - C\_I_t$	0.025	-0.080	0.005	-1.265	-0.142
$C\_I_{t+2} - C\_I_t$	-0.046*	0.009	-0.006	0.357	-0.091
$RWA_t - RWA_{t-1}$	0.001	-0.004	-0.087	-0.048**	0.348
$RWA_{t+1} - RWA_t$	-0.001	0.134	-0.033	-0.036	-0.290
$RWA_{t+2} - RWA_t$	-0.012	-0.017	-0.078	-0.015	-0.635

Note: The table reports the results of the average treatment effect on treated. We match migrating banks to each business model to detect whether migrating in a specific business model produces better outcomes. Due to the small number of banks in this subsample, to have an adequate number of matches, the control sample consists of all the observations in business models to which a bank does not migrate. In the second column we compare banks that migrated to the focused retail business model to all other migrations; in the third column we compare banks that migrated to the diversified retail (type 1) business model to all other migrations; in the fourth column we compare banks that migrated to the diversified retail (type 2) business model to all other migrations; in the fifth column we compare banks that migrated to the wholesale business model to all other migrations; in the last column we compare banks that migrated to the investment business model to all other migrations The outputs are: ROA as a proxy of bank's profitability, Z-score as a proxy of risk of default, the cost-income ratio as a proxy of a bank's cost-efficiency. RWA is the risk-weighted asset density and is a proxy of risk appetite. We test the effect on different time windows. The matching variables are those used in the main analysis to measure the propensity score. "***", "**" and "*" indicate 1%, 5%, and 10% significance levels, respectively.

Table 10. The effect of migration from diversified to specialised business models

ATET	Coef.	Std. Err.	[95% Conf.	Interval]
ROA_t - ROA_{t-1}	-0.005	0.004	-0.013	0.003
ROA_{t+1} - ROA_t	0.003	0.003	-0.003	0.01
ROA_{t+2} - ROA_t	0.002	0.0011	-0.0001	0.004
ROA_{t+1} - ROA_{t-1}	0.003	0.003	-0.004	0.009
ROA_{t+2} - ROA_{t+1}	0.0003	0.0008	-0.001	0.002
ROA_{t+2} - ROA_{t-1}	0.001	0.001	-0.0007	0.003
Z_t - Z_{t-1}	-2.054	1.834	-5.649	1.54
Z_{t+1} - Z_t	0.658	1.751	-2.772	4.09
Z_{t+2} - Z_t	0.251	2.355	-4.364	4.868
Z_{t+1} - Z_{t-1}	0.037	1.859	-3.606	3.681
Z_{t+2} - Z_{t+1}	-0.099	2.362	-4.731	4.531
Z_{t+2} - Z_{t-1}	-0.425	2.428	-5.185	4.334
$C\_I_t - C\_I_{t-1}$	-0.041	0.055	-0.151	0.0678
$C\_I_{t+1} - C\_I_t$	-0.1001	0.0535	-0.205	0.004
$C\_I_{t+2} - C\_I_t$	-0.213***	0.0763	-0.363	-0.063
$C\_I_{t+1} - C\_I_{t-1}$	-0.132**	0.0561	-0.242	-0.022
$C\_I_{t+2} - C\_I_{t+1}$	-0.059	0.048	-0.154	0.035
$C\_I_{t+2} - C\_I_{t-1}$	-0.2001***	0.076	-0.351	-0.05001
$RWA_t - RWA_{t-1}$	-0.192	0.148	-0.484	0.0986
$RWA_{t+1} - RWA_t$	0.142	0.147	-0.146	0.431
$RWA_{t+2} - RWA_t$	0.002	0.008	-0.0145	0.018
$RWA_{t+1} - RWA_{t-1}$	-0.095	0.2109	-0.509	0.317
$RWA_{t+2} - RWA_{t+1}$	0.005	0.004	-0.003	0.015
$RWA_{t+2} - RWA_{t-1}$	-0.215	0.2205	-0.647	0.216

Note: Table reports the results of the average treatment effect on treated. We group banks in two main business models: a) specialised business model (focused retail, investment, and wholesale business models) and b) diversified business model (diversified retail type 1 and type 2). We match banks from migrating from diversified to specialised BM with banks migrating from specialised to diversified BM. The outputs are: ROA as a proxy of bank's profitability, Z-score as a proxy of risk of default, the cost-income ratio as a proxy of a bank's cost-efficiency. RWA is the risk-weighted asset density and is a proxy of risk appetite. We test the effect on different time windows. The matching variables are those used in the main analysis to measure the propensity score. "***", "**" and "*" indicate 1%, 5%, and 10% significance levels, respectively.

Table 11. Robustness checks: determinants of banks' propensity to migrate (odds ratio)

VARIABLES	Mod1	Mod2
Constant	-0.315	0.489
	(0.561)	(0.577)
ETA_{t-1}	-0.277	-0.400
	(0.385)	(0.378)
$FINTECH_{t-1}$	-4.146	-7.383
	(4.511)	(4.634)
SIZE	-0.0953***	-0.129***
	(0.0189)	(0.0196)
ROA_{t-1}	-5.214***	-4.444***
	(1.150)	(1.123)
$COST\_INCOME_{t-1}$	0.0028	0.003
	(0.0153)	(0.0162)
RWA_{t-1}	0.042***	0.044***
	(0.0136)	(0.0139)
$Z\text{-}SCORE_{t-1}$	-0.007	-0.0003
	(0.0005)	(0.0005)
COMMERCIAL	0.076	0.143
	(0.170)	(0.172)
COOPERATIVE	-0.406**	-0.197
	(0.170)	(0.183)
SAVINGS	-0.105	0.164
	(0.181)	(0.184)
$BM\_FOCUSED_{t-1}$	-	-1.136***
		(0.118)
BM_TYPE1_{t-1}	-	-0.943***
		(0.114)
BM_TYPE2_{t-1}	-	-0.943***
		(0.114)
$BM\_WHOLESALE_{t-1}$	-	0.170
		(0.124)
YEAR FE	Yes	Yes
COUNTRY FE	Yes	Yes
Observations	16,786	16,786
R-squared	0.0325	0.0595
Log Likelihood	-5040.3329	-4899.8709

Note: The table reports the logit regression estimates of banks' propensity to migrate. This sample excludes those banks that are at the same time small, cooperative and clusterised as investment BM. The dependent variable is equal to 1 if a bank changes its business model and 0 otherwise. All explanatory variables, except for ownership structure, are lagged 1 year. ETA is the equity over total assets; FINTECH is the ratio of intangible assets to total assets; SIZE is the natural logarithm of total assets; ROA is the return on assets; COST_INCOME is the cost over total income; RWA is the risk-weighted assets over total assets; COMMERCIAL is a dummy variable equal to 1 if a bank is commercial and 0 otherwise; COOPERATIVE is a dummy variable equal to 1 if a bank is a cooperative bank and 0 otherwise; SAVINGS is a dummy variable equal to 1 if bank is a saving bank and 0 otherwise; BM_FOCUSED is a dummy variable equal to 1 if bank has a focused retail business model in the year before the migration and 0 otherwise; BM_TYPE1 is a dummy variable equal to 1 if bank has a diversified retail (type 1) business model in the year before the migration and 0 otherwise; BM_TYPE2 is a dummy variable equal to 1 if bank has a diversified retail (type 2) business model in the year before the migration and 0 otherwise; BM_WHOLESALE is a dummy variable equal to 1 if bank has a wholesale business model in the year before the migration and 0 otherwise *, **, *** stand for statistical significance at the 10%, 5%, 1% levels, respectively.

Table 12. Robustness checks: the effect of migration on bank performance

ATET	Coef.	Std. Err.	[95% Conf.	Interval]
ROA_t - ROA_{t-1}	-.0004531	.003652	-.007611	.0067047
ROA_{t+1} - ROA_t	.0038441	.0028488	-.0017394	.0094276
ROA_{t+2} - ROA_t	.0051874*	.0034414	-.0015576	.0119325
Z_t - Z_{t-1}	-1.428445	1.458807	-4.287655	1.430765
Z_{t+1} - Z_t	.6011512*	1.309877	-1.96616	3.168462
Z_{t+2} - Z_t	2.297256	1.676953	-.9895118	5.584023
$C\_I_t - C\_I_{t-1}$	.0514871	.0438916	-.0345387	.137513
$C\_I_{t+1} - C\_I_t$	-.1628442*	.0945211	-.3481021	.0224137
$C\_I_{t+2} - C\_I_t$	-.0738444	.0755973	-.2220124	.0743237
$RWA_t - RWA_{t-1}$	-.0546709	.050123	-.1529101	.0435684
$RWA_{t+1} - RWA_t$	.043572	.0499695	-.0543665	.1415105
$RWA_{t+2} - RWA_t$	-.0179782	.0233252	-.0636947	.0277384

Note: The table reports the results of the average treatment effect on the treated. This sample excludes those banks that are at the same time small, cooperative and clusterised as investment BM. The outputs are: ROA as a proxy of bank's profitability, Z-score as a proxy of risk of default, the cost-income ratio as a proxy of a bank's cost-efficiency. RWA is the risk-weighted asset density and is a proxy of risk appetite. We test the effect on different time windows. The matching variables are those used in the main analysis to measure the propensity score. "***", "**" and "*" indicate 1%, 5%, and 10% significance levels, respectively.

Table 13. Robustness check: the effect of migration on bank performance in different time windows

ATET	Coef.	Std. Err.	[95% Conf.	Interval]
ROA_{t+2}- ROA_{t-1}	.0019756	.0020365	-.0020159	.0059671
ROA_{t+1} - ROA_{t-1}	.000951	.0011656	-.0013335	.0032355
ROA_{t+2} - ROA_{t+1}	.0020104	.001396	-.0007258	.0047465
Z_{t+2} - Z_{t-1}	.087036	1.22639	-2.316645	2.490716
Z_{t+1} - Z_{t-1}	4.392732***	1.596403	1.26384	7.521624
Z_{t+2} - Z_{t+1}	4.202181***	1.581355	1.102782	7.30158
$C\_I_{t+2} – C\_I_{t-1}$	-.0634093	.0859003	-.2317709	.1049523
$C\_I_{t+1} – C\_I_{t-1}$	-.0140414	.0681924	-.147696	.1196132
$C\_I_{t+2} – C\_I_{t+1}$	.0534274	.0713616	-.0864386	.1932935
$RWA_{t+2} – RWA_{t-1}$	-.0214309	.0699531	-.1585365	.1156747
$RWA_{t+1} – RWA_{t-1}$	-.0108127	.0177904	-.0456813	.024055
$RWA_{t+2} – RWA_{t+1}$	-.0760959	.07382	-.2207803	.0685886

Note: The table reports the results of the average treatment effect on the treated. The outputs are: ROA as a proxy of bank's profitability, Z-score as a proxy of risk of default, the cost-income ratio as a proxy of a bank's cost-efficiency. RWA is the risk-weighted asset density and is a proxy of risk appetite. We test the effect on different time windows. The matching variables are those used in the main analysis to measure the propensity score. "***", "**" and "*" indicate 1%, 5%, and 10% significance levels, respectively.

Table 14. Robustness check: the effect of migration on bank performance with 3 matches

ATET	Coef.	Std. Err.	[95% Conf.	Interval]
ROA_t - ROA_{t-1}	.000441	.0038971	-.0071971	.0080791
ROA_{t+1} - ROA_t	.0036635	.0029747	-.0021668	.0094938
ROA_{t+2} - ROA_t	.0062565*	.0035518	-.0007049	.0132179
ROA_{t+1} - ROA_{t-1}	.0008458	.0020202	-.0031138	.0048053
ROA_{t+2} - ROA_{t+1}	.0011566	.0013546	-.0014984	.0038115
ROA_{t+2} - ROA_{t-1}	.002514	.0016083	-.0006382	.0056662
Z_t - Z_{t-1}	-1.02604	1.475106	-3.917194	1.865114
Z_{t+1} - Z_t	.4055029	1.237266	-2.019493	2.830499
Z_{t+2} - Z_t	4.364347***	1.622561	1.184185	7.544509
Z_{t+1} - Z_{t-1}	-.0022797	1.259388	-2.470635	2.466075
Z_{t+2} - Z_{t+1}	4.332779***	1.659219	1.080771	7.584788
Z_{t+2} - Z_{t-1}	3.79374**	1.640198	.5790106	7.00847
$C\_I_t - C\_I_{t-1}$	.0731673*	.0384739	-.0022402	.1485748
$C\_I_{t+1} - C\_I_t$	-.1526452	.0933692	-.3356455	.030355
$C\_I_{t+2} - C\_I_t$	-.0645278	.0732731	-.2081403	.0790848
$C\_I_{t+1} - C\_I_{t-1}$	-.0477929	.0880534	-.2203744	.1247886
$C\_I_{t+2} - C\_I_{t+1}$	-.0193538	.0704965	-.1575243	.1188167
$C\_I_{t+2} - C\_I_{t-1}$	.0591529	.0715569	-.0810961	.1994019
$RWA_t - RWA_{t-1}$	-.0511347	.0489144	-.1470052	.0447358
$RWA_{t+1} - RWA_t$	.0397687	.048598	-.0554816	.1350189
$RWA_{t+2} - RWA_t$	-.0139907	.0228423	-.0587608	.0307795
$RWA_{t+1} - RWA_{t-1}$	-.0230314	.0699476	-.1601262	.1140634
$RWA_{t+2} - RWA_{t+1}$	-.0082285	.0181598	-.0438211	.0273642
$RWA_{t+2} - RWA_{t-1}$	-.0705334	.0738485	-.2152738	.0742069

Note: The table reports the results of the average treatment effect on the treated. The outputs are: ROA as a proxy of bank's profitability, Z-score as a proxy of risk of default, the cost-income ratio as a proxy of a bank's cost-efficiency. RWA is the risk-weighted asset density and is a proxy of risk appetite. We test the effect on different time windows. The matching variables are those used in the main analysis to measure the propensity score. "***", "**" and "*" indicate 1%, 5%, and 10% significance levels, respectively.

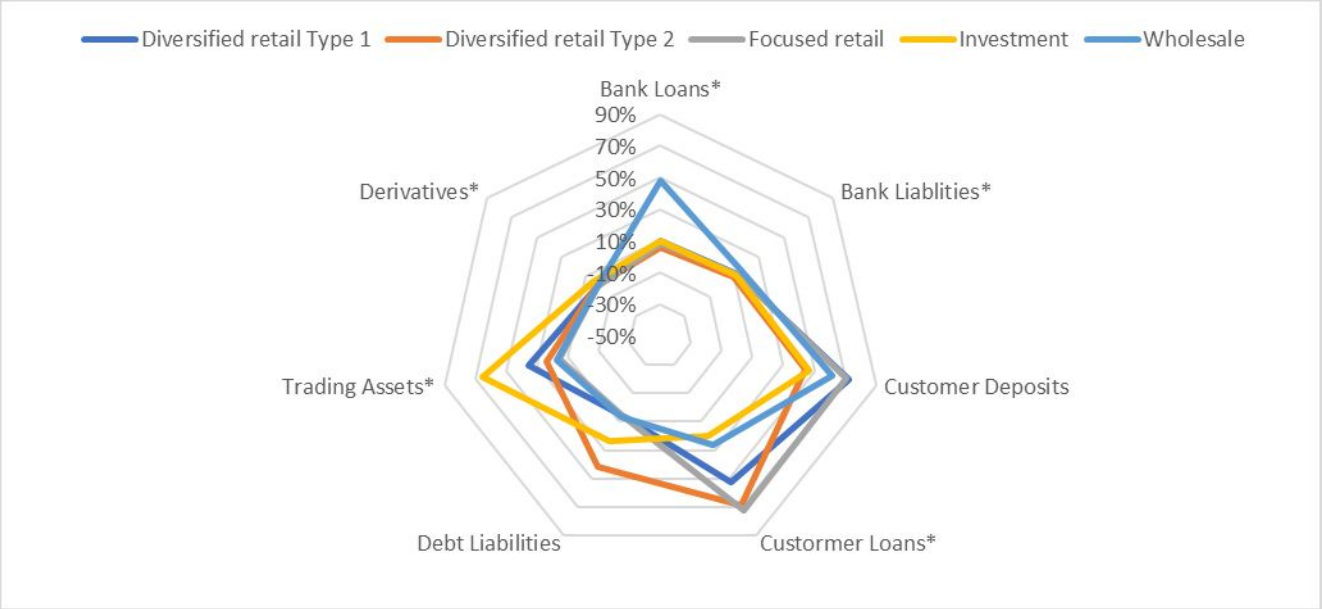
Table 15. Sensitivity test

Gamma	sig+	sig-	t-hat+	t-hat-	CI+	CI-
1	0.000163	0.000163	5.95267	5.95267	2.71291	9.20914
1.01	0.000288	0.00009	5.69571	6.21025	2.47187	9.45982
1.02	0.000496	0.000049	5.44405	6.46129	2.22872	9.71151
1.03	0.000832	0.000026	5.1934	6.70497	1.98815	9.96251
1.04	0.00136	0.000014	4.95942	6.94264	1.74195	10.2123
1.05	0.002169	7.20E-06	4.72956	7.17675	1.49645	10.4691
1.06	0.003378	3.70E-06	4.49661	7.40745	1.25451	10.7217
1.07	0.005141	1.90E-06	4.26348	7.64002	1.01525	10.9697
1.08	0.007652	9.30E-07	4.02363	7.87801	0.773997	11.2066
1.09	0.011145	4.60E-07	3.78936	8.11341	0.544579	11.4445
1.1	0.015898	2.20E-07	3.55472	8.35147	0.321871	11.6782
1.11	0.022222	1.10E-07	3.32366	8.58473	0.08411	11.9023
1.12	0.030462	5.00E-08	3.10157	8.80981	-0.142622	12.1287
1.13	0.040977	2.40E-08	2.88141	9.04378	-0.374663	12.3561
1.14	0.054126	1.10E-08	2.66508	9.2575	-0.602608	12.5745
1.15	0.070251	5.00E-09	2.44903	9.481	-0.832049	12.7979
1.16	**0.089648**	**2.20E-09**	**2.23791**	**9.69889**	**-1.05267**	**13.0172**
1.17	**0.11255**	**1.00E-09**	**2.02798**	**9.92139**	**-1.27868**	**13.2405**
1.18	0.139104	4.40E-10	1.81643	10.1377	-1.49197	13.4608
1.19	0.16935	1.90E-10	1.60126	10.3608	-1.70967	13.6752
1.2	0.203211	8.40E-11	1.38636	10.5853	-1.92721	13.8967
1.21	0.240486	3.60E-11	1.1784	10.806	-2.14019	14.1072
1.22	0.28085	1.50E-11	0.965678	11.0192	-2.35203	14.3208

Note: The table shows the results of the Rosenbaum (2002) bounding approach as a sensitivity test. This test calculates Rosenbaum bounds for average treatment effects on the treated in the presence of unobserved heterogeneity (hidden bias) between treatment and control cases. Sig+ is the p-value of the effect. The significance is lost at around 17%. Therefore it can be assumed that important confounders have not been overlooked.

List of Figures

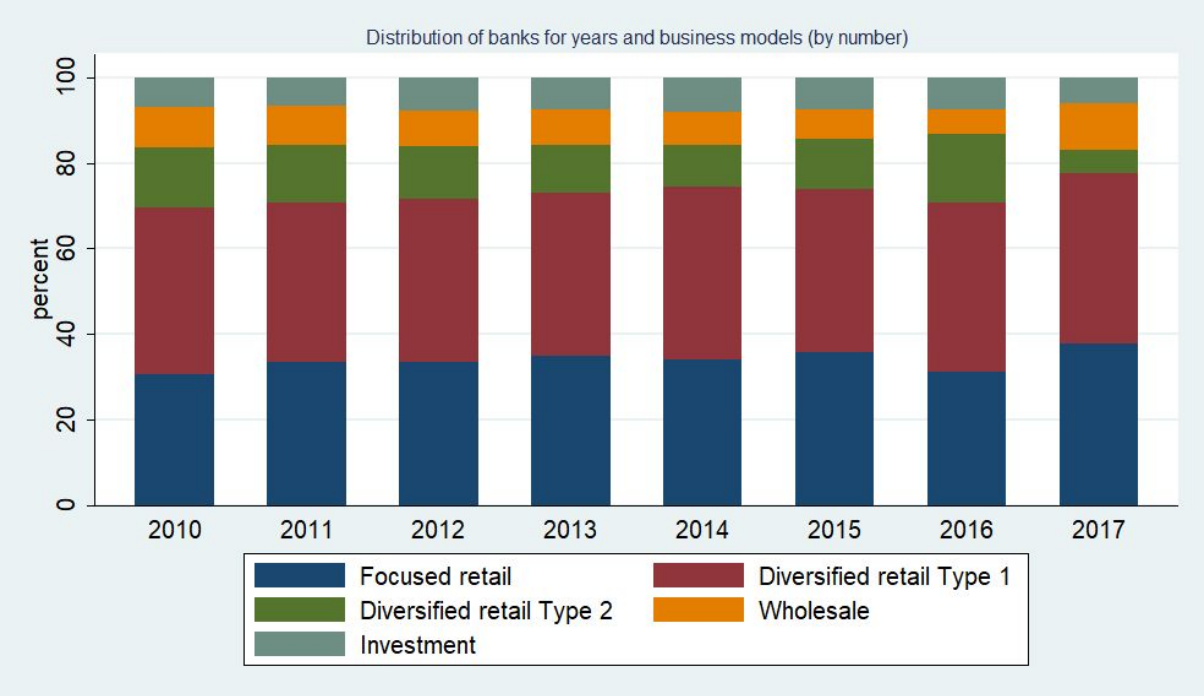
Figure 1 Bank business model definition



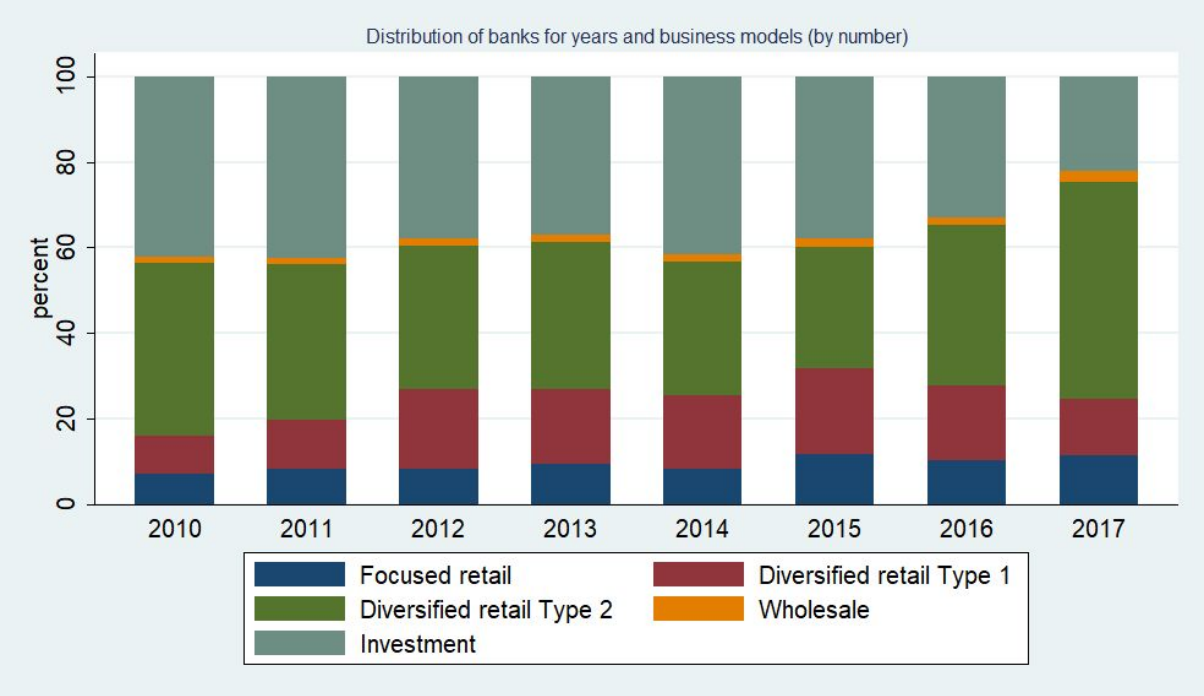
Note: The figure shows the differences in terms of bank assets and liabilities in the five business models identified. The items with the asterisk are those used in the cluster analysis to define the number of clusters. Focused retail, diversified retail (type 1) and (type 2) are those business models more retail-oriented, which differ on the diversification of the asset and liability sides. The wholesale business model groups banks oriented to the interbank market and the investment business model groups those banks more oriented to trading activities.

Figure 2 Distribution of banks for years and business models

Panel A - by number of banks

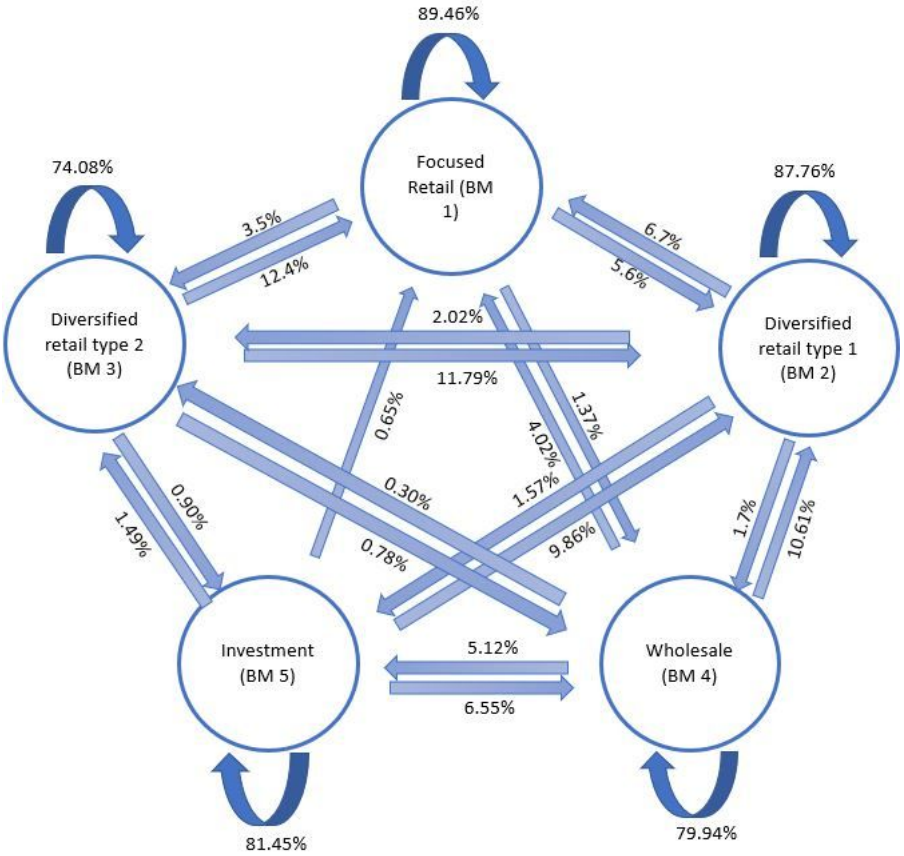


Panel B - by total assets



Note: Figure 2 Panel A shows the distribution of banks among different business models during the period under investigation. Figure 2 Panel B shows the distribution of banks by total assets among different business models during the period under investigation.

Figure 3 Transition chart for the period 2010-2017 and final distribution of the number of banks among different business models[8]



Composition	Focused retail	Diversified (type 1)	Diversified (type 2)	Wholesale	Investment	Total
Crisis	33.25%	37.97%	12.71%	8.86%	7.22%	100.00%
Recovery	34.79%	39.34%	10.67%	7.89%	7.30%	100.00%
Total period	33.99%	38.63%	11.73%	8.40%	7.26%	100.00%

Note: The figure shows the share of banks that belong to a specific model in one period switching to a different model and those remaining in the business model in the following period.
The table shows the distribution of banks among the different business models during the crisis and recovery period, and the distribution over the total period.

[8] When the transition between two business models is not shown, it means that the migration is lower than 0.5%.

Appendix 1: The cluster analysis

Bank business models can be classified using different methods. One approach used in literature is simply grouping banks with similar predefined criteria, such as the loans over total assets ratio. Other approaches are more data-driven and are based on statistical clustering techniques. In our paper, we adopt a cluster analysis that is a statistical technique for combining a set of observations into distinct homogenous clusters and, by definition, observations that are assigned into the same cluster have a certain degree of similarity with other observations. Cluster analysis is currently one of the most used mathematical grouping methods in economic researches. Among the different cluster analysis, we adopt the hierarchical approach, using Ward's methodology that allows us to measure the distance between clusters (Ward, 1963). This difference is between the total within-cluster sum of squares for the clusters observed separately, and the within-cluster sum of squares resulting from merging the clusters. This procedure works hierarchically, starting from largest number of cluster possible and merging clusters, step by step, to minimise the within-cluster sum of squared errors.

$$SSE = \sum_{i=1}^{K} \sum_{x \in C} (c_i - x)^2 \qquad (1)$$

Where SSE is the sum of standard errors, C_i is the i^{th} cluster, x is a point in C_i, c_i is the mean of the i^{th} cluster. We solve for the k^{th} centroid c_k, which minimizes the equation (1), by distinguishing the SSE, putting it equal to 0. Thus, the mean of the points in the cluster is the best centroid for minimizing the SSE of a cluster.

We use a hierarchical approach that allows us to not insert the number of clusters as input, but to obtain it as a result of clustering analysis. Indeed, using Ward's method, we choose the number of clusters on the base of the dendrogram (cutting it at the proper level) or using other tests (as presented below).[9] To choose the information to put in the cluster analysis we follow Ayadi et al. (2016) and we use five balance sheet ratios: a) the loans to bank over total assets; b) customer loans over total assets; c) trading assets over total assets; d) debt liabilities over total assets and finally, e) derivative exposures over total assets. We consider only data that refer to the asset and liability composition of the bank's strategy, without using the income statement ratios. This because banks undertake different activities, ranging from the traditional

[9] The hierarchical approach is opposed to the partitioning clustering, such as the K-means approach, because in the latter we have to decide the number of clusters before running the cluster analysis, while in the former we do not need and the number of cluster is decided at the end of the analysis, using the dendrogram or the F-statistic.

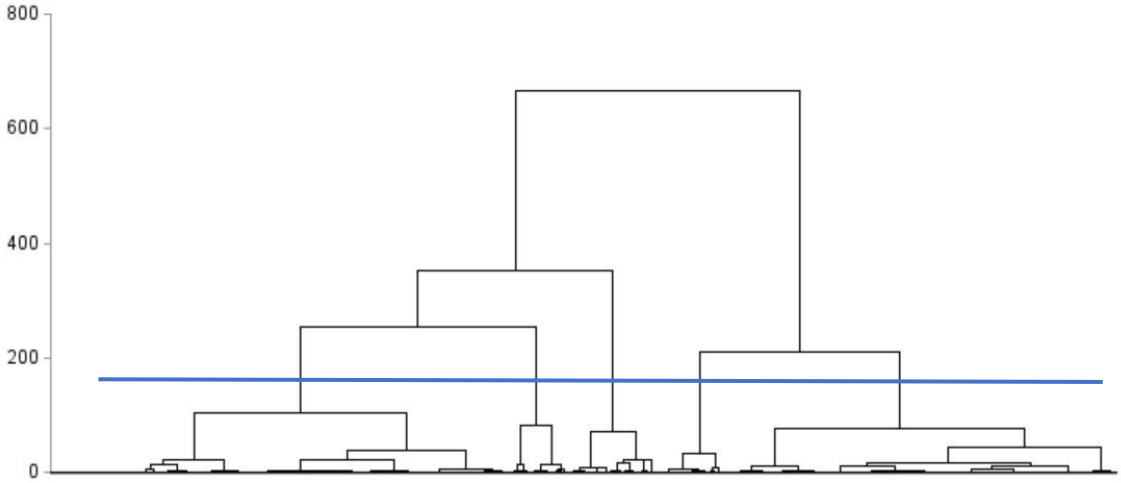
ones, such as lending activity, to more market-oriented activities, such as the trading activity. These differences are reflected in the balance sheet, both in termss of asset composition and in terms of funding sources. To check the right number of clusters, we adopt the pseudo-F index proposed by Calinski and Harabasz's (1974)[10]. The results show that the highest Pseudo-F statistic refers to the five-clusters configuration, confirming that the optimal number of clusters of bank business models is five.

Table 1.A Pseudo-F statistic

Number of clusters	Frequency	Pseudo-F statistic	Number of clusters	Frequency	Pseudo-F statistic
1	20,997	.	**6**	1,193	7,875
2	10,996	7,925	**7**	8,474	7,653
3	9,178	7,578	**8**	1,818	7,649
4	10,001	7,677	**9**	6,262	7,757
5	**7,985**	**8,196**	**10**	5,792	7,610

The same result is confirmed by the Dendrogram, the semi-partial R-squared and the cubic clustering criterion, in which we can observe that the best cluster configuration is composed always by five clusters.

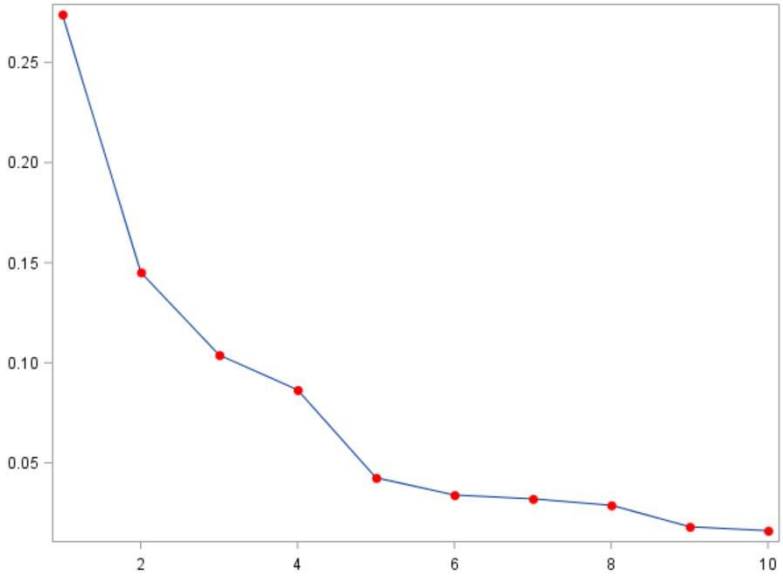
Figure 1.A Dendrogram



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, while keeping the number of clusters at 5. It is clear again that by selecting 5 clusters, most of the reduction in SSB is achieved.

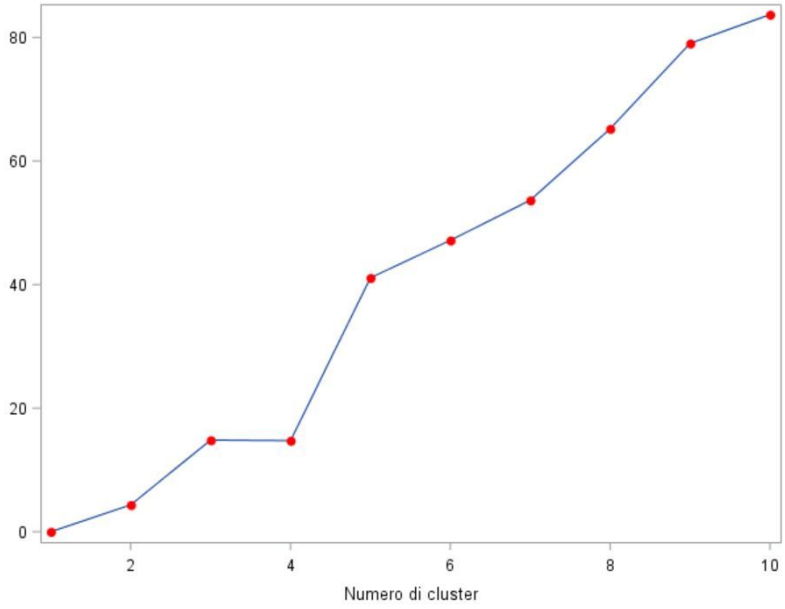
[10] The index is measured as the ratio between cluster variance and within-cluster variance.

Figure 1.B Semi Partial R-Squared (SPRSQ) across cluster



Notes: 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 an important 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.

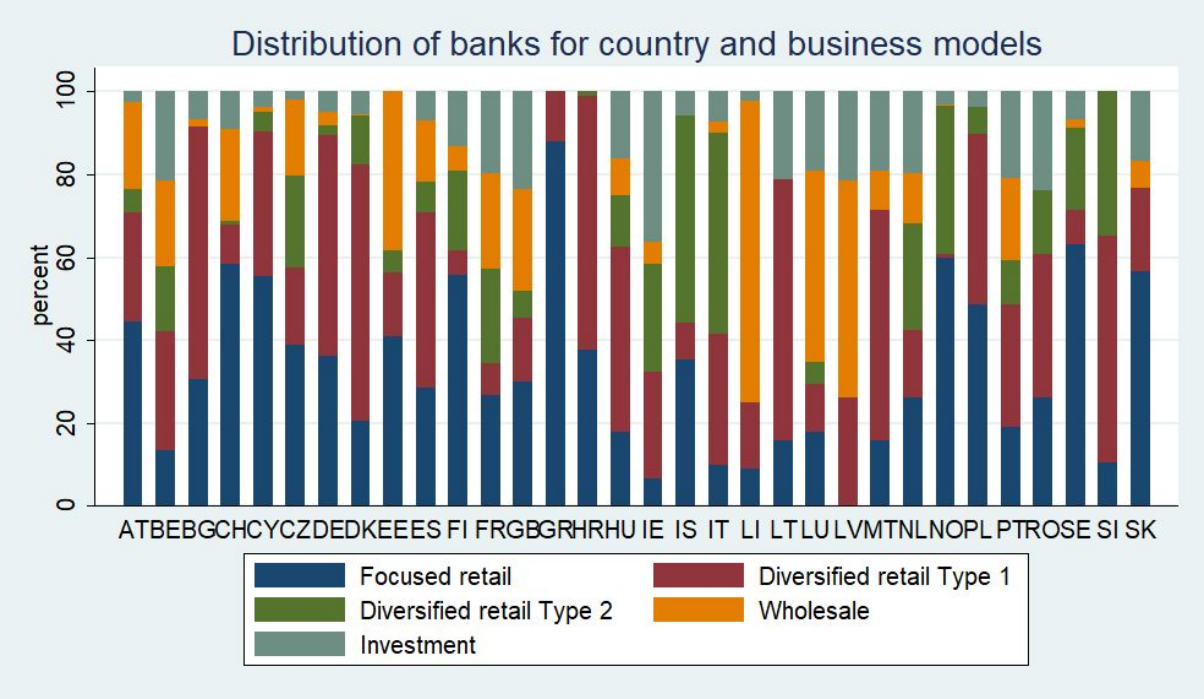
Figure 1.C Cubic Clustering Criterion (CCC)



Notes: The higher the Cubic Clustering Criterion (CCC) is, 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

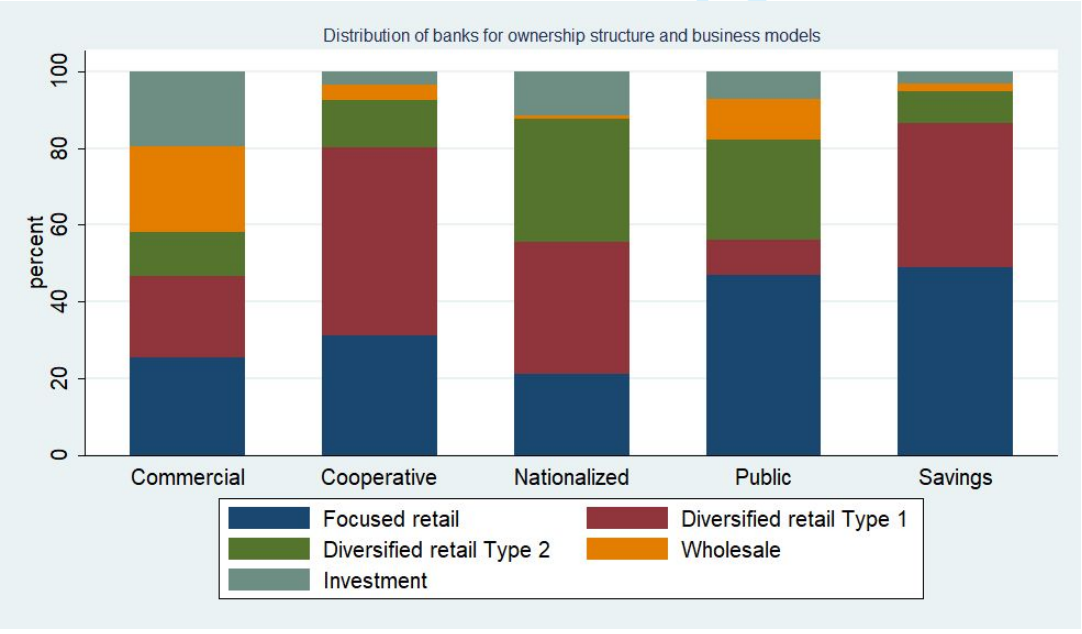
Appendix 2: Stylised facts on bank business models and migrations

Figure 2.A Distribution of banks among different business models in each country observed



Note: Figure 2A shows the distribution of banks among different business models in each country observed.

Figure 2.B Distribution of banks among different business models and ownership structure



Note: Figure 2B shows the distribution of banks among different business models and ownership structures identified in commercial banks, cooperative banks, public banks, and savings banks.

Table 2.A Migrating and Non-migrating banks during the period observed, as a percentage of total banks and total assets

	By Number		By Total Assets	
Year	**Non-migrating banks**	**Migrating banks**	**Non-migrating banks**	**Migrating banks**
2011	90.79%	9.21%	94.73%	5.27%
2012	91.96%	8.04%	96.63%	3.37%
2013	91.44%	8.56%	93.40%	6.60%
2014	92.08%	7.92%	95.31%	4.69%
2015	89.74%	10.26%	97.46%	2.54%
2016	90.35%	9.65%	92.70%	7.30%
2017	83.48%	16.52%	94.55%	5.45%
Total	91.38%	8.62%	95.57%	4.43%

Note: Table 2.A reports the distribution of migrating and non-migrating banks in each year observed.

Table 2.B Migrating and Non-migrating banks per country

COUNTRY	TOTAL SAMPLE			MIGRATING BANKS			
	Non - migrating	Migrating	Distance from sample mean	No-State aid	State aid	No M&A	M&A
AT	88.45%	11.55%	2.93%	11.60%	0.00%	11.32%	14.66%
BE	86.55%	13.45%	4.83%	14.11%	0.00%	12.62%	14.71%
BG	86.76%	13.24%	4.62%	13.33%	12.50%	12.50%	13.33%
CH	94.98%	5.02%	-3.60%	5.02%	-	5.01%	5.07%
CY	89.69%	10.31%	1.69%	10.00%	14.29%	10.77%	9.38%
CZ	83.87%	16.13%	7.51%	16.13%	-	31.82%	7.50%
DE	92.98%	7.02%	-1.59%	7.01%	11.36%	6.97%	7.94%
DK	92.44%	7.56%	-1.06%	7.29%	25.00%	7.62%	7.49%
EE	82.22%	17.78%	9.16%	17.78%	-	4.76%	29.17%
ES	88.01%	11.99%	3.37%	11.75%	16.67%	13.02%	10.17%
FI	91.95%	8.05%	-0.57%	8.05%	-	7.20%	10.20%
FR	92.23%	7.77%	-0.85%	7.88%	0.00%	8.17%	4.76%
GB	89.94%	10.06%	1.44%	10.11%	6.25%	10.34%	8.76%
GR	95.50%	4.50%	-4.11%	2.30%	12.50%	0.00%	12.50%
HR	90.65%	9.35%	0.73%	9.35%	-	11.11%	6.82%
HU	86.15%	13.85%	5.23%	13.85%	-	23.08%	7.69%
IE	92.31%	7.69%	-0.92%	7.46%	8.33%	6.67%	9.68%
IS	82.50%	17.50%	8.88%	17.50%	-	16.67%	18.75%
IT	87.48%	12.52%	3.90%	12.45%	22.73%	12.32%	13.83%
LI	90.20%	9.80%	1.19%	9.80%	-	9.80%	-
LT	91.67%	8.33%	-0.28%	8.33%	-	6.25%	12.50%
LU	89.66%	10.34%	1.73%	10.34%	-	9.76%	20.00%
LV	84.81%	15.19%	6.57%	17.14%	0.00%	18.75%	12.77%
MT	84.93%	15.07%	6.45%	15.07%	-	12.00%	21.74%
NL	86.64%	13.36%	4.74%	14.35%	4.17%	15.29%	10.00%
NO	95.19%	4.81%	-3.81%	4.81%	-	5.37%	3.63%
PL	87.91%	12.09%	3.47%	12.09%	-	10.00%	14.63%
PT	84.04%	15.96%	7.34%	13.04%	33.33%	9.40%	26.76%
RO	84.91%	15.09%	6.48%	15.09%	-	28.57%	10.26%
SE	94.13%	5.87%	-2.75%	5.87%	-	5.91%	5.56%
SI	88.31%	11.69%	3.07%	9.43%	16.67%	5.88%	16.28%
SK	80.00%	20.00%	11.38%	20.00%	-	33.33%	13.04%
TOTAL	**91.38%**	**8.62%**	**-**	**8.56%**	**13.33%**	**8.41%**	**9.97%**

Note: The table shows the distribution of migrating and non-migrating banks within each country. The fourth column reports the distance from the sample average migration. From the fifth to the last column, the Table shows the migrating banks that: a) did not receive a state aid during the financial crisis; b) received a state aid during the financial crisis; c) were not involved in M&A operations; d) were involved in M&A operations.

Appendix 3: Variables definition

Variables	Definition	Source
ROA	Return on total assets, as a measure of profitability	SNL (S&P Global Market Intelligence)
EQ_TA	Equity over total assets, as a measure of capitalisation	SNL (S&P Global Market Intelligence)
INTANGIBLE_TA	Intangible assets over total assets	SNL (S&P Global Market Intelligence)
C_I	Cost-to-income ratio, as a measure of operating efficiency	SNL (S&P Global Market Intelligence)
SIZE	Natural logarithm of total assets	SNL (S&P Global Market Intelligence)
Z-score	The Z-score measured as [(equity over total assets + the mean of bank's ROA)/the standard deviation of bank's ROA)]	SNL (S&P Global Market Intelligence) Authors' calculations
RWA	Risk weighted assets over total assets as a measure of regulatory risk requirement	SNL (S&P Global Market Intelligence)
COMMERCIAL	A dummy variable equal to 1 if the bank is a commercial bank, 0 otherwise	SNL (S&P Global Market Intelligence)
COOPERATIVE	A dummy variable equal to 1 if the bank is a cooperative bank, 0 otherwise	SNL (S&P Global Market Intelligence)
SAVINGS	A dummy variable equal to 1 if the bank is a saving bank, 0 otherwise	SNL (S&P Global Market Intelligence)
STATE AID	A dummy variable equal to 1 if the bank received a state aid during the financial crisis, 0 otherwise	European Commission and European Central Bank databases
M&A	A dummy variable equal to 1 if the bank is involved in a merger & acquisition (M&A), 0 otherwise	Zephyr Database (Bureau Van Dijk)
TARGET	A dummy variable equal to 1 if the bank is the target of a merger & acquisition (M&A), 0 otherwise	Zephyr Database (Bureau Van Dijk)
FOCUS	A dummy variable equal to 1 if the bank business model is the focused retail BM, 0 otherwise	Authors' calculations
TYPE1	A dummy variable equal to 1 if the bank business model is the diversified retail (type 1) BM, 0 otherwise	Authors' calculations
TYPE2	A dummy variable equal to 1 if the bank business model is the diversified retail (type 2) BM, 0 otherwise	Authors' calculations
WHOLESALE	A dummy variable equal to 1 if the bank business model is the wholesale BM, 0 otherwise	Authors' calculations
INVESTMENT	A dummy variable equal to 1 if bank business model is the investment BM, 0 otherwise	Authors' calculations

Note: The table reports the description of the variables used in the empirical analysis and in the last column it reports the sources.

Appendix 4: Propensity Score Matching

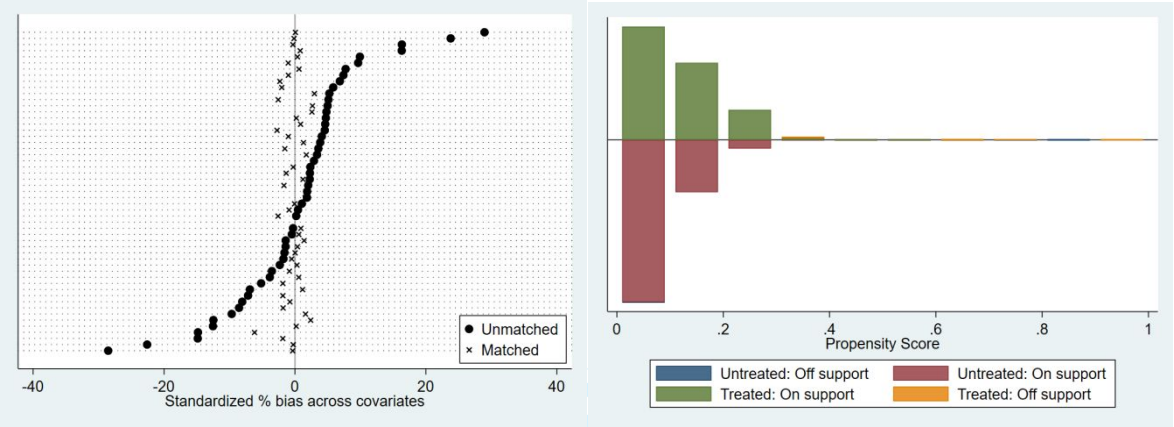
Table 4.A Common Support

Treatment	Off support	On support	Total
Untreated	27	15,398	15,425
Treated	5	1,581	1,586
Total	32	16,979	17,011

Note: Tables show the number of observations on support and off support for our analysis after the matching between treated and untreated banks. We observe that only 32 observations are off support and are excluded from our analysis.

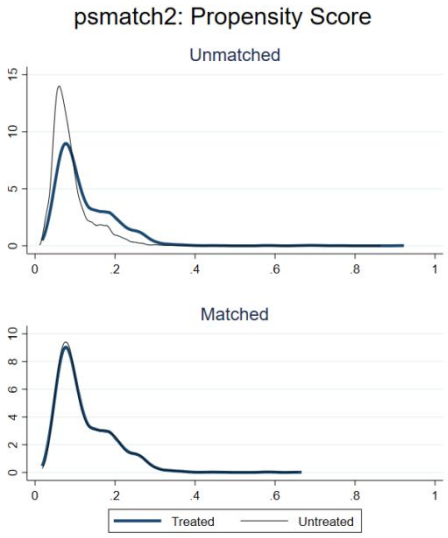
Figure 4.A Graphic-test after matching

Panel A *Panel B*



Note: Panel A displays the Dot chart showing standardized % bias for each covariate before and after matching. Panel B shows the distribution of the propensity score both of treated and untreated banks.

Figure 4.B Distribution of Propensity score before and after the matching procedure



Note: Figure shows the distribution of the propensity score before and after the matching procedure. Treated refers to the migrating banks and Untreated to non-migrating banks.