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Bank Business Model Migrations in Europe: Determinants and Effects

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In response to post-crisis regulatory reforms, the European banking sector has undergone significant 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 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 impact remains.

Introduction

Since the global financial crisis, the European banking sector has undergone fundamental changes that have led banks to reconsider their business models (BMs). The introduction of new and more stringent capital and liquidity regulation under Basel III; the intensifying competition by emerging Fintech firms under the new European Union (EU) Payment Services Directive (PSD2); the organizational restructuring imposed by political choices (such as Brexit or state-aid interventions); and a challenging macroeconomic environment with negative interest rates are among a few of the many challenges posed to bank performance. To remain profitable in such a fast-changing landscape, banks need to prioritize their activities as well as their funding sources. Boards' strategic choices will be reflected in changes in balance sheet composition, and these will ultimately influence bank performance and shareholders' value.

Banks change their BM for a variety of reasons: (i) to improve performance; (ii) to diversify risks/products/markets/revenue sources; (iii) to pursue growth strategies, via acquisitions; (iv) as a consequence of changes in demand for banking services; and (v) following regulatory changes. Business model changes are strategic

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organizational changes, and similar to mergers and acquisitions (M&As), do not always add value (Malmendier, Moretti and Peters, 2018). In addition, frictions linked to BM switching, including the costs – financial, organizational, technological and staff-related – associated with the decision to enter a new strategic business area, launch a new line of products or compete in new fields where incumbents have a competitive advantage (for instance, a greater mastering of emerging technologies) may harm performance, at least in the short term. This aspect might be even more crucial for poorly performing banks 'gambling for resurrection' by changing their BM.

Against this background, this paper investigates the determinants of bank BM migrations and their effects on bank performance. The importance of understanding and analysing bank BMs was also acknowledged by EU regulators: a central component of the Supervisory Review and Evaluation Process (SREP)[1] is the requirement that the EU competent supervisory authorities integrate bank BMs into the supervisory framework.

More specifically, our study addresses the following research questions: (i) What are the determinants of a bank's decision to change the BM? (ii) What are the effects of such strategic decisions on the bank performance (i.e. profitability, risk and cost efficiency) in subsequent years? (iii) Are the outcomes of migrations driven by exogenous circumstances different from strategically driven migrations?

To answer our research questions, we collect balance sheet data for a large sample of 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 BMs, using cluster analysis. We then track each bank over its lifetime in the sample to assess whether it changes its BM. We find that, in general, banks' BMs 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 BM migrations. We apply logistic regressions to the entire sample and find that smaller, less profitable banks are more likely to change their BM, perhaps in search of 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 BMs on bank performance, with the switch considered as the treatment, the switchers as the treated sample and the non-switcher as the untreated sample. Our results 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 exogenously driven migrations from strategic migrations. We find that when the BM switch is exogenously driven, as in the case of banks that were acquired or that received 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 matching procedures.

The contributions of our paper are manifold. First, we build on the literature on BM identification (Foss and Saebi, 2017; Saebi, Lasse and Foss, 2017; Zott and Amit, 2007, 2010; Zott, Amit and Massa, 2011) and present a detailed analysis of the BMs of a large and representative sample of European banks during an extended period, which includes the years during and after the sovereign debt crisis. We build upon the strand of the literature that posits balance sheet composition can be linked more directly and stably to banks' strategic choices (Ayadi and de Groen, 2011; Farnè and Vouldis, 2017; Hryckiewicz and Kozlowski, 2017; Roengpitya, Tarashev and Tsatsaronis, 2014). Second, we evaluate all BM migrations over the sample period and present a detailed analysis of migrating banks' characteristics. Except for Roengpitya *et al*. (2017), in most studies, bank BMs are considered static and are identified once over the sample period. Our analysis allows us to develop an understanding of the changing banking

[1]https://www.eba.europa.eu/documents/10180/935249/EBA-GL-201413+(Guidelines+on+SREP+methodologies+and+processes).pdf.

sector landscape post-crisis. Third, departing from the previous literature that focused on the definition of BMs and the analysis of the relationship between BMs and some accounting measures, such as performance or risk (Altunbas, Manganelli and Marques-Ibanez, 2011; Ayadi and de Groen, 2014; Kohler, 2015; Mergaerts and Vander Vennet, 2016), 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' BM decisions, and the effect of these strategic changes on banks' profitability, efficiency and risk profile.

Literature review

The BM concept has received increasing attention in the academic literature, given that BM choices affect firms' value creation and performance (Zott and Amit, 2008). Baden-Fuller and Morgan (2010) argue that both the concept and definition of BMs are useful to classify businesses in a taxonomy or typology; to compare their evolution and investigate how businesses are coping with technology and innovation. Despite the voluminous literature,[2] BM research has not yet reached a consensus on definitions and classifications (Baden-Fuller and Haefliger, 2013; Zott, Amit and Massa, 2011), making it difficult for managers to use research findings in their decision-making (Fjeldstad and Snow, 2018). In the context of our study, we consider the operational dimension of the BM, that is, how a firm conducts its business, in terms of its product/service offerings, its target customers and the markets it is active in (Christensen, 1997). We are also interested in the dynamic dimension of a BM: how firms adapt and change over time (Fjeldstad and Snow, 2018; Teece, 2010). In particular, we will focus on bank BMs as, unlike other service firms, their BMs are influenced not only by the value proposition to customers but also by regulatory restrictions.

The academic literature on bank BMs has grown substantially in recent years, as the exogenous shocks of the financial and economic crises, and the related re-regulation process, questioned the pre-crisis models of doing business and drove banks to reassess their choices and strategies. New technologies, together with regulatory changes, lead to a rapid shift in the provision of services, including banking. This trend, which started with the emergence of new electronic channels of delivery (Li, 2002), has been compounded by the global financial crisis and the rapid growth of fintech innovation leveraging new technologies and the use of 'big data' and their impact on firm performance (Sena *et al*., 2019).

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

Bank business model identification

The literature on bank BM identification builds on the stream of the management literature that rests on the idea that BMs are defined with respect to the activities that a firm (bank) undertakes (Parmigiani and Mitchell, 2009; Saebi, Lasse and Foss, 2017; Vidal and Mitchell, 2013; Zott and Amit, 2007, 2010; Zott, Amit and Massa, 2011). Accordingly, studies that follow this general approach have tried to offer an acceptable classification of bank BMs using balance sheet data (Ayadi and de Groen, 2011, 2014; Flori, Giansante, Girardone, and Pammolli 2019; Hryckiewicz and Kozlowski, 2017; Roengpitya, Tarashev and Tsatsaronis, 2014). As balance sheet structure can be linked more directly to banks' strategic choices compared to income composition, income statement variables are not used to define BMs. Instead, as financial and economic results depend on the strategy adopted, they are used primarily ex-post to gauge the existence of differential performance among different BMs.

Although the allocation of banks to business clusters is mainly data-driven, it incorporates subjective elements, since researchers select the balance sheet dimensions to perform hierarchical clustering. Two recent studies by Farnè and Vouldis (2017) and Roengpitya, Tarashev, Tsatsaronis, and Villegas (2017) propose a data-driven approach to minimize

[2]For a critical review of the literature on business models, see, among others, Foss and Saebi (2017).

subjective views and expert judgement in the choice of clustering variables. Taking a completely different approach, a recent study by Cernov and Urbano (2018) proposes a mixed methodology for BM classification, combining both qualitative and quantitative components. Although leveraging different methods, all studies tend to identify four/five different clusters that distinguish between retail-oriented and market-oriented BMs. 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 BMs and bank characteristics, such as size, capitalization, risk, performance, operating efficiency and ownership (Altunbas, Manganelli and Marques-Ibanez, 2011; Ayadi and de Groen, 2014; De Meo, De Nicola, Lusignani, Orsini, and Zicchino 2018; Hryckiewicz and Kozlowski, 2017; Köhler, 2015; Mergaerts and Vander Vennet, 2016) 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 (Flori *et al*., 2019; Lucas, Schaumburg and Schwaab, 2019).

This literature's main findings suggest that market-oriented BMs (investment and wholesale banks) delivered higher performance before the financial crisis, although at the expense of a more significant accumulation of risk. In contrast, retail-oriented banks contributed to the real economy significantly more than other BMs. Retail banks also appear to perform better in the long run (during and after the financial and economic crises) as they exhibited higher profitability in terms of return on assets (ROA), return on equity (ROE) and net interest margin (NIM) in addition to lower vulnerability to distress (Mergaerts and Vander Vennet, 2016).

The evolution of bank business models

In most studies, BMs 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 bank BMs have evolved and the extent to which the transition impacts relative performance, measured by ROE, around the time of the switch. Somewhat surprisingly, they find no evidence that underperformers are inclined to switch.

Data and descriptive statistics

Data

Our initial sample is composed of 3,287 banks from 32 EEA countries and Switzerland during the period 2010–2017, for a total of 23,883 bank-year observations. The sample covers more than 95% of the total banking assets in the EEA. In terms of specialization, our sample includes 815 commercial banks, 692 savings banks, 1,702 co-operative banks, 78 public banks and 32 banks that were nationalized 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) from the Zephyr database (Bureau Van Dijk).

Identification of business models

Our starting point is the identification of bank BMs, using cluster analysis. We build upon the work of Ayadi and de Groen (2014) and adopt Ward's method (Ward, 1963), which is a criterion applied in hierarchical cluster analysis with the aim of grouping together entities with similar characteristics. All bank-year observations are clustered together, and Ward's algorithm is run only once for the whole period investigated (2010–2017).[3]

Assuming that banks choose their BM, 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

[3]Although the average cluster characteristics remain constant during the sample period, the key advantage of this method is that the entire dataset is used for inference on cluster allocation and cluster means. This allows us to observe the migrations among different business models, because clusters are linked together across time.

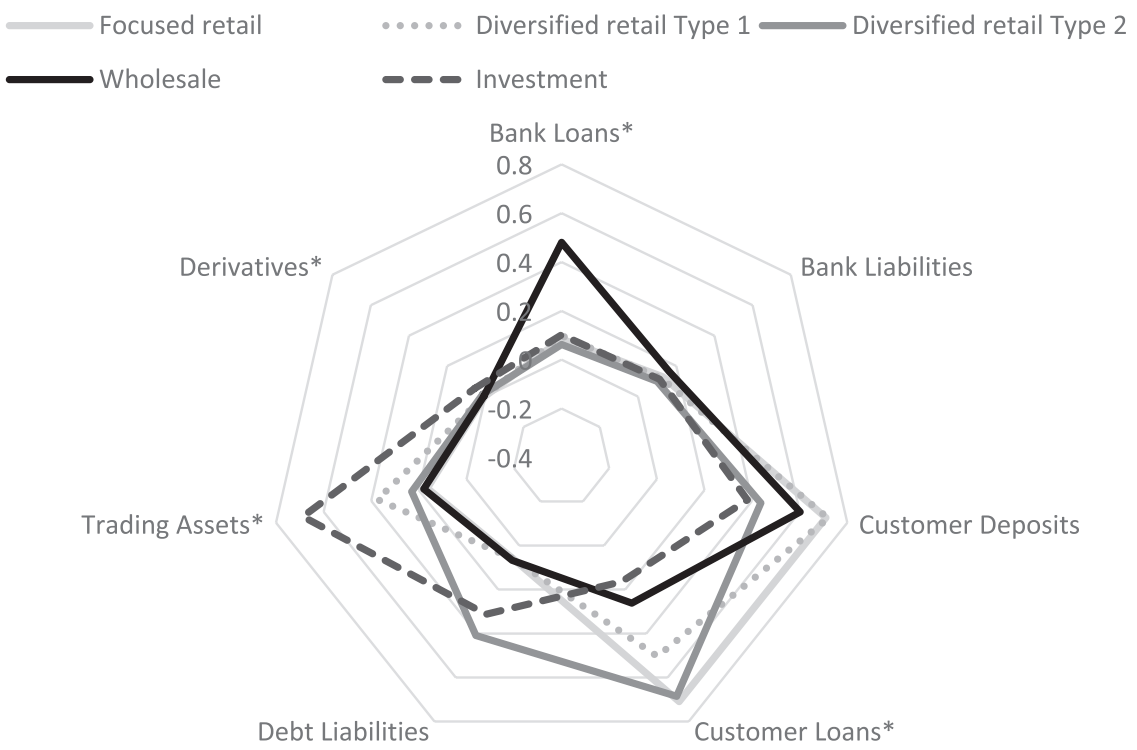

Figure 1. Bank business model definition
Note: The figure shows the differences in terms of bank assets and liabilities in the five BMs identified. The items with an asterisk are those used in the cluster analysis to define the number of clusters. Focused retail, diversified retail (type 1 and type 2)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

clusters: loans to banks, customer loans, trading assets, debt liabilities and derivative exposures; all variables are considered as a percentage of total assets.[4] In line with the literature, our cluster analysis results document the presence of five BMs in the European banking industry:

(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, and 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 BMs identified. Items with an asterisk are those used in the cluster analysis to define five BMs.[5]

[4]More specific information about the clustering methodology and the variables are included in the online Supporting Information (1. The cluster analysis).
[5]More details about the distribution of banks among business models, by year, by country, by ownership structure, etc., are included in the online Supporting Information (2. Stylized facts on bank business models and migrations).

Table 1. Business model migrations

Category	Number of banks	Bank-year observations
Non-migrating	1,815	21,825
Migrating:	1,472	2,058
- *One migration*	*998*	998
- *More than one migration*:	*474*	*1,060*
. *Progressively*	*353*	*789*
. *Revert back*	*121*	*271*
Total	**3,287**	**23,883**

Note: The table shows the composition of the sample in terms of the number of banks and bank-year observations, distinguishing between migrating and non-migrating banks. Migrating banks and bank-year observations are divided between banks that switch only once and those that switch more than once. Banks that change BM more than once during the sample period are further divided into banks that change BM progressively (e.g. from focused retail to a more diversified BM) and banks that eventually revert to their previous BM.

Identifying business model migrations

Given that we are interested in BM 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 its BM only if the bank does not return to the previous BM in the following year.[6] More specifically, we are interested in *stable migrations*, that is when: (a) the bank maintains the same BM for at least 2 years after migration; or (b) the yearly change in BM refers to a continuous evolution of BMs, from focused to diversified or vice versa.

Table 1 shows the results of our initial analysis regarding the distribution of migrating banks. From a total of 3,287 banks in our sample, 1,472 banks migrate at least once. Among migrating banks, 998 banks change BM just once and remain in the new BM for the rest of the sample period. The remaining 474 banks switch more than once. We observe two types of migrations: (a) banks that change BM in a progressive direction (i.e. from focused to diversified or vice versa); (b) banks that revert to their initial BM. Within the group of banks that migrate more than once, 353 banks switch progressively and 121 banks eventually return to the original BM. Therefore, in most cases, migration is permanent, and when banks move more than once, they generally do not return to the initial model. In terms of the total number of observations in the period under investigation (2010–2017), we identify 2,058 migrations, corresponding to about 8.6% of the sample (23,883 observations).

Next, we analyse migrations by bank size, by ownership and distinguishing between Eurozone and non-Eurozone countries.[7] To account for the possible crisis-induced changes in BMs, we divide the sample period into two subperiods: the sovereign debt crisis (2010–2013) and recovery (2014–2017).

Following the European Central Bank, we identify three size groups using a threshold based on the total assets of the banking sector in the preceding year. Large banks are those 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%; small banks are banks with total assets less than 0.005% of the total. Table 2(Panel A) 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 mi-

[6]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.

[7]The Eurozone is an economic and monetary union of 19 of the 28 EU 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 have joined: Greece (2001); Cyprus (2008); Malta (2008); Slovakia (2009); Estonia (2011); Latvia (2014); Lithuania (2015); and Slovenia (2017). We consider non-Eurozone banks from EU member states which have not adopted the euro as their national currency.

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

	Non-migrating banks		Migrating banks	
	Number of observations	Percentage	Number of observations	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%
Nationalized	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%
Panel E: Temporal distribution				
Crisis	11,633	93.49%	810	6.51%
Recovery	10,192	89.09%	1,248	10.91%
Total	**21,825**	**91.38%**	**2,058**	**8.62%**

Note: Panel A shows the distribution of migrating and non-migrating among banks of different sizes: large, medium and small. The size buckets are identified using the ECB threshold based on the total assets of the banking sector 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%; 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 bank ownership: cooperative, commercial, savings, public and nationalized banks. Panel C shows the distribution of migrating and non-migrating banks in the Eurozone and non-Eurozone. 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. Panel E shows the distribution of migrating and non-migrating banks in the crisis (2010–2013) and recovery (2014–2017) periods.

grations is present among nationalized and commercial banks – 12.96% and 11.09%, respectively (Table 2, Panel B).

Next, we investigate the distribution of migrations by the country of origin of the parent bank. First, we distinguish between Eurozone and non-Eurozone banks. Table 2(Panel C) shows a similar distribution of migrating banks in the two geographical areas. In Table 2(Panel D) we distinguish between Mediterranean countries, Eastern European countries and Continental/Nordic European countries.

We find that migrations are more frequent for banks headquartered in the Mediterranean and Eastern European countries. This result could be ascribed to their greater exposure to extreme institutional environments during our sample period. Southern Eurozone countries such as Greece, Italy and Spain were among the hardest hit by the sovereign debt crisis. Eastern European countries' banking sectors faced an aggressive reduction in lending by foreign-owned banks in response to the difficulties faced by parent banks in their home countries after the financial crisis (Iwanicz-Drozdowska, Bongini, Smaga, and Witkowski 2018).

Finally, in Table 2(Panel E) we look at the distribution of migrations over time: we observe that more migrations took place in the post-crisis period (10.91% vs. 6.51%), which is consistent with the restructuring the industry experienced post-crisis.

The analysis of migrations indicates that, by and large, BMs 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.

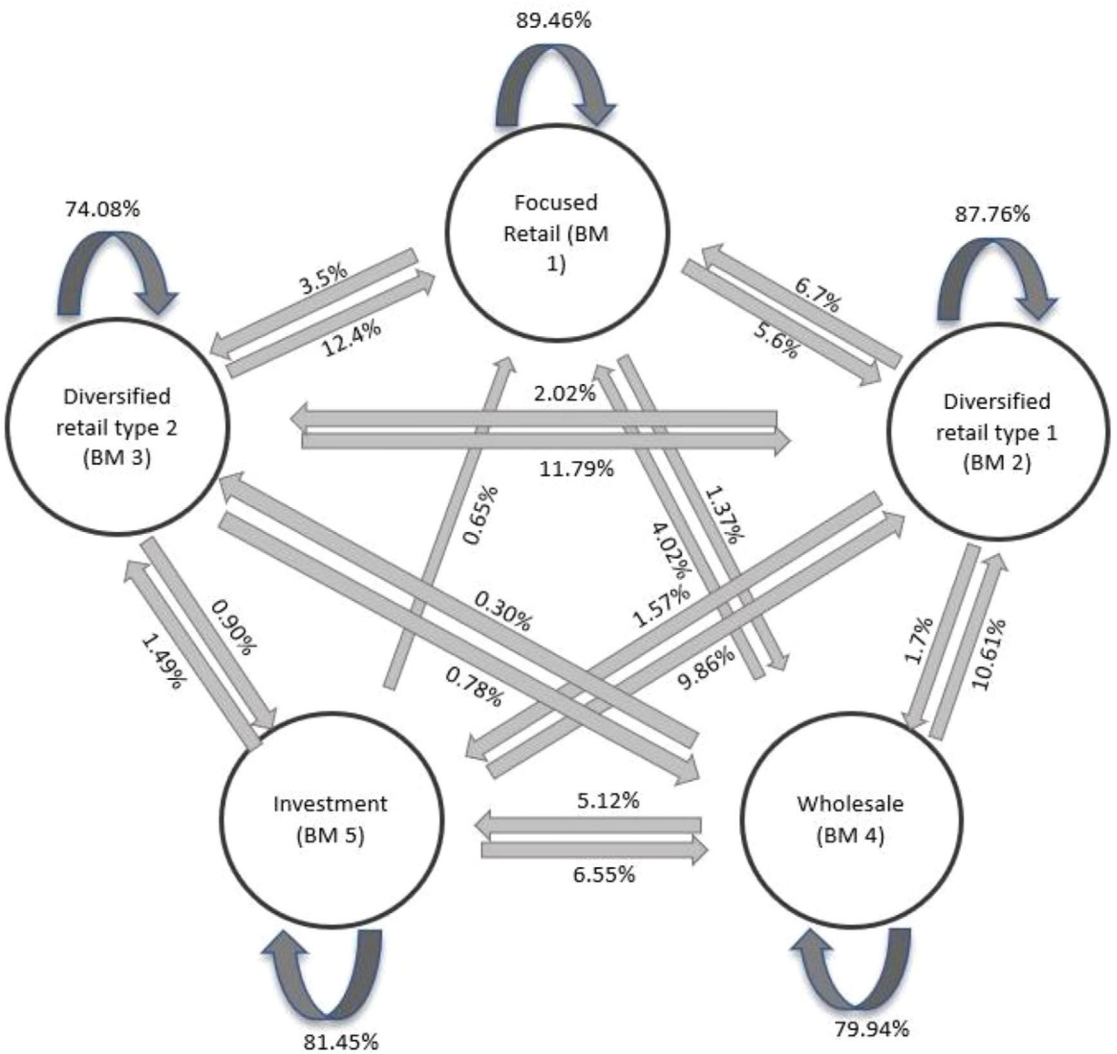

Figure 2. Transition chart for the period 2010–2017 and final distribution of the number of banks among different business models [Colour figure can be viewed at wileyonlinelibrary.com]

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 BM in the following period. The table shows the distribution of banks among the different BMs during the crisis and recovery period, and the distribution over the total period. When the transition between two BMs is not shown, it means that the migration is lower than 0.5%.

In the next step, we link the migrations to the different types of BMs identified for our sample of banks.

Figure 2 illustrates the transition matrix (in terms of the number of banks) for the five models, during the sample period. Focused retail banks show the highest persistence in their chosen BM: 90% remains within the same BM throughout the entire period. Similarly, the majority of diversified retail (type 1) banks maintains the same BM (87.7%), whereas the percentage is slightly lower for the other three BMs: less than 80% in the case of diversified retail (type 2) and investment banks; even lower for wholesale banks. Considering both inflows and outflows from one BM to another, focused retail banks are net acquirers (+13.27%) along with diversified retail (type 1) (+25.64%). By contrast, all other models lose more banks than they receive. Our results show a general tendency towards more retail-oriented BMs (i.e. focused retail and diversified type 1).

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

	Business models	Focused retail	Diversified (type 1)	Diversified (type 2)	Wholesale	Investment
Panel A: Full sample period (2010–2017)						
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 BMs during the whole period investigated (2010–2017). Shaded entries on the diagonal show 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 entries in bold (Total, Crisis and Recovery) illustrate the percentage of total bank assets that migrate from other BMs to the BM observed during the period.

Table 3 shows the distribution of migrations among different BMs. Table 3(Panel A) reports transitions across models over the entire sample period: we highlight which BMs are stable and which BMs are the most attractive (net acquirers). 'Banks that moved to the focused retail BM 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(Panels B and C) reports the transition matrix focusing on the two subperiods considered (i.e. sovereign debt crisis period (2010–2013) and recovery (2014–2017)). During the crisis period, we observe that banks migrated to the diversified retail (type 1) and investment BM, while during the recovery period, larger banks moved to the diversified retail (type 1 and type 2) BM.

Table 4 presents the descriptive statistics for the full sample, comparing the characteristics of banks that migrate with those that do not. Our findings emphasize that, on average, migrating banks have lower profitability and lower cost efficiency (higher cost-to-income ratio). They also display a lower credit portfolio quality, a higher loan loss provision ratio, even if the difference in means is not significant. Referring to the balance sheet structure, migrating banks are smaller, better capitalized, have a higher risk appetite and lower financial stability (a lower Z-score).[8] Moreover, our findings suggest that migrating banks have fewer loans to customers and more trading activities. Concerning their funding strategy, migrating banks have fewer customer deposits over total assets, suggesting a more diversified funding structure.

[8]The Z-score estimates the number of standard deviations that the bank's profits have to fall below its expected value before its equity becomes negative. We calculate the Z-score for a bank as the sum of its capital ratio and return on assets, divided by the standard deviation of its return on assets. The popularity of the Z-score stems from the fact that it has a negative relationship to the probability of bank insolvency (i.e. the probability that the value of bank assets becomes lower than the value of bank debt). A higher Z-score, therefore, implies a lower probability of insolvency (see, among others, Anginer *et al*., 2014; Laeven and Levine, 2009).

Table 4. Summary statistics for all sample banks

	Total sample			Non-migrating banks			Migrating banks			Differences in means		
Variable	Obs.	Mean	SD	Obs.	Mean	SD	Obs.	Mean	SD	Obs.	%	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												
ROA	23,556	0.005	0.054	21,627	0.005	0.049	1,929	0.000	0.095	0.006	106.73%	0.000
ROE	23,519	0.044	0.982	21,598	0.052	0.724	1,921	−0.044	2.430	0.096	184.01%	0.000
NIM	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

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 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. Variable definition

Variable	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 the 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 says the sources.

Empirical analysis

The determinants of business model migration

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

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

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 definitions are reported in Table 5.

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 the leverage ratio (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 BM is driven by the strategic choice of 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.[9]

Next, we include the BMs adopted by the banks in the period before the year observed (t−1) to check whether the probability of migration differs according to the specific BM initially adopted. We include four dummy variables: (i) FOCUSED_BM equals 1 if the bank adopted the focused retail BM 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 BM 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.[10]

The results of the logistic regressions (odd ratios and average marginal effects) are reported in Table 6. The second and third columns report the estimates of Model 1, that includes financial statement and ownership information, the fourth and fifth columns show the results of Model 2, which also controls for the BMs adopted by the 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.

Cooperative banks are less likely to change their BMs during the period under investigation than banks under other ownership forms. This is consistent with the fact that, as cooperative banks are typically not profit maximizers, they are less likely to respond quickly to changes in the competitive environment and might need more time to implement changes. Looking at the BM adopted before the migration, our findings suggest that more retail-oriented banks – those that adopt the focused retail and diversified retail (type 1) BMs – are 7.2 percentage points less likely to change their BM than investment banks (in our analysis this is the reference category), conversely, diversified retail (type 2) banks are 3.4 percentage points more likely to change their BM than investment banks.

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

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 decision to migrate.[11] First, the comparison of migrating banks to non-migrating banks might yield biased 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 BM or differences in the banks' characteristics prior to the migration. Second, considering only migrating banks eliminates the possibility of benchmarking

[9]When the four variables are 0 in all cases, the bank is a public or a nationalized bank.

[10]We do not control for differences in the regulatory framework. Since we focus on European countries, we assume a level of harmonization of the regulatory framework. Country-specific regulations that may affect banks' decisions to change BM (or discourage banks from switching) should be controlled for by country fixed effects.

[11]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.

Table 6. Determinants of banks' propensity to migrate

	Model 1		Model 2	
Variables	Odds	Margins	Odds	Margins
Constant	−0.269	–	0.536	–
	(0.560)		(0.573)	
ETA_{t-1}	−0.241	−0.020	0.0.346	−0.028
	(0.379)	(0.032)	(0.372)	(0.031)
$INTANGIBLE\_TA_{t-1}$	−3.848	−0.322	−6.044	−0.499
	(4.438)	(0.375)	(4.539)	(0.378)
SIZE	−0.097**	−0.008**	−0.129**	−0.011**
	(0.018)	(0.001)	(0.019)	(0.001)
ROA_{t-1}	−5.195**	−0.439**	−4.487**	−0.374**
	(1.138)	(0.096)	(1.113)	(0.092)
$COST\_INCOME_{t-1}$	−0.002	−0.0002	−0.003	−0.0002
	(0.009)	(0.001)	(0.010)	(0.001)
RWA_{t-1}	0.041**	0.003**	0.043**	0.003**
	(0.013)	(0.001)	(0.013)	(0.001)
Z_SCORE_{t-1}	−0.0007	−6.3e−05	−0.0003	−2.5e−05
	(0.0005)	(0.000)	(0.0004)	(0.000)
COMMERCIAL	0.068	0.005	0.155	0.012
	(0.170)	(0.014)	(0.172)	(0.014)
COOPERATIVE	−0.404**	−0.034**	−0.234	−0.019
	(0.181)	(0.015)	(0.183)	(0.015)
SAVINGS	−0.109	−0.009	0.143	0.011
	(0.182)	(0.015)	(0.183)	(0.015)
$BM\_FOCUSED_{t-1}$	–	–	−0.870**	−0.072**
			(0.113)	(0.009)
BM_TYPE1_{t-1}	–	–	−0.630**	−0.052**
			(0.108)	(0.009)
BM_TYPE2_{t-1}	–	–	0.408**	0.034**
			(0.120)	(0.010)
$BM\_WHOLESALE_{t-1}$	–	–	−0.034	−0.002
			(0.132)	(0.011)
YEAR FE	YES	YES	YES	YES
COUNTRY FE	YES	YES	YES	YES
Observations	17,137	17,137	17,137	17,137
No. banks	3,062	3,062	3,062	3,062
R-squared	0.0317	–	0.0572	–
Log likelihood	−5,244.5875	–	−5,106.1998	–

Note: The table reports both odds ratios and average marginal effects (AME) coefficients of the logit regression estimates of banks' propensity to migrate. The dependent variable is equal to 1 if a bank changes its BM and 0 otherwise. All explanatory variables, with the 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 equal to 1 if the bank is a commercial bank and 0 otherwise; COOPERATIVE is a dummy variable equal to 1 if the bank is a cooperative bank and 0 otherwise; SAVINGS is a dummy variable equal to 1 if the bank is a savings bank and 0 otherwise; BM_FOCUSED is a dummy variable equal to 1 if the bank has a focused retail BM in the year before the migration and 0 otherwise; BM_TYPE1 is a dummy variable equal to 1 if the bank has a diversified retail (type 1) BM in the year before the migration and 0 otherwise; BM_TYPE2 is a dummy variable equal to 1 if the bank has a diversified retail (type 2) BM in the year before the migration and 0 otherwise; BM_WHOLESALE is a dummy variable equal to 1 if the bank has a wholesale BM in the year before the migration and 0 otherwise.
,* Statistical significance at the 5% and 1% levels, respectively.

the hypothetical performance that the bank would have had, had it not changed its BM.

To mitigate these endogeneity issues, we employ a PSM approach. Matching is a popular non-parametric approach; it is largely adopted in policy impact analysis (Essama-Nssah, 2006) and has been adopted in the finance literature to gauge the impact of diverse strategic choices (Casu, Clare, Sarkisyan, and Thomas 2013; Palvia, Vahamaa and Vahamaa, 2015; Villalonga, 2004).

Table 7. The effect of migration on bank performance

ATET	Coefficient	Std. Error	95% confidence 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	0.0.345	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: The table reports the effects of migration on bank performance, shown as the average treatment effect on the treated (ATET). If the ATET is different from zero, the change in the performance indicator over the time window is different for switching banks, compared to their matched non-switching peers. We matched migrating banks with banks that never migrate during the period investigated, on the propensity score, by means of nearest-neighbour matching with replacement, with a 1% caliper. This resulted in 1,585 bank-year observations in the treated group and 4,762 bank-year observations in the control group. The performance indicators are: ROA as a proxy of bank's profitability, Z-score as a proxy of risk of default, the cost-to-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 of migration on different time windows. The matching variables are those used in the main analysis to measure the propensity score. The number of matches is equal to 4.
,* Statistical significance at the 5% and 1% levels, respectively.

To determine the impact of BM migration on bank performance, we focus on two groups of banks: the treatment group for the PSM analysis consists of banks that switch BM in any year from 2011 to 2017; the control group is built from banks that never switch BM over the same period. This results in 1,585 bank-year observations in the treatment group and 15,398 bank-year observations in the control group. We then proceed to the implementation of PSM, which 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 6 (Model 2).[12] Our matching procedure controls for: (i) bank-specific characteristics in terms of profitability, efficiency, stability and risk; (ii) bank ownership; and (iii) bank BMs at year t−1. This allows us to compare banks that share the same cluster (BM) and are very similar in terms of profitability, risk and ownership, differing only for the decision to change the BM. Once the propensity scores are estimated, we proceed to match migrating banks with banks that never migrate during the period investigated. We employ nearest-neighbour matching with replacement, and impose a caliper of 1% to minimize the risk of bad matches and increase the matching quality (Caliendo and Kopeinig, 2008). This leaves us with 1,585 bank-year observations in the treated group and 4,762 bank-year observations in the matched control group.[13]

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 distance to default (Z-score); cost efficiency (measured by cost-to-income ratio); and finally, risk appetite (measured by RWA density). 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 2-year window around the time of migration.

Table 7 reports the effects of migration on bank performance, shown as the average treatment effect on the treated (ATET). The interpretation of the results is as follows: if the ATET is different from zero, the change in the performance indicator over the time window is different for switching

[12]This was 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).
[13]The interested reader can refer to the online Supporting Information (3. Propensity score matching) for details about the distributions of the pre-matching sample and the post-matching sample.

banks, compared to their matched non-switching peers. 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 materialize. 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 coefficient, indicating that migrating banks improve their stability following migration more than non-migrating banks. Finally, after an increase in the year of migration, we find a negative coefficient for 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 summarize, 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 which change their BM improve their performance post-migration more than non-switching banks.

Exogenously driven migrations

To answer our third research question, we now focus on those migrations driven by exogenous circumstances. We expect that different reasons behind the decision to migrate might have a diverse impact on performance outcomes. To this end, we focus on two subsamples: (a) banks that, following an acquisition, continue to operate as separate entities (that is, the acquired bank becomes an integral part of the acquiring banking group) and both entities continue to trade with their original names;[14] and (b) banks that continue to operate after receiving state aid, in the form of recapitalizations, public guarantees or liquidity injections.

We argue that for targets, the change in the BM might be imposed by the acquirer. Target banks are often smaller institutions acquired by larger groups and, therefore, more likely to undergo substantial corporate restructuring initiated by the bidder post-acquisition. Similarly, for troubled banks, the change in the BM might be a precondition to accessing government funding. We then consider banks which switch BM following acquisitions or state aid and compare them with matched banks who do not. In this way, we aim to isolate the effects of migrations from the impact of acquisitions or state aid on bank performance. The results of this analysis are shown in Table 8.

Table 8 (Panel A) reports the impact of BM changes following acquisitions. Our results suggest that, after an initial deterioration in the year of migration, the cost-to-income ratio of migrating banks improves more than that of non-migrating banks. We also find a positive effect on profitability (ROA). It seems that acquired banks that change their BM improve their cost efficiency and profitability more than those banks that only face one extraordinary operation (acquisitions). Vander Vennet and Gropp (2003) and Al-Sharkas, Hassan and Lawrence (2008) provide evidence that M&As have a positive effect on bank cost efficiency. We add to these findings by showing that the positive impact on cost efficiency post-merger is driven by changes in the BM. We also find that 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).

Table 8(Panel B) reports the estimates of the effects of migrations for banks that received state aid. We find that, in the year of migration and subsequent years, troubled banks that also changed BM experience an 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.

Additional analysis and robustness tests

Migration effects and specific business models

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

[14]An example is the Halifax (UK), which is part of the Lloyds Banking Group since the takeover in 2009 but continues to trade under the Halifax brand. This allows us to continue observing both the acquirer and the acquired banks. We argue that the Halifax operating business model is decided by the parent bank, Lloyds Banking Group.

Table 8. The effect of externally imposed migrations

ATET	Coefficient	Std. Error	95% confidence interval	
Panel A: Effects of migrations on banks involved in acquisitions as targets				
$ROA_t - ROA_t$	−0.018	0.015	−0.048	0.011
$ROA_{t+1} - ROA_t$	0.003*	0.001	−0.000	0.007
$ROA_{t+2} - ROA_t$	0.003	0.003	−0.002	0.009
$Z_t - Z_{t-1}$	2.185*	1.319	−0.401	4.772
$Z_{t+1} - Z_t$	0.017*	1.836	−3.581	3.617
$Z_{t+2} - Z_t$	0.975*	1.347	−1.666	3.617
$C\_I_t - C\_I_{t-1}$	0.376	0.434	−0.475	1.227
$C\_I_{t+1} - C\_I_t$	−0.551*	0.338	−1.214	0.110
$C\_I_{t+2} - C\_I_t$	0.607*	0.335	−1.264	0.0502
$RWA_t - RWA_{t-1}$	−0.028	0.031	−0.0896	0.032
$RWA_{t+1} - RWA_t$	0.001	0.011	−0.020	0.024
$RWA_{t+2} - RWA_t$	0.003	0.016	−0.029	0.035
Panel B: Effects on migration of banks that received state aid				
$ROA_t - ROA_{t-1}$	−0.001	0.006	−0.013	0.012
$ROA_{t+1} - ROA_t$	0.004	0.017	−0.029	0.028
$ROA_{t+2} - ROA_t$	0.015	0.017	−0.018	0.048
$Z_t - Z_{t-1}$	0.849*	0.920	−0.954	2.652
$Z_{t+1} - Z_t$	0.195*	1.020	−1.804	2.196
$Z_{t+2} - Z_t$	0.279	1.427	−2.518	3.076
$C\_I_t - C\_I_{t-1}$	−0.135	0.764	−0.633	1.363
$C\_I_{t+1} - C\_I_t$	−0.914	0.683	−2.253	0.424
$C\_I_{t+2} - C\_I_t$	−0.914	0.815	−2.513	0.684
$RWA_t - RWA_{t-1}$	0.002	0.158	−0.030	0.031
$RWA_{t+1} - RWA_t$	−0.011	0.013	−0.037	0.015
$RWA_{t+2} - RWA_t$	0.006	0.024	−0.041	0.053

Note: The table reports the results of the average treatment effect on the treated (ATET). If the ATET is different from zero, the change in the performance indicator over the time window is different for switching banks, compared to their matched non-switching peers. We matched migrating banks with banks that never migrate during the period investigated, on the propensity score, by means of nearest-neighbour matching with replacement, with a 1% caliper. In the acquisition subsample there are 1,379 bank-year observations, relative to 454 banks. There are 99 migrations during the period observed. In the state-aid subsample, there are 285 bank-year observations, relative to 40 banks, of which 25 are migrating banks. The outputs are: ROA as a proxy of bank's profitability, Z-score as a proxy of risk of default, the cost-to-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.

*** Statistical significance at the 10% and 5% levels, respectively.

The results, reported in Table 9, show that migration outcomes differ according to the specific BM 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. Specifically, we do not find that investment banks moving to a retail BM improve their ROA. In this case, banks switching to a more retail-focused BM are increasing traditional lending, a strategy that, considering the present low interest-rate environment, does not necessarily deliver higher performance.

In general, our results underline that BM 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 BM, as some switches improve performance (in terms of profitability, stability, cost efficiency and risk) more than others. This result emphasizes that not all migrations are equal and deliver the same results. The choice of BM 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 BM and the BM after migration. To overcome this problem, we categorize BMs in two main clusters: (i) diversified, including diversified retail (type 1 and type 2); (ii) specialized, comprising those BMs that are

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 the treated (ATET). We match migrating banks to each BM to detect whether migrating in a specific BM 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 BMs to which a bank does not migrate. In the second column, we compare banks that migrated to the focused retail BM to all other migrations; in the third column, we compare banks that migrated to the diversified retail (type 1) BM to all other migrations; in the fourth column, we compare banks that migrated to the diversified retail (type 2) BM to all other migrations; in the fifth column, we compare banks that migrated to the wholesale BM to all other migrations; in the last column, we compare banks that migrated to the investment BM 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-to-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.
*, **, *** Statistical significance at the 10%, 5% and 1% levels, respectively.

oriented towards a more specialized activity (i.e. focused retail, investment and wholesale). 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 BM towards a more specialized one and vice versa. Results are reported in Table OA.1 in the Online Appendix and, not surprisingly, indicate that migrating banks that move to a more specialized BM reduce their costs more than banks that move in more diversified BMs.

Robustness tests

To check the robustness of our results, we re-ran our analysis excluding small cooperative banks. The findings of this analysis are reported in Tables OA.2 and OA.3 in the Online Appendix and are in line with those obtained in the main analysis. We also re-ran the analysis excluding banks that adopt the investment BM, to focus on migrations that do not depend on the sale of trading assets. Results are reported in Tables OA.4 and OA.5 and corroborate our main findings, both in terms of variables that determine the change in the BM and in terms of the effect on bank performance.

Discussion and conclusions

This study evaluates the effects of BM migrations in the European banking industry during a period characterized by profound economic, technological and regulatory changes. Banks face unprecedented threats arising from a combination of factors, such as a damaged reputation, low interest rates, increased digitalization and intensifying competition from non-banks. These trends were compounded by the sovereign debt crisis, which left many banks in several EU countries in need of government bailouts. The re-evaluation of existing BMs is one of the key strategic priorities of banks' senior management, in order to remain profitable in a fast-changing institutional and macroeconomic environment. 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 the structural reforms of the EU banking sector following the turmoil that ensued from the financial and Eurozone crises. Based on a unique definition of BMs and a robust clustering method, we identify the five BMs EU banks operate with and track their evolution over the sample

period. We find that BMs are generally stable, but a substantial part of the sector changed strategic orientation during the sample period. These BM changes do not lead to a banking sector concentration in a particular BM, but each bank's strategic decision depends on its key internal objectives. For our sample banks, the main drivers of BM migration were related to performance improvements: our results show that larger, less profitable and riskier banks are more likely to change their BM.

Is this migration useful, in terms of the ultimate supervisory goals of a more profitable and more stable banking system? 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. Our findings also indicate that the effect of migration differs depending on the BM to which the bank moves. We show that switches to some BMs improve performance more than others, suggesting that banks may choose a specific BM based on their short-term objectives, as well as their long-term plans.

We also conjectured that migrations exogenously imposed on bank management could lead to different results (vis-à-vis non-switchers). For this reason, we investigated the ex-post outcomes of migrations following an acquisition or following state aid, as examples of exogenously driven migrations. We find that the performance effect of exogenous switches is to improve cost efficiency and stability, rather than profitability. In particular, we show that banks which changed their BM post-bailout improved their stability more compared to those which did not change. Government interventions in the banking sector are one of the key manifestations of the impact of a challenging macroeconomic and institutional environment on banks' strategic decisions. Our results provide support for government decisions to grant public funds to troubled banks in exchange for a thorough corporate restructuring.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Table OA.1: The effect of migration from diversified to specialized BMs
Table OA.2: Robustness checks: determinants of banks' propensity to migrate (excluding small cooperative banks)
Table OA.3: Robustness checks: the effect of migration on bank performance (excluding small cooperative banks)
Table OA.4: Robustness checks: determinants of banks' propensity to migrate (excluding investment banks)
Table OA.5: Robustness checks: the effect of migration on bank performance (excluding investment banks)
Additional Material for Bank Business Model Migrations in Europe: Determinants and Effects

1. The cluster analysis
2. Stylised facts on bank business models and migrations
3. Propensity Score Matching