Monetary policy, bank risk taking and financial stability: The role of 'biodiversity' in European banking

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Abstract

This paper examines how ownership structure interacts with monetary policy in shaping financial intermediaries' risk appetite. By constructing an unbalanced panel of commercial, cooperative and savings banks from 17 Western European countries over the 1999-2011 period, we find that differences in organisational form influence the transmission of monetary impulses via the risk-taking channel. While shareholder banks appear to alter the composition of their portfolios more proactively over the business cycle, there is evidence that the effects of lower interest rates on the aggregate level of risk in the economy are dampened by the presence of stakeholder banks. These results suggest that omitting ownership type may lead to incomplete conclusions about the impact of monetary actions on bank risk taking. From a policy perspective, our findings point to the systemic benefits to be derived from a 'biodiversity' of organisational forms in the European banking sector.

Keywords: Cooperative banking model; Corporate governance; Financial crisis; GMM; Shareholder wealth maximisation; Stakeholder value creation

JEL classification: D23; E43; E52; G01; G21; L21

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1. Introduction

The global financial crisis has once again highlighted the wide-ranging implications of a sound financial system for real growth and economic welfare. What triggered this credit crisis and the ensuing economic contraction is likely to intrigue scholars and other observers for years (Acharya and Naqvi, 2012). A growing line of thought places the spotlight on monetary policy and the role it played in influencing financial intermediaries' behaviour (Ioannidou et al., 2015; Jiménez et al., 2014). In the aftermath of the dot-com bust, a number of central banks throughout the world tackled fears of an economic slowdown by gradually decreasing nominal interest rates. By mid-2000s, these policies resulted in nominal rates reaching historically low levels. In the US, money market rates dropped from 6.26% in 2000 to 3.22% in 2005, with a record low of 1.13% in 2003. Similarly, in the euro area money market rates fell from 4.12% in 2000 to 2.09% in 2005, while in the UK they went down from 5.84% in 2000 to 4.68% in 2005. This 'too-low-for-too-long' interest rate environment—the theory goes—spurred risk-taking by banks through changes in risk perception and aversion, thereby adding to the build-up of risks in the economy via a 'risk-taking channel' of monetary transmission (Borio and Zhu, 2012).

Notwithstanding the closer link between monetary conditions and bank risk-taking incentives, little is the attention placed by researchers on how ownership structures interact with monetary actions in influencing the risk appetite of banks. This is surprising, since standard property rights (Alchian and Demsetz, 1972) and agency (Jensen and Meckling, 1976) theories suggest that the form of ownership is a key determinant of firm risk-taking. In addition, whilst the banking literature abounds with attempts to quantify risk-taking behaviour at profit-maximising banks (i.e. 'shareholder banks'), there has been limited focus on the contribution of banks that pursue social as well as financial objectives (i.e. 'stakeholder banks') towards financial stability (Hesse and Cihák, 2007). Such a void is at odds with the financial architecture of many European countries, in which shareholder banks coexist with a substantial—sometimes even dominant—stakeholder banking sector (Ferri et al., 2013). For instance, this is the case in Germany, Italy and Austria, where customer-owned cooperatives and not-for-profit savings banks far outweigh in number their commercial peers. The debate over the benefits of a 'biodiverse' banking system for financial stability has witnessed a renewed interest during most recent years, as stakeholder banks weathered the financial turmoil somewhat unscathed (Ayadi et al., 2009). A case in point is the high resilience exhibited by cooperative banks, which suffered a relatively small portion of the total losses incurred by European banks and hardly required government support (Groeneveld, 2011).[1]

Against this backdrop, the aim of this paper is to reconsider the role of stakeholder banks in monetary economics by examining how bank ownership affects the transmission of monetary policy through the risk-taking channel. Our study is a first attempt to shed light on the implications of banks' missions for the propagation of monetary impulses via the risk-taking channel.[2] Broadly speaking, this article lies at the inter-

[1] According to Groeneveld (2011), the cooperative banking sector is responsible for 8% of all direct losses and write-downs of European banks during the crisis, whilst UBS and HSBC alone accounted for 12% and 10%, respectively.

[2] To our knowledge, the only paper that accounts for differences in bank types—among other aspects—

section of three major bodies of literature. It joins the growing discussion around the link between interest rates and banks' risk appetite. As anticipated above, this strand of research provides empirical support for a risk-taking channel of monetary transmission operating through bank risk perception and tolerance (Ioannidou et al., 2015; Jiménez et al., 2014), yet it is silent on whether differences in ownership structures influence this transmission mechanism. Furthermore, our paper is related to the body of evidence on the implications of bank ownership for monetary policy effectiveness. As this line of enquiry shows (Drakos et al., 2014; Ferri et al., 2014), differences in ownership type indeed matter for the reactions of banks to monetary policy changes. Our research also draws its theoretical foundation from the literature on organisational form and financial stability. Consistent with underlying differences in their business models, empirical evidence suggests that stakeholder banks are generally more stable (Ayadi et al., 2010) and behave less cyclically (Foos, 2009) than their shareholder counterparts.

This paper makes a threefold contribution. First, in responding to recent calls for a better understanding of banks' incentives to take on risk (Gambacorta and Marqués-Ibánez, 2011), our study brings concepts from the property rights (Alchian and Demsetz, 1972) and agency theory (Jensen and Meckling, 1976) perspectives into the analysis of the risk-taking channel. By estimating the differential effects of monetary interventions on bank risk taking owing to organisational forms, our findings may present an enhanced picture of the role played by financial institutions as conduits for monetary policy transmission. Second, this article adds to the paucity of evidence on the functioning of the risk-taking channel during periods of financial distress.[3] As our sample includes the euro area sovereign debt crisis alongside the global financial crisis, it provides us with the opportunity to investigate the extent to which the risk-taking behaviours of banks with alternative forms of ownership vary over the business cycle. Third, this research deals with a significant financial and economic impact, that is, the benefits stemming from a diversity of business models in the banking sector (Ayadi et al., 2009; Ferri et al., 2013). On this front, novel insights into how the interplay between monetary policy and ownership structure shapes banks' risk-taking incentives may be of particular interest to policymakers, especially in countries that are considering processes of mandatory conversion of financial cooperatives to limited company status.

The remainder of the paper is organised as follows. Section 2 reviews the relevant literature and advances our theoretical predictions. Section 3 describes the process we followed in selecting the sample and constructing the variables, along with the econometric model to be estimated. Section 4 illustrates our empirical results and discusses the implications, as well as limitations, of our findings. Section 5 concludes.

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while examining the risk-taking channel of monetary policy is Jiménez et al. (2014).

[3] A notable exception is Maddaloni and Peydró (2013), who use the answers from the *Bank Lending Survey* for the euro area and find that interest rates, together with long-term liquidity provision, led to a softening in lending standards.

2. Literature review

2.1. Monetary policy and bank risk taking

Fuelled by the recent economic downturn, a growing strand of the literature has pointed to an additional channel of monetary transmission operating through the risk-taking incentives of banks. According to Borio and Zhu (2012), changes in official rates affect either risk perception or tolerance via a risk-taking channel of monetary policy.[4] In a nutshell, this channel works via three primary mechanisms: (1) the impact of interest rates on valuations, incomes and cash flows (Borio and Zhu, 2012), (2) the existence of 'sticky' target rates of return (Rajan, 2006) and (3) the reaction function and communication policies of the central bank (Farhi and Tirole, 2012). Among these mechanisms, particular attention has been devoted by researchers to the link between interest rates and the search-for-yield effect. Simply put, this theory posits that a prolonged period of low interest rates may induce a greater degree of procyclical risk taking into the financial system (Rajan, 2006), eventually generating an equilibrium with deteriorated bank portfolios, lower and more volatile profits and higher aggregate credit (Dell'Ariccia and Marquez, 2006). Specifically, the relationship between interest rates and bank risk taking is shown to depend on the bank capital structure (Dell'Ariccia et al., 2014) and the size of the monetary shock (Valencia, 2014).

Drawing on the theoretical framework above, empirical evidence has recently started to explore the link between monetary policy and banks' risk appetite. In what is generally viewed as one of the pioneering contributions in the field, Jiménez et al. (2014) use a micro-level dataset for Spain and find support for a risk-taking channel operating through less-capitalised banks. In a similar vein, Ioannidou et al. (2015) focus on the Bolivian credit market and show that an expansionary monetary policy causes the granting of new loans to less creditworthy borrowers. By building a panel of 'shadow banks', broker-dealers and commercial banks for the US, Germany, UK and Japan, Adrian et al. (2010) uncover a joint dynamics between monetary conditions, financial intermediaries' risk appetite and macro risk premium.

Besides these seminal studies, additional evidence of a risk-taking channel is found for both the US and Europe. On the basis of US data for market-based financial intermediaries vis-à-vis commercial banks, Adrian and Shin (2010) submit that short-term interest rates are important in determining the balance sheet size of financial institutions. Further support for a risk-taking channel in the US is offered by Paligorova and Santos (2013), who collect data at the Bank Holding Company (BHC) level and find that banks charge riskier borrowers (compared to safer borrowers) lower loan spreads in periods of monetary easing than in periods of monetary tightening. Moreover, the relationship between policy rates and bank risk taking appears to be more pronounced for domestic banks of smaller size (Buch et al., 2014) and for better capitalised banks (Dell'Ariccia et al., 2013). Within the European context, early evidence of a link between interest rates and bank risk taking is put forward by Delis and Kouretas (2011), who construct a sample of commercial, savings and cooperative banks from 16 euro area countries and show that the impact

[4] An alternative explanation for monetary policy-induced changes in bank risk taking is put forward by Kishan and Opiela (2012), who identify a 'risk-pricing channel' of monetary transmission operating through the risk pricing of uninsured bank debt in the market for jumbo CDs.

of loose monetary policy on risk assets is amplified for banks with less equity capital as well as more Off-Balance-Sheet (OBS) items. In addition, the strength of the risk-taking channel is found to be reduced by means of more stringent prudential policy on either bank capital or Loan-To-Value (LTV) ratio (Maddaloni and Peydró, 2013). Interestingly, the negative relationship between interest rates and bank risk seems to hold even if one considers somewhat more heterogeneous samples (Altunbas et al., 2014; Maddaloni and Peydró, 2011).

2.2. Bank ownership and monetary policy transmission

In line with the revived interest in the ownership structure of banks and its implications for financial intermediation (Cull and Martínez Pería, 2013), a recent strand of research has begun to examine how banks with different types of ownership react to variations in monetary policy. By focusing primarily on the bank lending channel of monetary transmission (Bernanke and Blinder, 1988, 1992), this literature has been concerned with the consequences of bank ownership for the transmission of monetary impulses via the loan supply of banks. One of the first contributions in this area is advanced by Andries and Billon (2010), who develop a theoretical model to analyse the effects of state ownership and deposit insurance on monetary transmission. By considering a representative bank whose ownership is shared between the government and the private sector, Andries and Billon (2010) show that lending from state-owned banks is less responsive to changes in monetary policy than lending from private banks due to the former's superior ability to raise additional deposits.

Turning to the empirical evidence, support for heterogeneous reactions of different types of banks to variations in the monetary policy stance is provided by Bhaumik et al. (2011). Drawing on bank-level data for India, Bhaumik et al. (2011) find that during periods of monetary tightening state-owned, old private and foreign banks cut back on lending following an increase in interest rates, whilst during periods of monetary easing higher interest rates are associated with a greater disbursal of credit only by old private banks. A different approach to studying the lending channel-bank ownership nexus is advanced by Ferri et al. (2014), who test for the existence of different lending policies between stakeholder- and shareholder-oriented banks. By employing euro-area data over a period covering the global financial crisis, Ferri et al. (2014) offer evidence suggesting that stakeholder banks attempt to smooth financial conditions for their customers by adopting less procyclical lending policies—regardless of their financial situation or the general economic environment—than shareholder banks. A recent effort to take the ownership status of banks into account when estimating the link between interest rates and bank risk taking is presented by Drakos et al. (2014). On the basis of a panel of commercial, savings and cooperative banks from 10 Central and Eastern European countries as well as Russia, Drakos et al. (2014) submit that the risk behaviours of foreign, well capitalised banks from the former countries appear to be the most responsive to declining short-term rates.

2.3. Organisational form and financial stability

There is plentiful evidence in the literature suggesting that the organisational form of banks has a bearing on their behaviour, performance and ultimate survival (Fama and Jensen, 1983; O'Hara, 1981; Rasmusen, 1988). While commercial banks are driven by the main objective of maximising shareholder wealth, cooperative and savings banks strive to create value for a larger set of stakeholders. The distinguishing feature of cooperative banks is that they are owned by their members, thus implying the absence of any formal separation between owner-customers and non-owner-customers (Ayadi et al., 2010). Furthermore, members are entitled to only one vote, stakes are generally not marketable[5] and the distribution of profits is limited, consistent with cooperatives being built around an intergenerational endowment for the benefit of both current and future customers (Fonteyne, 2007). Like cooperatives, savings banks are not strictly profit-oriented institutions and are characterised by a dual financial and social mission (i.e. 'double bottom line') to serve the community in which they operate (Ayadi et al., 2009). However, savings banks differ from cooperatives in that they are owned by either an organisation that belongs to the government or by private foundations, suggesting that customers of savings banks have less ownership rights than at cooperative banks (Ferri et al., 2013). For all of these reasons, it is unlikely that the property right structure of stakeholder banks leads to profit-maximising behaviour (Amess, 2002), since there is no party in these institutions who would benefit from an increase in the firm's value (Ferri et al., 2014). Similarly, the lower incentives for stakeholder banks to use leverage in an attempt to increase the expected return on equity (Ayadi et al., 2009), along with the greater obstacles—at least for cooperative banks—in raising external capital (Ayadi et al., 2010), may make stakeholder banks less prone to risk taking.

Consonant with the aforementioned theoretical predictions, empirical research points to a number of differences in the behaviours of stakeholder banks vis-à-vis shareholder banks. Drawing on Italian data over the 2007-2010 period, Bolton et al. (2013) find that banks oriented towards relationship lending charge higher spreads in normal times, but deliver stable lending at more favourable terms than transaction banks during a crisis. In addition, there is evidence that lending rates for banks other than cooperatives tend to increase with the length of the relationship for all customers, whereas in the case of cooperative banks this is true only for non-member customers (Angelini et al., 1998). Similarly, Foos (2009) focuses on Germany and provides evidence consistent with cooperative and savings banks adjusting their loan rates less cyclically compared to commercial banks.

Most importantly, the literature lends strong support to the view of stakeholder banks as major contributors to financial stability. In line with their 'stakeholder-value ethos' (Ayadi et al., 2009), early evidence from the US suggests that stakeholder banks are generally less risk-inclined than their shareholder peers. While O'Hara (1981) finds that stock associations hold substantially higher amounts of real estate owned property and rely more on borrowed funds than mutual associations, Verbrugge and Goldstein (1981) offer support for a poorer quality of the stocks' loan portfolio relative to mutuals. Moreover, there is evidence that stock firms exhibit higher concentration in those lines of business and geographic areas with the greatest risk (Lamm-Tennant and Starks, 1993),

[5] In some cases, it is nonetheless possible for members to sell their ownership stakes back to the bank.

together with the adoption of high-risk strategies through an investment in risky assets and a mismatch between assets and liabilities (Esty, 1997).

Further support in favour of a different risk appetite between stakeholder and shareholder banks is found for Europe, where the large presence of cooperative and savings banks alongside commercial banks has contributed to an increasing academic and policy interest in the stakeholder banking model (Groeneveld, 2011). Ayadi et al. (2009, 2010) compute Z-scores for six Western European countries and show that stakeholder banks are generally more stable than shareholder banks. Likewise, García-Marco and Robles-Fernández (2008) focus on the Spanish context and submit that savings banks have a lower insolvency risk than their commercial counterparts. In addition, empirical support is found for significant differences between the two organisational forms in terms of loan quality, with stakeholder banks having lower non-performing loans (Beck et al., 2009) and loan loss provisions (Iannotta et al., 2007) compared to shareholder banks. Among the explanations behind the relatively low levels of bad debts held by stakeholder banks is the lower branch manager turnover characterising these firms (Ferri, 1997), which may lead to improved customer relationships and a greater ability to allocate loans. The higher stability of stakeholder banks compared to their shareholder peers is also confirmed by findings from a wider sample of developed countries (Hesse and Cihák, 2007), emphasising the prominent role played by the stakeholder banking sector in fostering financial stability. Therefore, it comes to no surprise that the discussion around the systemic benefits arising from a mix of ownership structures has gained momentum over the last few years, especially in light of stakeholder banks' ability to come through the recent crisis relatively unaffected (Ayadi et al., 2009; Groeneveld, 2011).

Taken together, the three major bodies of literature reviewed above combine to make a key testable prediction, that is, bank ownership affects the transmission of monetary impulses via the risk-taking channel. Specifically, we expect monetary policy to exert a greater impact on the risk appetite of shareholder banks vis-à-vis stakeholder banks. In other words, we posit that the risk-taking behaviours of banks that strive to balance the interests of a multiplicity of stakeholders respond less procyclically to variations in monetary conditions relative to banks that focus almost exclusively on maximising shareholder wealth. To disentangle the effects of alternative organisational forms on bank risk taking, our econometric specifications include a set of other bank-level characteristics (e.g. size, capitalisation and profitability) that are deemed important by the literature in explaining bank risk-taking incentives.

3. Data and methodology

3.1. Sample selection

Our primary source of data is Bankscope, a global database of banks' financial statements and ownership structures maintained by Bureau van Dijk. To our knowledge, this is the most comprehensive database that allows comparisons of both listed and unlisted financial institutions worldwide.[6] We use annual report data for a panel of banks operating in 17

[6]Although Bankscope provides balance sheet and income statement data in a global format, some differences in accounting practices—particularly for the period before the adoption of the International

Western European countries, including the 15 economies that joined the European Union before the 2004 accession (i.e. Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and the UK) as well as Norway and Switzerland.[7] The validity of employing annual data when studying the risk-taking channel of monetary transmission is supported by Delis and Kouretas (2011), who build a quarterly dataset with information collected from Bloomberg and find that their results are not sensitive to the frequency of the underlying data.[8] Our sample starts in 1999 (the year in which the euro was officially launched) and ends in 2011 (the last year for which data for our regulatory indices is available).[9] This time window is interesting, as it encompasses the global financial crisis alongside the eurozone sovereign debt crisis.

We started off with a sample of 10,375 financial intermediaries classified by Bankscope under the heading 'commercial banks', 'savings banks', 'cooperative banks', 'real estate and mortgage banks', 'specialised governmental credit institutions' and 'bank holdings and holding companies'. To mitigate survivorship bias, we included all active and inactive banks with at least one year of accounts between 1999 and 2011.[10] To avoid double counting, we used data from unconsolidated statements if available, otherwise from consolidated statements.[11] We decided to work with unconsolidated accounts for two main reasons. First, the large majority of stakeholder banks included in our sample report at an unconsolidated level. Second, consolidated statements might end up duplicating the data (Micco et al., 2007). Furthermore, we were very careful not to include subsidiaries of banks for which we had to resort to consolidated accounts. Similarly, we considered intermediaries at the institutional level, as many BHCs and holding companies may own financial firms of a different nature.

By far, the most demanding part of our sample selection was represented by the categorisation of financial institutions into commercial, cooperative and savings banks. Following an approach similar to Ferri et al. (2013), we first reclassified as cooperative banks UK and Irish building societies that survived the recent wave of consolidation and demutualisation, as they are owned by—and run in the interests of—their members. Our list of stakeholder banks was extended to include a number of savings banks

Financial Reporting Standards—may still exist. We attempt to account for these remaining differences by including country and time fixed effects in our estimations.

[7]While the bulk of our observations come from euro area countries, unreported correlations of GDP growth and inflation across these countries point to significant heterogeneities in their business cycles.

[8]Further evidence suggesting that annual observations are sufficient to capture the effects of monetary policy on bank behaviour is presented by Ashcraft (2006) and Gambacorta (2005).

[9]The survey results used to construct the regulatory indices are available at four points in time (i.e. 2001, 2003, 2007 and 2011) and cover the period from 1999 to 2011. A thorough discussion of the results can be found in Barth et al. (2013).

[10]Since Greece qualified to join the euro area in 2000 and was admitted in 2001, Greek banks enter the sample in 2001.

[11]Specifically, we considered financial statements with consolidation codes U1 (unconsolidated statement with no consolidated companion), U2 (unconsolidated statement with a consolidated companion) and U* (additional unconsolidated statement). Whenever banks did not report unconsolidated accounts, we employed consolidated statements C1 (consolidated statement with no unconsolidated companion), C2 (consolidated statement with an unconsolidated companion) and C* (additional consolidated statement). To prevent double entries, accounts with consolidation code A1 (aggregated statement with no companion) were dropped.

that were found among the group of specialised governmental credit institutions, such as state-owned German *Landesbanken* or Swiss *Kantonalbanken*.[12] Moreover, several intermediaries that were originally categorised as BHCs and holding companies were added to the set of commercial banks. In a second step, the profile of each institution that was classified by Bankscope as either commercial, cooperative or savings bank was examined.[13] This screening led us to a series of major refinements. We changed the categorisation of most of the Swiss cooperatives in the Raiffeisen Group, as these had been classified as savings banks. Likewise, the specialisation of some of the German *Volksbanken* that were found within the group of savings banks was modified accordingly. We also re-coded the ownership status of a number of savings banks in Belgium, Italy and Spain for which the private foundation has ceased to be the ultimate owner. In addition, since our analysis requires deposit-taking and loan-making institutions, we excluded financial firms that could not be reasonably considered as either commercial, cooperative or savings banks.

To ensure that our results are not driven by Mergers and Acquisitions (M&As), we painstakingly reviewed the M&A history of all the banks included in our sample. Consistent with the literature (Claessens and van Horen, 2014; Iannotta et al., 2013), banks that either merged with or were acquired by other entities remained in the sample until the year prior to the takeover, while from that year onwards only the accounts of the merged or acquiring bank were kept. The information on M&A activity was retrieved mainly from Bankscope, although in many instances it was complemented by additional data collected from Thomson Reuters' SDC Platinum. After controlling for M&As, we were left with an unbalanced panel of 5,677 commercial, cooperative and savings banks. Table 1 shows the composition of the sample by country and ownership structure, while Fig. 1 depicts the density of stakeholder banks in each economy. The diversity of organisational forms in European banking is epitomised by the cross-country differences in the number of stakeholder and shareholder banks. Whereas the German and Italian financial systems—among others—appear to be characterised by an overwhelming majority of stakeholder banks (92.34% and 74.39%, respectively), shareholder banks have a dominant presence in countries such as Luxembourg (96.92%) and the UK (69.72%). Besides Italy (68.92%) and Germany (67.29%), other countries that exhibit a large number of cooperative banks are Austria (52.45%) and Switzerland (45.55%). Savings banks are strongly present in the Scandinavian region, especially in Norway (85.52%) and Sweden (82.73%). In terms of total assets, the stakeholder banking sector is particularly large in Austria (58.10%) and Germany (55.73%), whilst it is relatively small in Belgium (1.65%) and Greece (3.24%). While the greatest aggregate size of cooperative banks is found in France (37.61%), savings banks constitute a major player in Spain (43.54%). Interestingly, the sum of total assets for the 148 Spanish cooperative and savings banks is almost twice the corresponding value for the 639 Italian stakeholder banks.

[12] In line with the literature (Ayadi et al., 2009), we defined savings banks as those financial intermediaries that are owned by either a municipality or a private foundation and have a primary mandate to serve the community in which they operate.

[13] If the information provided by Bankscope was not sufficiently detailed, banks' individual websites alongside a variety of other sources were accessed.

Table 1. Distribution of banks by country and ownership structure.

	Shareholder banks		Cooperative banks		Savings banks		Stakeholder banks		Total	
	No.	Total assets	No.	Total assets	No.	Total assets	No.	Total assets	No.	Total assets
Austria	77	144.37	171	115.46	78	84.71	249	200.17	326	344.54
Belgium	52	966.65	12	9.75	11	6.44	23	16.19	75	982.84
Denmark	62	633.34	9	1.22	64	32.35	73	33.57	135	666.91
Finland	10	232.81	4	69.29	8	7.05	12	76.35	22	309.16
France	186	3107.85	165	1874.61	13	2.12	178	1876.74	364	4984.58
Germany	183	3467.63	1607	1046.40	598	3318.37	2205	4364.77	2388	7832.40
Greece	19	252.33	2	1.95	1	6.50	3	8.45	22	260.78
Ireland	23	536.21	3	21.05	0	0.00	3	21.05	26	557.26
Italy	220	1896.31	592	483.62	47	139.96	639	623.58	859	2519.89
Luxembourg	126	634.27	2	2.00	2	45.65	4	47.64	130	681.91
Netherlands	45	977.64	1	450.51	2	4.08	3	454.58	48	1432.22
Norway	19	225.84	2	1.63	124	98.53	126	100.16	145	326.00
Portugal	39	306.07	4	2.26	3	18.68	7	20.94	46	327.00
Spain	88	1242.68	87	84.36	61	1023.36	148	1107.72	236	2350.40
Sweden	19	556.23	0	0.00	91	21.01	91	21.01	110	577.24
Switzerland	159	1452.74	225	92.52	110	324.91	335	417.43	494	1870.17
UK	175	4481.79	68	401.63	8	3.02	76	404.66	251	4886.45
EA-12	1068	13 764.81	2650	4161.26	824	4656.91	3474	8818.17	4542	22 582.98
EU-15	1324	19 436.18	2727	4564.11	987	4713.29	3714	9277.40	5038	28 713.58
Total	1502	21 114.75	2954	4658.26	1221	5136.74	4175	9795.00	5677	30 909.75

Notes: The table shows the composition of the sample by country and ownership structure. *Shareholder banks* are commercial banks, while *stakeholder banks* include cooperative and savings banks. *Total assets* is the annual average of total assets in billions of US dollars. *EA-12* are the founding euro area countries, namely Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain. *EU-15* are the economies that joined the European Union before the 2004 accession, notably the *EA-12* countries plus Denmark, Sweden and the UK. The sample period goes from 1999 to 2011. *Sources*: Bankscope; authors' calculations.

3.2. Variable construction

3.2.1. Bank risk taking

We measure the risk-taking behaviour of banks with two proxies commonly used in the literature, notably the ratio of risk assets to total assets (*asset risk*) and the ratio of loans to total assets (*credit risk*). Risk assets are calculated as the difference between total assets and the sum of loans and advances to banks, government securities and cash. Therefore, this ratio includes all assets with non-negligible credit and market risk (Gropp et al., 2011) and captures the overall riskiness of bank portfolios at any point in time (Delis and Kouretas, 2011). The loans-to-asset ratio is defined as net loans (i.e. residential mortgage loans, other mortgage loans, other consumer loans, corporate and commercial loans and other loans minus reserves for loan losses) over total assets. This variable reflects the riskiness of bank portfolios due to changes in credit quality and offers a more direct proxy for credit risk, as it is expected that banks specialising in the granting of loans may be more exposed to credit risk (Maudos and de Guevara, 2004). Therefore, our measures of bank risk taking attempt to describe—although imperfectly—the level of asset and credit risk taken on by banks in response to changing monetary conditions.

Data for our risk-taking proxies are collected from Bankscope and descriptive statistics

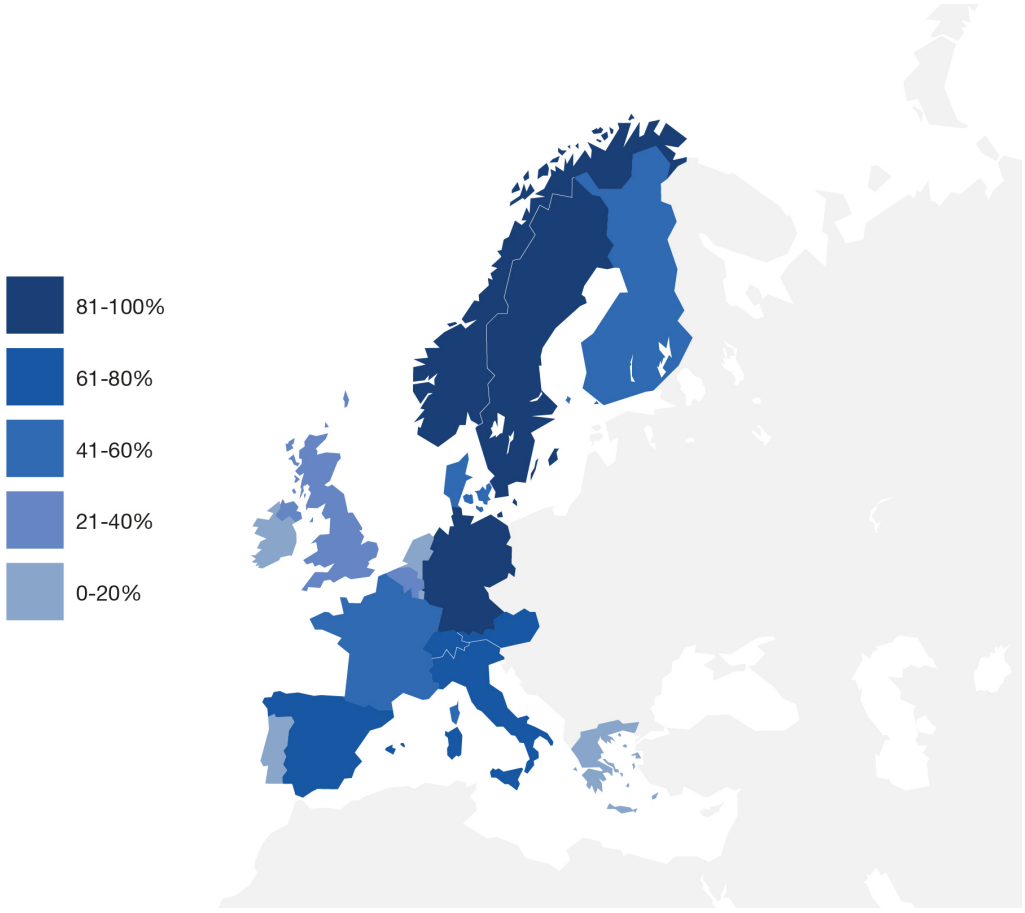

Fig. 1. Stakeholder bank density. *Notes*: The figure depicts the density of stakeholder banks in each of the economies included in the sample. Percentage values refer to the number of stakeholder banks over the sum of commercial, cooperative and savings banks in the country. Darker colours indicate greater presence of stakeholder banks. *Sources*: Bankscope; authors' calculations.

are summarised in Table 2.[14] Over our sample period, *asset risk* has an average value of 79.54% and a standard deviation of 17.17%. The lowest mean value is observed in 1999 (76.83%) and the highest in 2004 (80.20%), suggesting a 3.37% increase in the average risk-taking behaviour of banks until mid-2000s. In turn, *credit risk* is characterised by a lower mean (59.93%) and a higher standard deviation (20.14%) compared to our measure of asset risk. While the credit risk appetite of banks seemed at its lowest in 1999 (55.85%), it reached its highest level in 2007 (61.43%). Table 3 presents summary statistics for our dependent variable by dividing the sample according to ownership type. At a first glance, we can notice several important differences among banks with alternative organisational forms. Whereas the average values of *asset* and *credit risk* for stakeholder banks are higher than for their shareholder peers, the lower standard deviation for cooperative and savings banks implies less volatility in their risk-taking behaviours relative to commercial banks. Interestingly, the standard deviation of *asset risk* for stakeholder banks (11.03%) is less than half that for their shareholder counterparts (25.59%), with the lowest value observed among savings banks (9.64%).

[14]To mitigate the impact of outliers, we winsorize our accounting variables at the 1st and 99th percentiles of their sample distributions.

Table 2. Descriptive statistics.

	Obs	Mean	SD	Min	Q1	Median	Q3	Max
Asset risk	45735	79.54	17.17	7.96	75.24	84.68	90.55	99.46
Credit risk	45735	59.93	20.14	0.80	49.86	62.58	73.55	95.32
Overnight rate	45735	2.50	1.39	0.00	0.91	2.74	3.86	7.35
Size	45735	6.49	1.70	2.48	5.33	6.27	7.45	12.46
Capitalisation	45735	8.66	7.15	1.07	5.00	6.71	9.97	79.11
Deposits	45735	87.45	13.64	35.69	82.98	93.10	97.05	99.61
Securitisation	45735	10.30	15.16	0.01	3.29	5.75	10.92	175.66
Profitability	45735	0.68	0.91	−5.20	0.30	0.54	0.93	7.89
Efficiency	45735	68.58	17.08	15.11	60.24	68.27	75.56	198.09
Income diversity	45735	0.49	0.20	0.00	0.37	0.48	0.61	0.98
Concentration	45735	1014.39	914.40	329.21	433.60	662.00	944.73	6116.74
Activity restrictions	45735	6.71	2.78	2.00	5.00	7.00	9.00	12.00
Capital stringency	45735	6.14	1.59	2.00	5.00	6.00	8.00	9.00
Supervisory power	45735	9.61	2.24	4.00	8.00	10.00	11.00	14.00
Deposit insurance	45735	1.83	0.86	0.00	1.00	2.00	2.00	4.00
Private monitoring	45735	7.93	0.84	5.00	7.00	8.00	9.00	10.00
Institutions	45735	1.37	0.37	0.35	1.25	1.48	1.59	1.99
GDP growth	45735	1.53	2.36	−8.86	0.71	1.71	3.27	8.44
Inflation	45735	1.73	0.85	−4.48	1.10	1.67	2.30	4.88
Volatility	45735	22.05	7.63	7.95	15.20	22.01	27.69	54.71
Housing prices	45735	1.30	4.12	−15.49	−1.74	0.47	3.82	18.99

Notes: The table summarises descriptive statistics for the main regression variables. *Asset risk* is the ratio of risk assets to total assets; *Credit risk* is the ratio of loans to total assets; *Overnight rate* is the annual average of the daily overnight interbank rate; *Size* is the natural logarithm of real total assets; *Capitalisation* is the ratio of equity to total assets; *Deposits* is the ratio of deposits to total liabilities; *Securitisation* is the ratio of Off-Balance-Sheet (OBS) items to total assets; *Profitability* is the ratio of profit before tax to total assets; *Efficiency* is the ratio of cost to total income; *Income diversity* is a measure of income diversification; *Concentration* is the Herfindahl-Hirschman Index of market concentration; *Activity restrictions* is an index of the extent to which banks can engage in a number of activities; *Capital stringency* is an index of the regulatory oversight of bank capital; *Supervisory power* is an index of the power of the supervisory authority to influence the behaviour on the part of banks; *Deposit insurance* is an index of each country's explicit deposit insurance regime; *Private monitoring* is an index of the degree to which regulatory and supervisory policies affect the private monitoring of banks; *Institutions* is a composite measure of country-level governance; *GDP growth* is the annual growth rate of real GDP; *Inflation* is the annual change in the Consumer Price Index; *Volatility* is the annual average of the daily historical volatility of the country's stock market index; *Housing prices* is the annual change in the residential property price index (divided by the GDP deflator).

3.2.2. Monetary policy

Since the onset of the global financial crisis, market observers were swift to blame the relatively low interest rate environment in the first half of 2000s for the softening of lending standards by banks and the subsequent materialisation of risks in the economy. More recently, a related discussion has ensued on whether the current environment of exceptionally low interest rates is already sowing the seeds for the next financial crisis (Dell'Ariccia et al., 2013). For this reason, the main measure of monetary policy used in this paper is the short-term interest rate (*overnight rate*), computed as the annual average of the daily overnight interbank rate. Fig. 2 illustrates the movements in money market rates in the period from 1999 to 2011. Looking at the time window before the outbreak of the crisis, there is evidence of strong cross-country commonalities in the conduct of

Table 3. Summary statistics of bank-level variables by ownership structure.

	Shareholder banks		Cooperative banks		Savings banks		Stakeholder banks	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Asset risk	64.84	25.59	82.14	11.37	86.49	9.64	83.55	11.03
Credit risk	47.18	27.47	62.44	15.80	65.40	16.06	63.41	15.94
Size	7.25	2.00	5.94	1.41	7.00	1.55	6.29	1.54
Capitalisation	12.31	12.26	7.74	4.17	7.50	4.86	7.66	4.41
Deposits	85.70	14.88	87.30	14.26	89.21	10.70	87.92	13.24
Securitisation	19.52	25.87	7.65	8.29	8.07	10.24	7.79	8.97
Profitability	0.98	1.58	0.59	0.54	0.60	0.65	0.60	0.58
Efficiency	68.03	28.00	70.11	12.53	65.88	12.08	68.73	12.54
Income diversity	0.55	0.26	0.48	0.18	0.46	0.16	0.48	0.17

Notes: The table presents summary statistics for the bank-specific variables by dividing the sample according to ownership type. *Shareholder banks* are commercial banks, while *stakeholder banks* include cooperative and savings banks. *Asset risk* is the ratio of risk assets to total assets; *Credit risk* is the ratio of loans to total assets; *Size* is the natural logarithm of real total assets; *Capitalisation* is the ratio of equity to total assets; *Deposits* is the ratio of deposits to total liabilities; *Securitisation* is the ratio of Off-Balance-Sheet (OBS) items to total assets; *Profitability* is the ratio of profit before tax to total assets; *Efficiency* is the ratio of cost to total income; *Income diversity* is a measure of income diversification.

monetary policy, as overnight rates declined considerably in all the economies included in our sample and reached their lowest levels around 2005. In this period, money market rates were particularly low in Switzerland (with an average value of 0.17% in 2003), while they dropped substantially in Norway (with an annual decrease of 52.09% between 2003 and 2004).

In the wake of the credit crisis, policy rates were rapidly lowered towards the zero lower bound. After the collapse of Lehman Brothers in the third quarter of 2008, many central banks attempted to counter the risks to financial and economic stability by implementing an unprecedented set of non-standard monetary policy measures. As a result, central bank balance sheets in many advanced economies expanded sharply, largely reflecting the increase in the amount of liquidity provided to the banking sector (Gambacorta et al., 2014). Between 2008 and 2011, the assets of the Bank of England tripled, while the size of the balance sheets of the Eurosystem and the Swiss National Bank doubled. Significant was also the growth in the asset size of the Sveriges Riksbank and the Danmarks Nationalbank, whereas the Norges Bank expanded its balance sheet only in the period following the Lehman bankruptcy.[15] To disentangle the effects of these measures on bank portfolios from those due to variations in short-term rates, our estimations for the crisis period also include the ratio of central bank assets to nominal GDP (*central bank assets*) as a proxy for unconventional monetary policy.[16]

[15]For the Norges Bank, central bank assets are calculated as total assets minus investments in the *Government Pension Fund Global*.

[16]Although support for the use of the central-bank-asset-to-GDP ratio as a measure of unconventional monetary policy is found in the literature (Fungácová et al., 2014; Gambacorta and Marqués-Ibánez, 2011), we acknowledge that this proxy may not allow to capture the qualitative component of non-standard interventions (i.e. 'qualitative easing'). Unfortunately, the empirical challenges associated with deriving measures of qualitative easing in a heterogeneous panel such as the one constructed in this paper prevented us from employing more inclusive proxies for non-conventional policies.

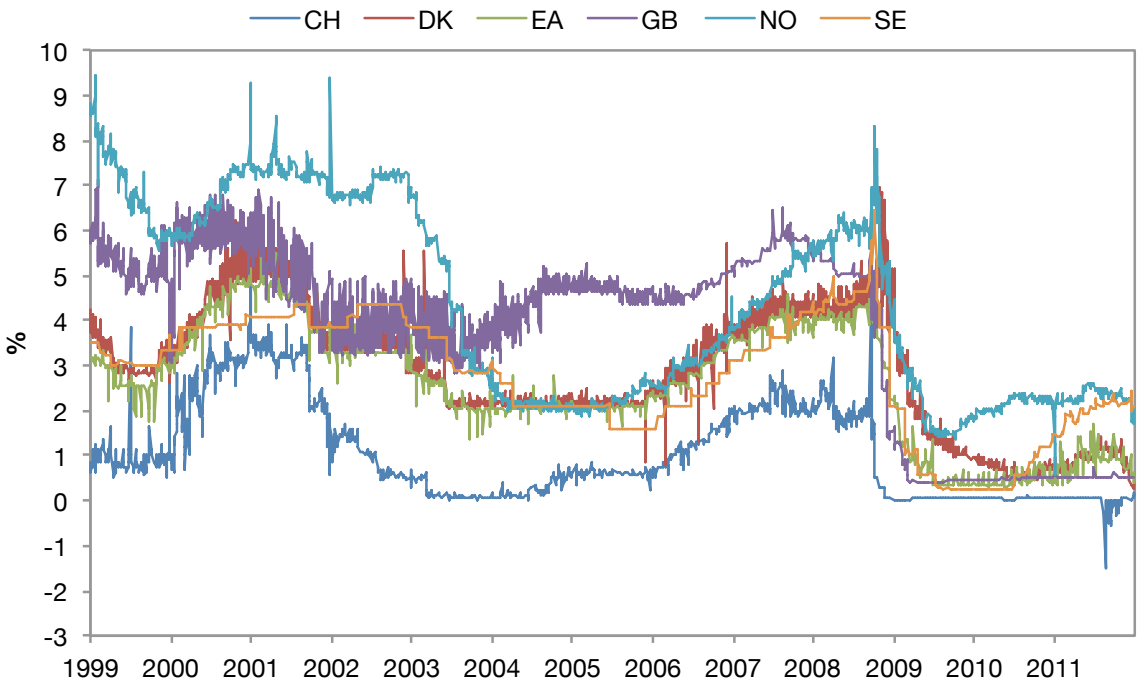

Fig. 2. Overnight interbank rates. *Notes*: The figure illustrates the movements in money market rates in the period from 1999 to 2011. CH, Switzerland: call money rate; DK, Denmark: tomorrow/next rate; EA, euro area: Euro OverNight Index Average (EONIA); GB, United Kingdom: Sterling OverNight Index Average (SONIA); NO, Norway: Norwegian Overnight Weighted Average (NOWA); SE, Sweden: tomorrow/next STockholm InterBank Offered Rate (STIBOR). *Sources*: Datastream; national data.

3.2.3. Control variables

To avoid omitted-variable bias, we control for a number of bank-level, industry-specific and macroeconomic factors that might affect the risk appetite of banks. At the micro level, we account for a possible 'too-big-to-fail' phenomenon by including bank size (*size*), defined as the natural logarithm of real total assets.[17] Although the existence of a relationship between bank size and risk is well documented in the literature, its sign appears to be fairly ambiguous (Iannotta et al., 2007; Mohsni and Otchere, 2014). In a similar vein, there is evidence that banks with higher capital invest in riskier projects (Williams, 2014), whilst other studies find a more prudent behaviour by well-capitalised intermediaries (Delis and Kouretas, 2011). Therefore, we test for these conflicting predictions by considering the ratio of equity to total assets (*capitalisation*). As recent empirical evidence suggests that banks' funding ability is important in explaining their risk positions (Altunbas et al., 2014; Fiordelisi and Marqués-Ibánez, 2013), we control for the liability structure of intermediaries' balance sheets. For this purpose, we condition on the deposits-to-total-liabilities ratio (*deposits*). Likewise, the shift from the traditional 'originate-to-hold' to the 'originate-to-distribute' model observed over the last two decades may have reduced banks' funding needs in the event of a monetary tightening (Altunbas et al., 2009), thereby leading to an increase in the share of risk assets held in

[17] To ensure comparability across banks, all balance sheet and income statement data is converted to US dollars using the relevant exchange rates at each closing date.

their portfolios (Loutskina, 2011). To proxy for asset securitisation (*securitisation*), we include the ratio of OBS items to total assets.[18] Furthermore, we add the ratio of profit before tax to total assets as a measure of bank profitability (*profitability*). One could argue that poorly performing intermediaries have reasons to embark in risky activities to regain profitability (Casu et al., 2011), while a positive link exists if the current profits are used to expand the proportion of assets carrying credit and market risk (García-Marco and Robles-Fernández, 2008). In turn, technically efficient banks could have a better ability to manage risk and—ceteris paribus—a greater willingness to adopt risky balance sheets (Drakos et al., 2014), whereas the opposite might hold if lower efficiency encourages banks to take on greater risk in an attempt to generate profits (Dong et al., 2014). Bank efficiency (*efficiency*) is proxied by the cost-to-income ratio, with higher values indicating less efficient operations. As empirical findings show that diversification away from traditional lines of business influences bank risk taking (Beltratti and Stulz, 2012; Hesse and Cihák, 2007), we also include a measure of differences in banks' income (*income diversity*). Building on Laeven and Levine (2007), this measure is calculated as follows:

$$Income\ diversity = 1 - \left| \frac{(Net\ interest\ income - Other\ operating\ income)}{Total\ operating\ income} \right| \quad (1)$$

Our set of industry-related controls comprises the Herfindahl-Hirschman Index as a proxy for market concentration (*concentration*), computed as the sum of squared market shares of all banks in the country.[19] We do not have a clear prediction on the concentration-risk nexus, since the literature suggests that more concentrated markets are conducive to either higher or lower levels of banking stability (Beck et al., 2006; Schaeck et al., 2009). To capture the regulatory environment, we construct five indices using data from the *Bank Regulation and Supervision Survey* conducted by the World Bank and described in Barth et al. (2001, 2004, 2006, 2012). *Activity restrictions* measures the extent to which banks can engage in a number of activities (e.g. securities underwriting, brokering and dealing), with higher numbers indicating more regulatory impediments on non-lending activities. Greater restrictions on the operations of financial institutions either discourage risk taking (García-Kuhnert et al., 2015) or increase the fragility of the system by preventing banks from diversifying outside their traditional lines of business (Beck et al., 2006). *Capital stringency* proxies for the regulatory oversight of bank capital, with higher values denoting more stringent guidelines on the nature and sources of regulatory capital. While stricter capital regulations could be negatively related to bank risk due to the option value of deposit insurance (Keeley and Furlong, 1990), greater capital stringency might lead banks to adjust their portfolios towards riskier structures through an induced decrease in leverage (Kim and Santomero, 1988). *Supervisory power* reflects the right of the supervisory agency to take actions such as forcing banks to change their organisational structures, suspending directors' decisions to distribute dividends and declaring insolvency, with a higher index implying greater supervisory power. Consistent with empirical findings (Altunbas et al., 2014; Lee and Hsieh,

[18]Taken together, the above characteristics may also help us disentangle the risk-taking channel from the partially overlapping bank lending channel (Bernanke and Blinder, 1988, 1992).

[19]In alternative specifications, we use the Lerner Index as a more direct measure of market power, computed following the approach in Demirgüç-Kunt and Martínez Pería (2010).

2013), we would expect more supervisory power to be associated with lower risk taking by banks. *Deposit insurance* aims to capture each country's explicit deposit insurance regime, with greater values pointing to higher protection of depositors in case of bank default. In light of the moral hazard problem induced by deposit insurance (Angkinand and Wihlborg, 2010; Forssbaeck, 2011), we anticipate a positive relationship between the aforementioned index and the risk appetite of intermediaries. *Private monitoring* shows the degree to which regulatory and supervisory policies affect the private monitoring of banks, with higher numbers reflecting greater incentives for market discipline. We do not have a strong prior on this index, as the literature submits that higher incentives to scrutiny financial institutions on the part of the private sector can either encourage or curtail bank risk taking (Beltratti and Stulz, 2012; Delis and Kouretas, 2011).

At the country-level, we account for an array of institutional and macroeconomic variables that are likely to influence the risk-taking choices of banks. Since there is evidence that greater institutional development contributes to banking stability (Beck et al., 2006; Hesse and Cihák, 2007), our econometric estimations include a composite measure of country-level governance (*institutions*) constructed using the *Worldwide Governance Indicators* by Kaufmann et al. (2010).[20] Following Beltratti and Stulz (2012), we average the six indicators (i.e. 'voice and accountability', 'political stability and absence of violence', 'government effectiveness', 'regulatory quality', 'rule of law' and 'control of corruption') into a single index per country. As a wealth of studies suggest (Chalermchatvichien et al., 2014; Lee and Hsieh, 2013), general economic conditions have a bearing on the riskiness of financial intermediaries. For this reason, we control for the growth rate of real GDP (*GDP growth*) and the annual change in the Consumer Price Index (*inflation*). Similarly, we attempt to capture developments in stock markets by computing a measure of share price volatility (*volatility*), calculated as the annual average of the daily historical volatility of the country's stock market index.[21] To the extent that improvements in stock markets release risk budgets and present banks with incentives to take on additional risks (Borio and Zhu, 2012; Paligorova and Santos, 2013), we hypothesise a negative link between our volatility proxy and banks' risk appetite. Finally, our empirical setup aims to distinguish the risk-taking channel from the standard 'financial accelerator' à la Bernanke et al. (1999), given that easing monetary conditions might lead banks to expand their lending due to increases in borrowers' net worth (Matsuyama, 2007). For this purpose, we include the annual change in the residential property price index (divided by the GDP deflator) as a measure of the value of borrowers' collateral (*housing prices*). Table 4 reports the correlation coefficients for our set of explanatory variables, suggesting that multicollinearity is unlikely to affect the parameter estimates.[22]

[20] Alternatively, we proxy institutional quality using the *Corruption Perceptions Index* by Transparency International, which scores countries based on how corrupt their public sector is perceived to be.

[21] In unreported regressions, stock market conditions are captured by the annual change in the total return index (divided by the GDP deflator).

[22] Definitions and sources of all the variables used in the analysis are detailed in Appendix Table A1.

Table 4. Correlation matrix.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
(1)	1.000																		
(2)	−0.023	1.000																	
(3)	−0.003	−0.281	1.000																
(4)	−0.004	−0.092	−0.225	1.000															
(5)	0.079	0.179	0.178	−0.164	1.000														
(6)	0.073	−0.056	0.344	−0.113	0.166	1.000													
(7)	0.022	−0.212	0.018	0.066	−0.111	−0.491	1.000												
(8)	0.049	0.257	−0.051	0.061	0.151	0.003	0.058	1.000											
(9)	−0.236	−0.039	0.106	−0.022	0.008	0.095	−0.092	−0.169	1.000										
(10)	0.150	−0.008	0.204	−0.477	0.205	0.168	−0.034	0.037	0.004	1.000									
(11)	−0.314	0.146	−0.078	0.150	−0.113	−0.067	−0.066	−0.023	0.119	−0.413	1.000								
(12)	−0.335	0.007	−0.076	0.048	−0.146	−0.093	−0.043	−0.110	0.301	−0.312	0.463	1.000							
(13)	0.005	0.063	0.011	−0.005	0.109	0.064	−0.035	−0.057	0.103	−0.015	0.191	0.110	1.000						
(14)	−0.151	0.088	0.033	0.019	0.000	−0.022	0.011	0.097	0.012	0.077	0.126	−0.252	−0.268	1.000					
(15)	0.018	−0.040	−0.157	0.510	−0.120	−0.030	−0.049	−0.050	0.439	−0.540	0.101	0.213	−0.054	−0.125	1.000				
(16)	0.249	−0.005	−0.001	0.094	0.038	0.108	−0.072	0.041	0.074	0.009	−0.034	−0.077	0.069	−0.151	0.205	1.000			
(17)	0.463	0.061	0.113	−0.147	0.144	0.026	−0.011	0.047	−0.151	0.234	−0.062	−0.186	0.006	0.063	−0.300	0.289	1.000		
(18)	0.129	0.007	−0.047	0.065	−0.055	−0.149	0.088	−0.056	−0.122	−0.261	0.022	0.155	0.065	0.035	−0.029	−0.470	0.104	1.000	
(19)	0.033	0.079	0.151	−0.087	0.201	0.200	−0.100	0.095	0.118	0.144	−0.022	−0.134	0.127	−0.066	−0.059	0.380	0.153	−0.255	1.000

Notes: The table reports the correlation coefficients for the main explanatory variables. (1) *Overnight rate*: annual average of the daily overnight interbank rate; (2) *Size*: natural logarithm of real total assets; (3) *Capitalisation*: ratio of equity to total assets; (4) *Deposits*: ratio of deposits to total liabilities; (5) *Securitisation*: ratio of Off-Balance-Sheet (OBS) items to total assets; (6) *Profitability*: ratio of profit before tax to total assets; (7) *Efficiency*: ratio of cost to total income; (8) *Income diversity*: measure of income diversification; (9) *Concentration*: Herfindahl-Hirschman Index of market concentration; (10) *Activity restrictions*: index of the extent to which banks can engage in a number of activities; (11) *Capital stringency*: index of the regulatory oversight of bank capital; (12) *Supervisory power*: index of the power of the supervisory authority to influence the behaviour on the part of banks; (13) *Deposit insurance*: index of each country's explicit deposit insurance regime; (14) *Private monitoring*: index of the degree to which regulatory and supervisory policies affect the private monitoring of banks; (15) *Institutions*: composite measure of country-level governance; (16) *GDP growth*: annual growth rate of real GDP; (17) *Inflation*: annual change in the Consumer Price Index; (18) *Volatility*: annual average of the daily historical volatility of the country's stock market index; (19) *Housing prices*: annual change in the residential property price index (divided by the GDP deflator).

3.3. Econometric model

The equation to be estimated has the following functional form:

$$y_{i,k,t} = \alpha + \beta y_{i,k,t-1} + \eta x_{k,t} + \theta x_{k,t} \times z_{i,k} + \lambda \boldsymbol{W}_{i,k,t} + \tau \boldsymbol{U}_{k,t} + \phi_k + \psi_t + \epsilon_{i,t} \qquad (2)$$

with $i = 1,..., N$, $k = 1,..., 17$ and $t = 1,..., T$, where N is the number of banks, k is the country and T is the final year. The dependent variable, $y_{i,k,t}$, for bank i headquartered in country k at time t is proxied by either *asset risk* or *credit risk*.[23] Since evidence is found of a relatively high persistence of risk over time (Delis and Kouretas, 2011; Jiménez and Saurina, 2006), we include the lagged dependent variable among the regressors. $x_{k,t}$ is our main measure of monetary policy, namely the overnight interbank rate. In line with the risk-taking channel literature (Borio and Zhu, 2012; Dell'Ariccia et al., 2014), we would expect the coefficient η to be negative. The differential effects of interest rates on banks' risk appetite owing to alternative organisational forms is captured by interacting the monetary policy variable with an ownership dummy, $z_{i,k}$, which equals 1 for stakeholder banks and 0 otherwise. To address multicollinearity issues due to the inclusion of the multiplicative term alongside the interest rate variable, we mean-centre the latter variable prior to forming the product term. Consistent with the theoretical predictions advanced in Section 2, we anticipate the parameter θ to be positive. As central banks loosen monetary conditions, cooperative and savings banks would take on less portfolio risk compared to their commercial peers. Our bank-specific controls are contained in the vector $\boldsymbol{W}_{i,k,t}$, while $\boldsymbol{U}_{k,t}$ represents the set of industry- and macro-level variables. To account for unobserved country-specific factors and time-varying common shocks that might influence bank risk taking, all our econometric specifications include country, ϕ_k, as well as time, ψ_t, fixed effects.

The estimation of Eq. 2 presents a number of empirical challenges. A major identification limitation of examining the monetary policy-bank risk taking nexus is that monetary conditions might be endogenous to the risk observed in the banking sector (Jiménez et al., 2014). This may be particularly true since the onset of the financial crisis, as central banks' concerns regarding the situation of the banking sector led to a rapid expansion on the set of conventional and unconventional policy measures (Altunbas et al., 2014). From an econometric standpoint, endogeneity implies that the interest rate variable, $x_{k,t}$, might be correlated with the error term, $\epsilon_{i,t}$, thereby potentially biasing our estimates. In addition, the inclusion of the lagged dependent variable on the right-hand side may induce autocorrelation in the residuals and render the Ordinary Least Squares estimator biased and inconsistent even if the idiosyncratic errors are not serially correlated (Baltagi, 2013). To obtain consistent and unbiased estimates of the interplay between monetary policy, ownership structure and bank risk taking, we estimate our econometric model using the dynamic Generalised Method of Moments (GMM) introduced by Holtz-Eakin et al. (1988) and Arellano and Bond (1991) and further developed by Arellano and Bover (1995) and Blundell and Bond (1998).[24] By building a 'stacked' system of equations in

[23] As these ratios are bounded between 0 and 100, we allow the dependent variable to range from negative to positive infinity by employing its logarithmic transformation (i.e. $\ln(y_{i,k,t}/(100 - y_{i,k,t}))$).

[24] The 'system GMM' is preferred over the 'difference GMM' due to the improvement in efficiency when the autoregressive parameter is particularly high and the time-series dimension of the underlying data is moderately small (Blundell and Bond, 1998).

both levels and differences, this estimator allows to control for unobserved heterogeneity, simultaneity and the dynamic relationship between past realisations of the dependent variable and current values of the explanatory variables (Wintoki et al., 2012). Therefore, it ensures the efficiency and consistency of the estimated parameters (Gambacorta and Marqués-Ibánez, 2011), provided that there is no second-order serial correlation and the instrument set is valid.

In line with Arellano and Bover (1995) and Blundell and Bond (1998), endogenous and predetermined variables are instrumented by their own lags in levels in the first-difference equation and by their lagged first differences in the level equation, while exogenous regressors are instrumented by themselves. This generates a system of equations that takes the following form:

$$\begin{aligned}\begin{bmatrix} y_{i,k,t} \\ \Delta y_{i,k,t} \end{bmatrix} = \alpha + \beta \begin{bmatrix} y_{i,k,t-j} \\ \Delta y_{i,k,t-j} \end{bmatrix} + \eta \begin{bmatrix} x_{k,t} \\ \Delta x_{k,t} \end{bmatrix} + \theta \begin{bmatrix} x_{k,t} \times z_{i,k} \\ \Delta x_{k,t} \times z_{i,k} \end{bmatrix} \\ + \lambda \begin{bmatrix} \boldsymbol{W}_{i,k,t} \\ \Delta \boldsymbol{W}_{i,k,t} \end{bmatrix} + \tau \begin{bmatrix} \boldsymbol{U}_{k,t} \\ \Delta \boldsymbol{U}_{k,t} \end{bmatrix} + \phi_k + \psi_t + \epsilon_{i,t} \end{aligned} \tag{3}$$

Besides the lagged dependent and the monetary policy variables, we treat as endogenous all the bank-specific characteristics with the exception of *size*. For endogenous variables, this means that their second and further lags are available as instruments, while first and deeper lags can be effectively employed for variables that are predetermined but not strictly exogenous. We also consider as predetermined our set of regulatory indices, implying that banks are aware of their size and the regulatory environment when deciding on their level of risk taking.[25] To avoid overfitting, the proxy for market concentration and all macroeconomic controls are taken as exogenous. Following Roodman (2009), we attempt to prevent instrument proliferation by using a collapsed instrument matrix and limiting lag depth.[26] We use the two-step estimator with Windmeijer (2005) finite-sample corrected standard errors clustered by bank.

4. Results and discussion

4.1. Main estimations

Table 5 presents the results of our main empirical estimations.[27] The Arellano-Bond test for autocorrelation in the first-differenced errors rejects the presence of second-order serial correlation, $AR(2)$, while the Hansen test of overidentifying restrictions confirms the validity of our instrument set. The estimations for the full period are reported in the first two columns of Table 5, where bank risk taking is proxied by either *asset risk* or *credit*

[25] A similar treatment of endogenous and predetermined variables in risk equations is adopted by Delis and Kouretas (2011).

[26] We perform our regressions by using the *xtabond2* command in Stata. The *collapse* option indicates that *xtabond2* should create one instrument for each variable and lag distance instead of one for each time period, variable and lag distance.

[27] Before running our estimates, we use panel unit-root tests to ensure that the continuous variables included in our model are stationary. The results of Fisher-type (Choi, 2001) tests strongly reject the null hypothesis that all the panels contain a unit root.

risk.[28] The coefficient on *overnight rate* is negative and strongly significant under both specifications, suggesting that lower interest rates alter the composition of commercial banks' portfolios towards riskier positions. In a nutshell, this evidence is consistent with a risk-taking channel operating through the risk appetite of shareholder banks. The interaction term between monetary policy and the stakeholder bank dummy has a positive and highly significant coefficient, indicating that the effects of monetary conditions on the riskiness of financial intermediaries are lower for stakeholder banks. These results offer preliminary support to our initial hypothesis, in that the risk-taking behaviours of banks characterised by alternative organisational forms appear to respond differently to variations in the monetary policy stance. With respect to the bank-specific variables, less profitable but more efficient intermediaries tend to have greater levels of asset and credit risk, whilst banks of a larger size exhibit a lower exposure to changes in credit quality. In line with the concentration-stability view (Beck et al., 2006), financial institutions in less competitive markets seem to have lower incentives to take on risk. Interestingly, we find support for a moral hazard problem induced by explicit deposit insurance, while the stringency of capital regulations does not appear to restrain banks from engaging in greater risk taking. Consistent with other empirical findings (Lee and Hsieh, 2013), financial intermediaries operating in countries with higher growth rates of GDP hold less risky portfolios. In addition, incentives for credit risk-taking are exacerbated by lower institutional quality and improved conditions on the borrowers' side.

As we noted in Section 3, the last years covered by our estimations saw the adoption by many central banks of unprecedented actions aimed at restoring financial stability. For this reason, we attempt to provide novel insights into the functioning of the risk-taking channel during times of financial distress by distinguishing between two periods, notably the years before the outbreak of the crisis (i.e. 1999-2007) and the period after the collapse of Lehman Brothers (2008-2011).[29] The results for the first time window largely resemble those obtained over the whole sample period. Lower interest rates are associated with an increase in the risk appetite of shareholder banks, with this effect being stronger when our dependent variable is proxied by *asset risk*. However, the impact of looser monetary policy on intermediaries' risk taking appears to be dampened by the presence of stakeholder banks, as denoted by the positive and highly significant coefficient on the multiplicative term. This evidence is consistent with recent empirical findings (Ferri et al., 2014), according to which the loan supply of stakeholder banks prior to the start of the crisis was less affected by changing monetary conditions. Again, we find that banks with lower profitability but greater efficiency have riskier balance sheets, while *size* is important in explaining differences in the riskiness of financial institutions only if this is measured by *credit risk*. As indicated by other studies (Hesse and Cihák, 2007), higher income diversity tends to increase bank risk, although this relationship is statistically significant only under the specification that considers *asset risk*. Regarding the variables capturing the regulatory environment, greater stringency in terms of capital regulations,

[28] We consider only the first lag of the dependent variable among the regressors, since the coefficient on the second lag is not found to be statistically significant.

[29] The validity of splitting the sample around 2008 is tested by replacing the vector of time-fixed effects included in our full-period estimates with a dummy variable that equals 1 for the crisis years and 0 otherwise. In both cases, the coefficient on the dummy is strongly significant, possibly suggesting fundamental differences in the operation of the risk-taking channel between the crisis and non-crisis periods.

power of the supervisory authority and market discipline seems to be effective in limiting the risk-taking incentives of banks, whilst further support is provided for a risk-shifting effect associated with deposit insurance. In a similar vein, macroeconomic conditions have a bearing on banks' portfolio risk, yet at varying degrees. Whereas *GDP growth* is negatively related to both of our proxies of bank risk taking, a lower inflationary environment is found to influence only banks' exposure to credit risk. Consonant with theoretical predictions (Paligorova and Santos, 2013), lower stock market volatility offers financial firms incentives to take on additional asset risk. Moreover, our findings for the years before the crisis seem to confirm that changes in borrowers' net worth lead banks to alter the proportion of assets carrying credit risk.

Turning to the crisis period, we note several striking results. *Overnight rate* takes a positive and insignificant coefficient in both our specifications, implying that a risk-taking channel is no longer operative for shareholder banks. This is not surprising, as the havoc wrought by the financial turmoil resulted in an average increase in risk aversion and a widespread seizure of liquidity in financial markets (Acharya et al., 2009). Conversely, we find that monetary impulses are still effective in influencing the composition of stakeholder banks' portfolios, although this impact is lower in absolute value compared to the non-crisis period. In showing that the risk appetite of stakeholder banks is less affected by the business cycle relative to their shareholder counterparts, our evidence is in line with the literature pointing to a less cyclical behaviour by stakeholder banks (Foos, 2009). To account for the effects of unconventional monetary policy on the functioning of the risk-taking channel, we add to our estimations the ratio of central bank assets to GDP (*central bank assets*) and its interaction with the stakeholder bank dummy. At a first glance, the positive coefficients on these two terms seem to denote an important role played by non-standard measures in counteracting the shift by intermediaries towards riskless assets.[30] Nevertheless, a closer look at the sign of the coefficients reveals that the expansion in central bank assets is associated with a change in portfolio composition only for stakeholder banks, suggesting that monetary authorities might exert an impact on the non-financial sector via the risk-taking behaviours of cooperative and savings banks. Concerning the bank-level controls, we first notice that lower income diversification results in higher risk taking, while institutions of smaller size seem to be less inclined to take on asset risk during times of financial instability. Likewise, *profitability* and *efficiency* are positively linked to the overall riskiness of bank portfolios, whereas greater asset securitisation allows intermediaries to increase their exposure to credit risk. Interestingly, banks operating in industries characterised by higher degrees of concentration and greater restrictions on banking activities hold more risk assets on their balance sheets, although this evidence is somewhat limited if *credit risk* is considered. As expected, increases in borrowers' collateral encourage risk taking on the part of banks, whilst greater institutional development is associated with lower asset risk.

[30]Similar evidence of a positive relationship between unconventional monetary policy measures and risk assets is put forward by Lambert and Ueda (2014).

Table 5. Main estimations.

	1999-2011		1999-2007		2008-2011	
	Asset risk	*Credit risk*	*Asset risk*	*Credit risk*	*Asset risk*	*Credit risk*
Lagged asset risk	0.845***		0.706***		0.553***	
	(0.051)		(0.044)		(0.046)	
Lagged credit risk		0.886***		0.849***		0.756***
		(0.035)		(0.053)		(0.068)
Overnight rate	-0.239***	-0.272***	-0.262***	-0.092**	0.049	0.006
	(0.079)	(0.061)	(0.062)	(0.039)	(0.047)	(0.042)
Overnight rate × Stakeholder	0.032**	0.023**	0.063***	0.029**	-0.074***	-0.033**
	(0.015)	(0.011)	(0.022)	(0.014)	(0.014)	(0.015)
Central bank assets					0.001	0.001
					(0.009)	(0.008)
Central bank assets × Stakeholder					0.017***	0.018***
					(0.005)	(0.006)
Size	-0.002	-0.096***	-0.036	-0.041**	0.139**	-0.073
	(0.030)	(0.019)	(0.035)	(0.020)	(0.068)	(0.107)
Capitalisation	-0.001	0.002	0.007	-0.008	-0.022	0.009
	(0.008)	(0.007)	(0.011)	(0.008)	(0.013)	(0.017)
Deposits	0.003	-0.002	0.007	0.004	0.003	0.000
	(0.003)	(0.002)	(0.004)	(0.003)	(0.003)	(0.003)
Securitisation	-0.000	0.001	0.003	-0.001	0.010	0.015**
	(0.002)	(0.002)	(0.002)	(0.001)	(0.007)	(0.006)
Profitability	-0.227**	-0.157***	-0.410***	-0.317***	0.283***	-0.077
	(0.109)	(0.055)	(0.104)	(0.093)	(0.082)	(0.112)
Efficiency	-0.026***	-0.006*	-0.040***	-0.018***	0.021***	0.010
	(0.006)	(0.003)	(0.007)	(0.005)	(0.005)	(0.008)
Income diversity	0.318	-0.052	1.428***	0.323	-1.819***	-1.247***
	(0.254)	(0.099)	(0.340)	(0.201)	(0.264)	(0.390)
Concentration	-0.000***	-0.000***	0.000	-0.000	0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Activity restrictions	-0.007	-0.009	0.028	-0.041	0.064***	0.035*
	(0.017)	(0.009)	(0.035)	(0.033)	(0.021)	(0.019)
Capital stringency	0.024	0.025**	-0.047**	0.019	0.014	0.002
	(0.020)	(0.011)	(0.022)	(0.020)	(0.033)	(0.029)
Supervisory power	-0.006	-0.009	-0.148***	-0.035*	0.020	-0.006
	(0.013)	(0.011)	(0.031)	(0.018)	(0.021)	(0.021)
Deposit insurance	0.089***	0.087***	0.124***	0.005	-0.060	0.084
	(0.029)	(0.014)	(0.026)	(0.016)	(0.069)	(0.090)
Private monitoring	0.036	0.014	-0.187***	-0.023	-0.095*	0.022
	(0.022)	(0.017)	(0.034)	(0.021)	(0.053)	(0.055)
Institutions	-0.012	-0.313***	-0.026	-0.071	-1.027***	0.210
	(0.192)	(0.089)	(0.164)	(0.088)	(0.326)	(0.368)
GDP growth	-0.052***	-0.017***	-0.109***	-0.031***	-0.007	0.010
	(0.007)	(0.004)	(0.015)	(0.010)	(0.008)	(0.010)
Inflation	0.017	0.002	-0.012	-0.022*	0.003	0.002
	(0.013)	(0.007)	(0.018)	(0.013)	(0.016)	(0.015)
Volatility	-0.001	-0.002	-0.030***	0.001	-0.005	-0.005
	(0.003)	(0.002)	(0.006)	(0.004)	(0.004)	(0.004)
Housing prices	0.005	0.004***	-0.003	0.004**	0.013***	0.012***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	40256	40189	26407	26352	13849	13837

Table 5. *(Continued)*

	1999-2011		1999-2007		2008-2011	
	Asset risk	*Credit risk*	*Asset risk*	*Credit risk*	*Asset risk*	*Credit risk*
No. of instruments	63	63	59	59	58	58
Wald χ^2 (p-value)	0.000	0.000	0.000	0.000	0.000	0.000
$AR(1)$	0.000	0.000	0.000	0.000	0.000	0.000
$AR(2)$	0.176	0.146	0.240	0.574	0.140	0.968
Hansen χ^2 (p-value)	0.118	0.199	0.239	0.194	0.187	0.110

Notes: The table presents the results of the main empirical estimations. *Asset risk* is the ratio of risk assets to total assets; *Credit risk* is the ratio of loans to total assets; *Overnight rate* is the annual average of the daily overnight interbank rate; *Stakeholder* is a dummy that equals 1 for either cooperative or savings banks and 0 otherwise; *Central bank assets* is the ratio of central bank assets to nominal GDP; *Size* is the natural logarithm of real total assets; *Capitalisation* is the ratio of equity to total assets; *Deposits* is the ratio of deposits to total liabilities; *Securitisation* is the ratio of Off-Balance-Sheet (OBS) items to total assets; *Profitability* is the ratio of profit before tax to total assets; *Efficiency* is the ratio of cost to total income; *Income diversity* is a measure of income diversification; *Concentration* is the Herfindahl-Hirschman Index of market concentration; *Activity restrictions* is an index of the extent to which banks can engage in a number of activities; *Capital stringency* is an index of the regulatory oversight of bank capital; *Supervisory power* is an index of the power of the supervisory authority to influence the behaviour on the part of banks; *Deposit insurance* is an index of each country's explicit deposit insurance regime; *Private monitoring* is an index of the degree to which regulatory and supervisory policies affect the private monitoring of banks; *Institutions* is a composite measure of country-level governance; *GDP growth* is the annual growth rate of real GDP; *Inflation* is the annual change in the Consumer Price Index; *Volatility* is the annual average of the daily historical volatility of the country's stock market index; *Housing prices* is the annual change in the residential property price index (divided by the GDP deflator). All econometric specifications include country as well as time fixed effects. Robust standard errors (clustered at the bank level) are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

4.2. Robustness tests

To evaluate the robustness of our findings, we perform a number of additional tests. Since our group of cooperative banks includes intermediaries of a heterogeneous nature, we first re-estimate Eq. 3 after excluding central institutions in cooperative networks. Due to their primary role as service providers for the affiliated cooperative banks, these institutions are characterised by different business models compared to other banks within the respective networks. Furthermore, some of them have broadened their scope of activities and are large commercial banks in their own right, as it is the case for *Deutsche Zentral-Genossenschaftsbank* (DZ Bank AG) and *Westdeutsche Genossenschafts-Zentralbank* (WGZ Bank AG) in Germany. Table 6 reports the results for the full period as well as for the years before and after the collapse of Lehman Brothers when cooperative banks' central institutions are dropped from the sample. The coefficients on our main variables are qualitatively similar and leave our conclusions virtually unchanged.

Table 6. Robustness test: exclusion of cooperative banks' central institutions.

	1999-2011		1999-2007		2008-2011	
	Asset risk	*Credit risk*	*Asset risk*	*Credit risk*	*Asset risk*	*Credit risk*
Lagged asset risk	0.839***		0.709***		0.560***	
	(0.051)		(0.045)		(0.045)	
Lagged credit risk		0.887***		0.842***		0.762***
		(0.035)		(0.055)		(0.066)
Overnight rate	-0.242***	-0.274***	-0.265***	-0.098**	0.052	0.004
	(0.080)	(0.061)	(0.063)	(0.039)	(0.047)	(0.041)
Overnight rate × Stakeholder	0.033**	0.024**	0.069***	0.035**	-0.075***	-0.033**
	(0.015)	(0.011)	(0.023)	(0.015)	(0.014)	(0.015)
Central bank assets					-0.000	0.002
					(0.009)	(0.008)
Central bank assets × Stakeholder					0.018***	0.017***
					(0.005)	(0.006)
Size	-0.001	-0.096***	-0.030	-0.038*	0.141**	-0.083
	(0.030)	(0.020)	(0.036)	(0.021)	(0.067)	(0.105)
Capitalisation	-0.002	0.002	0.005	-0.010	-0.020	0.008
	(0.008)	(0.007)	(0.011)	(0.008)	(0.013)	(0.016)
Deposits	0.003	-0.002	0.007	0.004	0.003	-0.000
	(0.003)	(0.002)	(0.004)	(0.003)	(0.003)	(0.003)
Securitisation	-0.000	0.001	0.003	-0.001	0.010	0.016**
	(0.002)	(0.002)	(0.002)	(0.001)	(0.007)	(0.006)
Profitability	-0.238**	-0.158***	-0.418***	-0.327***	0.275***	-0.087
	(0.111)	(0.055)	(0.108)	(0.095)	(0.081)	(0.110)
Efficiency	-0.027***	-0.006*	-0.041***	-0.018***	0.021***	0.009
	(0.007)	(0.003)	(0.007)	(0.005)	(0.005)	(0.007)
Income diversity	0.366	-0.036	1.436***	0.365*	-1.787***	-1.226***
	(0.258)	(0.100)	(0.351)	(0.207)	(0.259)	(0.381)
Concentration	-0.000***	-0.000***	0.000	-0.000	0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Activity restrictions	-0.007	-0.010	0.026	-0.048	0.068***	0.036*
	(0.017)	(0.009)	(0.036)	(0.034)	(0.021)	(0.018)
Capital stringency	0.025	0.025**	-0.046**	0.023	0.021	0.005
	(0.020)	(0.011)	(0.023)	(0.021)	(0.033)	(0.028)
Supervisory power	-0.008	-0.010	-0.152***	-0.036*	0.018	-0.007
	(0.014)	(0.011)	(0.032)	(0.019)	(0.022)	(0.021)
Deposit insurance	0.092***	0.086***	0.123***	0.002	-0.060	0.079
	(0.030)	(0.014)	(0.027)	(0.016)	(0.069)	(0.089)
Private monitoring	0.036	0.015	-0.191***	-0.025	-0.101*	0.019
	(0.022)	(0.017)	(0.035)	(0.022)	(0.053)	(0.054)
Institutions	-0.024	-0.316***	-0.014	-0.071	-1.022***	0.213
	(0.195)	(0.089)	(0.167)	(0.090)	(0.322)	(0.366)
GDP growth	-0.053***	-0.018***	-0.109***	-0.031***	-0.008	0.009
	(0.007)	(0.004)	(0.016)	(0.010)	(0.008)	(0.010)
Inflation	0.018	0.002	-0.011	-0.024*	0.004	0.002
	(0.013)	(0.007)	(0.018)	(0.013)	(0.016)	(0.015)
Volatility	-0.001	-0.002	-0.030***	0.002	-0.004	-0.005
	(0.003)	(0.002)	(0.006)	(0.004)	(0.004)	(0.004)
Housing prices	0.005	0.004**	-0.002	0.004**	0.013***	0.012***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	40093	40026	26290	26235	13803	13791

Table 6. *(Continued)*

	1999-2011		1999-2007		2008-2011	
	Asset risk	*Credit risk*	*Asset risk*	*Credit risk*	*Asset risk*	*Credit risk*
No. of instruments	63	63	59	59	58	58
Wald χ^2 (p-value)	0.000	0.000	0.000	0.000	0.000	0.000
$AR(1)$	0.000	0.000	0.000	0.000	0.000	0.000
$AR(2)$	0.184	0.156	0.246	0.509	0.179	0.951
Hansen χ^2 (p-value)	0.145	0.247	0.201	0.209	0.220	0.123

Notes: The table reports the results of the empirical estimations after excluding cooperative banks' central institutions from the sample. *Asset risk* is the ratio of risk assets to total assets; *Credit risk* is the ratio of loans to total assets; *Overnight rate* is the annual average of the daily overnight interbank rate; *Stakeholder* is a dummy that equals 1 for either cooperative or savings banks and 0 otherwise; *Central bank assets* is the ratio of central bank assets to nominal GDP; *Size* is the natural logarithm of real total assets; *Capitalisation* is the ratio of equity to total assets; *Deposits* is the ratio of deposits to total liabilities; *Securitisation* is the ratio of Off-Balance-Sheet (OBS) items to total assets; *Profitability* is the ratio of profit before tax to total assets; *Efficiency* is the ratio of cost to total income; *Income diversity* is a measure of income diversification; *Concentration* is the Herfindahl-Hirschman Index of market concentration; *Activity restrictions* is an index of the extent to which banks can engage in a number of activities; *Capital stringency* is an index of the regulatory oversight of bank capital; *Supervisory power* is an index of the power of the supervisory authority to influence the behaviour on the part of banks; *Deposit insurance* is an index of each country's explicit deposit insurance regime; *Private monitoring* is an index of the degree to which regulatory and supervisory policies affect the private monitoring of banks; *Institutions* is a composite measure of country-level governance; *GDP growth* is the annual growth rate of real GDP; *Inflation* is the annual change in the Consumer Price Index; *Volatility* is the annual average of the daily historical volatility of the country's stock market index; *Housing prices* is the annual change in the residential property price index (divided by the GDP deflator). All econometric specifications include country as well as time fixed effects. Robust standard errors (clustered at the bank level) are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

A second concern relates to the inclusion among shareholder banks of financial intermediaries that are ultimately owned by the government or another public authority. The number of state-owned commercial banks increased sharply during the last years of our sample period, as many European banks required extensive government support following the outbreak of the global financial crisis. Cases in point are Royal Bank of Scotland in the UK, ABN AMRO in the Netherlands and Allied Irish Banks in Ireland, which are still under the control of their governments. According to the literature (Shleifer and Vishny, 1997), bureaucrats—who have the de facto control of state firms—generally pursue goals that are dictated by their political interests rather than the generation of profits. For this reason, one may expect shareholder wealth maximisation not to be the ultimate objective of this type of intermediaries. Consistent with this argument, recent empirical evidence for Western European countries shows that government ownership indeed alters the risk-taking incentives at commercial banks (Iannotta et al., 2013). Therefore, we re-run our baseline equation on a reduced sample that excludes state-owned commercial banks. The results, presented in Table 7, remain substantially unaffected.

Table 7. Robustness test: exclusion of state-owned commercial banks.

	1999-2011		1999-2007		2008-2011	
	Asset risk	*Credit risk*	*Asset risk*	*Credit risk*	*Asset risk*	*Credit risk*
Lagged asset risk	0.858***		0.717***		0.571***	
	(0.051)		(0.044)		(0.045)	
Lagged credit risk		0.880***		0.865***		0.753***
		(0.035)		(0.053)		(0.071)
Overnight rate	-0.274***	-0.272***	-0.265***	-0.088**	-0.009	-0.001
	(0.078)	(0.063)	(0.063)	(0.039)	(0.047)	(0.039)
Overnight rate × Stakeholder	0.037**	0.025**	0.058***	0.029**	-0.075***	-0.031**
	(0.015)	(0.012)	(0.022)	(0.014)	(0.014)	(0.014)
Central bank assets					-0.016	-0.001
					(0.011)	(0.007)
Central bank assets × Stakeholder					0.025***	0.020***
					(0.006)	(0.006)
Size	-0.001	-0.099***	-0.041	-0.040**	0.187***	-0.108
	(0.029)	(0.019)	(0.034)	(0.020)	(0.069)	(0.099)
Capitalisation	0.002	0.004	0.003	-0.008	0.000	0.015
	(0.008)	(0.007)	(0.011)	(0.008)	(0.015)	(0.016)
Deposits	0.005	-0.002	0.007	0.003	0.006**	0.002
	(0.003)	(0.002)	(0.004)	(0.003)	(0.003)	(0.003)
Securitisation	0.000	0.002	0.003*	-0.000	0.011	0.019***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.007)	(0.006)
Profitability	-0.244**	-0.179***	-0.387***	-0.309***	0.122	-0.108
	(0.110)	(0.060)	(0.103)	(0.090)	(0.079)	(0.104)
Efficiency	-0.026***	-0.007**	-0.038***	-0.016***	0.018***	0.008
	(0.006)	(0.004)	(0.007)	(0.005)	(0.005)	(0.007)
Income diversity	0.158	-0.082	1.342***	0.332*	-1.646***	-1.336***
	(0.254)	(0.098)	(0.339)	(0.198)	(0.245)	(0.364)
Concentration	-0.000***	-0.000***	0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Activity restrictions	-0.013	-0.005	0.033	-0.043	0.072***	0.052***
	(0.017)	(0.009)	(0.036)	(0.033)	(0.020)	(0.016)
Capital stringency	0.021	0.023**	-0.051**	0.020	0.042	0.004
	(0.020)	(0.011)	(0.023)	(0.021)	(0.033)	(0.030)
Supervisory power	-0.003	-0.011	-0.150***	-0.039**	-0.014	0.014
	(0.013)	(0.011)	(0.032)	(0.019)	(0.022)	(0.019)
Deposit insurance	0.076***	0.092***	0.123***	0.005	0.048	0.020
	(0.028)	(0.014)	(0.027)	(0.016)	(0.072)	(0.071)
Private monitoring	0.033	0.014	-0.184***	-0.023	-0.091*	-0.033
	(0.023)	(0.017)	(0.034)	(0.021)	(0.051)	(0.041)
Institutions	0.014	-0.374***	0.001	-0.054	-0.543*	0.137
	(0.197)	(0.090)	(0.167)	(0.088)	(0.322)	(0.323)
GDP growth	-0.052***	-0.020***	-0.112***	-0.032***	-0.004	0.006
	(0.007)	(0.004)	(0.016)	(0.010)	(0.008)	(0.009)
Inflation	0.014	0.003	-0.014	-0.025*	0.005	-0.008
	(0.013)	(0.007)	(0.018)	(0.013)	(0.015)	(0.014)
Volatility	-0.001	-0.002	-0.032***	0.001	0.002	-0.004
	(0.003)	(0.002)	(0.006)	(0.004)	(0.004)	(0.003)
Housing prices	0.005	0.005***	-0.002	0.004**	0.010***	0.014***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.004)	(0.003)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	39708	39643	26062	26008	13646	13635

Table 7. *(Continued)*

	1999-2011		1999-2007		2008-2011	
	Asset risk	*Credit risk*	*Asset risk*	*Credit risk*	*Asset risk*	*Credit risk*
No. of instruments	63	63	59	59	58	58
Wald χ^2 (p-value)	0.000	0.000	0.000	0.000	0.000	0.000
$AR(1)$	0.000	0.000	0.000	0.000	0.000	0.000
$AR(2)$	0.106	0.240	0.118	0.931	0.323	0.889
Hansen χ^2 (p-value)	0.222	0.180	0.175	0.193	0.172	0.150

Notes: The table reports the results of the empirical estimations after excluding state-owned commercial banks from the sample. *Asset risk* is the ratio of risk assets to total assets; *Credit risk* is the ratio of loans to total assets; *Overnight rate* is the annual average of the daily overnight interbank rate; *Stakeholder* is a dummy that equals 1 for either cooperative or savings banks and 0 otherwise; *Central bank assets* is the ratio of central bank assets to nominal GDP; *Size* is the natural logarithm of real total assets; *Capitalisation* is the ratio of equity to total assets; *Deposits* is the ratio of deposits to total liabilities; *Securitisation* is the ratio of Off-Balance-Sheet (OBS) items to total assets; *Profitability* is the ratio of profit before tax to total assets; *Efficiency* is the ratio of cost to total income; *Income diversity* is a measure of income diversification; *Concentration* is the Herfindahl-Hirschman Index of market concentration; *Activity restrictions* is an index of the extent to which banks can engage in a number of activities; *Capital stringency* is an index of the regulatory oversight of bank capital; *Supervisory power* is an index of the power of the supervisory authority to influence the behaviour on the part of banks; *Deposit insurance* is an index of each country's explicit deposit insurance regime; *Private monitoring* is an index of the degree to which regulatory and supervisory policies affect the private monitoring of banks; *Institutions* is a composite measure of country-level governance; *GDP growth* is the annual growth rate of real GDP; *Inflation* is the annual change in the Consumer Price Index; *Volatility* is the annual average of the daily historical volatility of the country's stock market index; *Housing prices* is the annual change in the residential property price index (divided by the GDP deflator). All econometric specifications include country as well as time fixed effects. Robust standard errors (clustered at the bank level) are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

As a third robustness check, we attempt to ensure that our results are not driven by the proxy for monetary policy used in the empirical estimations. Although the overnight interbank rate is commonly employed while studying the functioning of the risk-taking channel (Jiménez et al., 2014; Maddaloni and Peydró, 2011), standard monetary policy can be effectively measured in a variety of different ways. To this end, we enquire into the sensitivity of our findings by replacing the overnight rate with the central bank's official rate (*central bank rate*), computed as the annual average of the daily central bank rate. The results of this exercise are reported in Table 8 and are largely in line with those of the benchmark specifications.[31]

[31] We also experiment with interest rates of longer maturities, namely the one-month and three-month interbank rates. Our results, not reported to save space, are again confirmed.

Table 8. Robustness test: alternative measure of monetary policy.

	1999-2011		1999-2007		2008-2011	
	Asset risk	*Credit risk*	*Asset risk*	*Credit risk*	*Asset risk*	*Credit risk*
Lagged asset risk	0.846***		0.703***		0.586***	
	(0.047)		(0.045)		(0.042)	
Lagged credit risk		0.872***		0.848***		0.756***
		(0.028)		(0.053)		(0.070)
Central bank rate	-0.286***	-0.332***	-0.256***	-0.100**	0.049	-0.033
	(0.105)	(0.080)	(0.062)	(0.042)	(0.069)	(0.060)
Central bank rate × Stakeholder	0.031*	0.023*	0.059***	0.030**	-0.111***	-0.041**
	(0.017)	(0.013)	(0.022)	(0.015)	(0.017)	(0.018)
Central bank assets					-0.010	0.002
					(0.011)	(0.008)
Central bank assets × Stakeholder					0.025***	0.018***
					(0.006)	(0.006)
Size	0.000	-0.090***	-0.039	-0.045**	0.150**	-0.107
	(0.030)	(0.020)	(0.036)	(0.020)	(0.072)	(0.107)
Capitalisation	-0.004	0.003	0.008	-0.009	0.011	0.010
	(0.007)	(0.006)	(0.012)	(0.008)	(0.014)	(0.016)
Deposits	0.006**	-0.003	0.006	0.003	0.005*	0.001
	(0.003)	(0.002)	(0.004)	(0.003)	(0.003)	(0.003)
Securitisation	-0.001	0.000	0.003	-0.001	0.011	0.018**
	(0.002)	(0.002)	(0.002)	(0.001)	(0.007)	(0.007)
Profitability	-0.129	-0.120**	-0.411***	-0.306***	0.094	-0.089
	(0.087)	(0.050)	(0.105)	(0.091)	(0.086)	(0.105)
Efficiency	-0.023***	-0.006*	-0.041***	-0.017***	0.018***	0.011
	(0.006)	(0.003)	(0.007)	(0.005)	(0.005)	(0.007)
Income diversity	0.068	-0.056	1.508***	0.350*	-1.692***	-1.199***
	(0.243)	(0.097)	(0.335)	(0.197)	(0.262)	(0.382)
Concentration	-0.000***	-0.000***	0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Activity restrictions	-0.010	-0.024**	0.027	-0.044	0.070***	0.034*
	(0.014)	(0.011)	(0.036)	(0.034)	(0.021)	(0.019)
Capital stringency	0.022	0.037***	-0.049**	0.020	0.037	0.016
	(0.019)	(0.011)	(0.022)	(0.021)	(0.036)	(0.031)
Supervisory power	-0.000	-0.007	-0.148***	-0.035*	-0.006	-0.012
	(0.010)	(0.010)	(0.032)	(0.019)	(0.024)	(0.022)
Deposit insurance	0.090***	0.035***	0.123***	0.003	0.030	0.095
	(0.023)	(0.013)	(0.027)	(0.016)	(0.078)	(0.086)
Private monitoring	0.042*	-0.009	-0.188***	-0.024	-0.082	0.021
	(0.023)	(0.015)	(0.035)	(0.022)	(0.055)	(0.054)
Institutions	0.031	-0.098	-0.001	-0.054	-0.568	0.416
	(0.142)	(0.104)	(0.164)	(0.087)	(0.357)	(0.390)
GDP growth	-0.047***	-0.015***	-0.110***	-0.031***	-0.008	0.010
	(0.007)	(0.004)	(0.016)	(0.010)	(0.008)	(0.010)
Inflation	0.014	0.001	-0.012	-0.022*	0.007	0.006
	(0.011)	(0.007)	(0.018)	(0.013)	(0.016)	(0.016)
Volatility	0.000	0.003	-0.031***	0.001	-0.002	-0.005
	(0.003)	(0.002)	(0.006)	(0.004)	(0.005)	(0.004)
Housing prices	0.004	0.000	-0.003	0.004**	0.012***	0.011***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.004)	(0.003)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	40256	40189	26407	26352	13849	13837

Table 8. *(Continued)*

	1999-2011		1999-2007		2008-2011	
	Asset risk	*Credit risk*	*Asset risk*	*Credit risk*	*Asset risk*	*Credit risk*
No. of instruments	63	63	59	59	58	58
Wald χ^2 (p-value)	0.000	0.000	0.000	0.000	0.000	0.000
$AR(1)$	0.000	0.000	0.000	0.000	0.000	0.000
$AR(2)$	0.132	0.182	0.273	0.599	0.318	0.966
Hansen χ^2 (p-value)	0.121	0.171	0.207	0.182	0.229	0.140

Notes: The table reports the results of the empirical estimations with the central bank's official rate as an alternative measure of monetary policy. *Asset risk* is the ratio of risk assets to total assets; *Credit risk* is the ratio of loans to total assets; *Central bank rate* is the annual average of the daily central bank rate; *Stakeholder* is a dummy that equals 1 for either cooperative or savings banks and 0 otherwise; *Central bank assets* is the ratio of central bank assets to nominal GDP; *Size* is the natural logarithm of real total assets; *Capitalisation* is the ratio of equity to total assets; *Deposits* is the ratio of deposits to total liabilities; *Securitisation* is the ratio of Off-Balance-Sheet (OBS) items to total assets; *Profitability* is the ratio of profit before tax to total assets; *Efficiency* is the ratio of cost to total income; *Income diversity* is a measure of income diversification; *Concentration* is the Herfindahl-Hirschman Index of market concentration; *Activity restrictions* is an index of the extent to which banks can engage in a number of activities; *Capital stringency* is an index of the regulatory oversight of bank capital; *Supervisory power* is an index of the power of the supervisory authority to influence the behaviour on the part of banks; *Deposit insurance* is an index of each country's explicit deposit insurance regime; *Private monitoring* is an index of the degree to which regulatory and supervisory policies affect the private monitoring of banks; *Institutions* is a composite measure of country-level governance; *GDP growth* is the annual growth rate of real GDP; *Inflation* is the annual change in the Consumer Price Index; *Volatility* is the annual average of the daily historical volatility of the country's stock market index; *Housing prices* is the annual change in the residential property price index (divided by the GDP deflator). All econometric specifications include country as well as time fixed effects. Robust standard errors (clustered at the bank level) are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

4.3. Discussion

The major lesson from our empirical analysis is that bank ownership indeed affects the transmission of monetary policy via the risk-taking channel. The evidence that stakeholder banks—of which cooperative banks form a major part—alter the composition of their portfolios less procyclically than shareholder banks suggest that they can play a useful role in stabilising the aggregate level of risk in the economy. In a nutshell, these findings highlight the systemic benefits to be derived from a critical mass of banks that strive to create value for an array of stakeholders rather than almost solely for their shareholders. A case in point are the results for the crisis period, which show that stakeholder banks may continue to act as conduits for monetary transmission even at times of adverse economic conditions. This notwithstanding, our argument is by no means that the stakeholder banking model should be viewed as a superior alternative to its shareholder counterpart. In fact, there have been instances during the recent crisis where stakeholder banks engaged in similar risky lines of business as large shareholder banks, thereby falling into trouble and suffering relatively high losses.[32] Instead, we contend that it is the presence of financial intermediaries characterised by a plurality of ownership structures that

[32]One of the main examples is represented by the heavy losses in trading incurred by the Dutch cooperative group Rabobank.

is conducive to financial stability. By virtue of their underlying differences in risk appetite and portfolio structure, the existence of cooperative and savings banks vis-à-vis commercial banks may contribute to lowering systemic risk. As Ayadi et al. (2010, p. 149) effectively put it, "[t]he issue of having a financial system populated by a diversity of organisational forms is as significant as the merits and drawbacks of each particular form of organization".

Our results feed into an intense academic and policy debate over the causes of the global financial crisis. The primary implication of this paper is that monetary policy is not neutral from a financial stability perspective. For this reason, our evidence concurs with the increasing role of monetary authorities on macroprudential regulation and supervision, as epitomised by the creation—under the responsibility of the European Central Bank—of the European Systemic Risk Board in late 2010. In addition, this study finds that heterogeneity of ownership types in the European banking sector is important in explaining the effects of monetary policy on bank risk taking. Therefore, our findings call for the inclusion of measures capturing the diversity of the banking system into the central bank's reaction function, as this is ultimately deemed to influence the functioning of the risk-taking channel. Most importantly, this research indicates that attempts to regulate the European banking sector should not impair the biodiversity of its organisational forms. Our evidence on the contribution of a mixed banking system to financial stability suggests that not only is such a system worth preserving, but it should be promoted through the adoption of effective regulations. On this front, it seems vital for policymakers to ensure that the specific features of stakeholder banks are not hindered by regulatory constraints aimed at and devised for shareholder banks.

By providing novel insights into how bank ownership interacts with monetary policy in shaping banks' risk appetite, this paper sparks a number of new questions that await to be addressed. First, future research could move the analysis one step further and explore what specific features of stakeholder banks help explain their different reactions to changing monetary conditions relative to shareholder banks. For instance, it would be interesting to shed light on the extent to which observed differences between these two groups of banks stem from characteristics such as geographical scope of operation, orientation towards relationship lending and belonging to a network of similar institutions. Second, efforts might be directed at examining the impact that conversion of cooperative banks to joint stock companies has on their risk appetite and ensuing responses to fluctuations in the monetary policy stance. For this purpose, researchers could consider a smaller sample of financial intermediaries than the one built in this study and construct time-varying proxies for bank ownership. Third, a fruitful line of enquiry would be to complement the results of our research by focusing more specifically on the implications that varying interest rates have for the softening of lending standards by banks with alternative organisational forms. On this front, one could compute more fine-grained measures of credit risk than the one used in this study, such as the proportion of non-performing loans held in bank portfolios or the ratio of charge-offs to total loans. This is a major endeavour we are currently working on.

5. Conclusions

Recent years have witnessed a revived interest in the far-reaching effects of banks' risk-taking behaviour on financial stability and economic performance. This paper adds to a rapidly evolving line of research that contributes to a better understanding of how financial intermediaries' risk appetite is influenced by the monetary conditions prevailing in the economy. Theory suggests that a key determinant of firms' risk-taking is their ownership structure, which ultimately affects the extent to which multiple stakeholder claims find recognition alongside those by shareholders. By constructing an unbalanced panel of commercial, cooperative and savings banks operating in 17 Western European countries over the period from 1999 to 2011, we find robust evidence that heterogeneity in organisational forms accounts for a differential impact of monetary policy on intermediaries' risk taking. While this impact appears to be particularly strong for shareholder banks, our results indicate that the effects of lower interest rates on the riskiness of the financial sector are dampened by the presence of stakeholder banks. Comparison of the results before and after the onset of the global market turmoil shows that our findings are driven by the years prior to the collapse of Lehman Brothers, during which commercial banks are found to alter the composition of their portfolios towards riskier structures more proactively than cooperative and savings banks. Our findings for the period since the outbreak of the crisis highlight that monetary impulses are no more effective in changing the proportion of risk-related assets held by shareholder banks, whereas the observed reaction of stakeholder banks to the unprecedented set of conventional and unconventional monetary policy measures points to their important role as vehicles for monetary transmission at times of financial distress.

Taken together, the results of this study suggest that ignoring differences in organisational form leads to partial and possibly inaccurate conclusions about the implications of monetary policy for bank risk taking. Therefore, we would hope to see more research examining how various features of intermediaries' ownership structures (e.g. nature of the ultimate owner, concentrated ownership and executive compensation) influence the functioning of the risk-taking channel. At the same time, our findings emphasise that it is systematically beneficial to have a banking sector populated by a critical mass of stakeholder banks vis-à-vis shareholder banks. For this reason, our hope is that the contribution advanced in this paper helps draw greater attention to the benefits arising from a biodiverse banking sector for the stability of the financial and economic system. To use the words of American biologist Edward Osborne Wilson, "[b]iodiversity is the totality of all inherited variation in the life forms of Earth, of which we are one species. We study and save it to our great benefit. We ignore and degrade it to our great peril".

Appendix A.

Table A1. Variable definitions and sources.

Variable	Definition	Source
Bank risk taking		
Asset risk	Ratio of risk assets to total assets. Risk assets are calculated as the difference between total assets and the sum of loans and advances to banks, government securities and cash.	Bankscope; authors' calculations
Credit risk	Ratio of loans to total assets. Loans are defined as residential mortgage loans, other mortgage loans, other consumer loans, corporate and commercial loans and other loans minus reserves for loan losses.	Bankscope; authors' calculations
Monetary policy		
Overnight rate	Annual average of the daily overnight interbank rate.	Datastream; national data; authors' calculations
Central bank rate	Annual average of the daily central bank rate.	Datastream; IFS; authors' calculations
Central bank assets	Ratio of central bank assets to nominal GDP. For the Norges Bank, central bank assets are computed as the difference between total assets and investments in the *Government Pension Fund Global*.	National data; IFS; authors' calculations
Ownership structure		
Stakeholder	Dummy that equals 1 for either cooperative or savings banks and 0 otherwise.	Bankscope; authors' calculations
Bank-level		
Size	Natural logarithm of total assets (divided by the GDP deflator).	Bankscope; WDI; authors' calculations
Capitalisation	Ratio of equity to total assets.	Bankscope; authors' calculations
Deposits	Ratio of deposits to total liabilities. Deposits include total customer deposits, deposits from banks as well as other deposits and short-term borrowings.	Bankscope; authors' calculations
Securitisation	Ratio of Off-Balance-Sheet (OBS) items to total assets.	Bankscope; authors' calculations
Profitability	Ratio of profit before tax to total assets.	Bankscope; authors' calculations
Efficiency	Ratio of overheads to total operating income.	Bankscope; authors' calculations
Income diversity	$1 - \left\lvert \frac{(Net\ interest\ income - Other\ operating\ income)}{Total\ operating\ income} \right\rvert$	Bankscope; authors' calculations
Industry-specific		
Concentration	Herfindahl-Hirschman Index of market concentration. The index is calculated as the sum of squared market shares of all banks in the country in terms of total assets.	Bankscope; authors' calculations

Table A1. *(Continued)*

Variable	Definition	Source
Activity restrictions	Index that captures the extent to which national regulations restrict banks from engaging in: (1) securities activities, (2) insurance activities, (3) real estate activities and (4) ownership of non-financial firms. Regulatory restrictiveness for each of these activities takes values between 1 and 4, depending on whether they are *unrestricted*, *permitted*, *restricted* or *prohibited*. We compute an aggregate index by summing the values for the four categories.	BRSS; Barth et al. (2001, 2004, 2006, 2012); authors' calculations
Capital stringency	Index that measures the stringency of regulatory capital requirements. It is constructed by adding 1 if the answer to questions 1-7 is 'yes' and 0 otherwise, while the opposite holds for questions 8 and 9 (i.e. 'yes' = 0; 'no' = 1): (1) Are the sources of funds to be used as capital verified by the regulatory/supervisory authorities? (2) Is this ratio risk weighted in line with the Basel guidelines? (3) Does the minimum ratio vary as a function of an individual bank's credit risk? (4) Does the minimum ratio vary as a function of market risk? (5-7) Before minimum capital adequacy is determined, which of the following are deducted from the book value of capital? (a) Market value of loan losses not realised in accounting books? (b) Unrealised losses in securities portfolios? (c) Unrealised foreign exchange losses? (8) Can the initial disbursement or subsequent injections of capital be done with assets other than cash or government securities? (9) Can initial disbursement of capital be done with borrowed funds?	BRSS; Barth et al. (2001, 2004, 2006, 2012); authors' calculations

Table A1. *(Continued)*

Variable	Definition	Source
Supervisory power	Index that proxies for the power of the supervisory authority to influence the behaviour on the part of banks. It is obtained by adding 1 if the answer to each of the following questions is 'yes' and 0 otherwise: (1) Does the supervisory agency have the right to meet with external auditors to discuss their report without the approval of the bank? (2) Are auditors required by law to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse? (3) Can supervisors take legal action against external auditors for negligence? (4) Can the supervisory authority force a bank to change its internal organisational structure? (5) Are off-balance sheet items disclosed to supervisors? (6) Can the supervisory agency order the bank's directors or management to constitute provisions to cover actual or potential losses? (7-9) Can the supervisory agency suspend the directors' decision to distribute: (a) Dividends? (b) Bonuses? (c) Management fees? (10) Can the bank supervisor legally declare—such that this declaration supersedes some of the rights of shareholders—that a bank is insolvent? (11) According to the Banking Law, has the bank supervisor authority to intervene—that is, suspend some or all ownership rights—a problem bank? (12-14) Regarding bank restructuring and reorganisation, can the supervisory agency do the following: (a) Supersede shareholder rights? (b) Remove and replace management? (c) Remove and replace directors?	BRSS; Barth et al. (2001, 2004, 2006, 2012); authors' calculations
Deposit insurance	Index that describes the explicit deposit insurance regime adopted in the country. It is determined by adding 1 if the answer to each of the following questions is 'yes' and 0 otherwise: (1) Is the explicit deposit insurance protection system funded by the banks? (2) Does the deposit insurance authority make the decision to intervene a bank? (3) Does the deposit insurance authority by itself have the legal power to cancel or revoke deposit insurance for any participating bank? (4) Can the deposit insurance agency/fund take legal action for violations against laws, regulations, and bylaws (of the deposit insurance agency) against bank directors or other bank officials? (5) Has the deposit insurance agency/fund ever taken legal action for violations against laws, regulations, and bylaws (of the deposit insurance agency) against bank directors or other bank officials?	BRSS; Barth et al. (2001, 2004, 2006, 2012); authors' calculations

Table A1. *(Continued)*

Variable	Definition	Source
Private monitoring	Index that quantifies the incentives for private investors to monitor and exert effective governance over banks. It is constructed by adding 1 if the answer to questions 1-9 is 'yes' and 0 otherwise, while the reverse occurs for questions 10 and 11 (i.e. 'yes' = 0; 'no' = 1): (1) Is subordinated debt allowable (required) as part of regulatory capital? (2) Is an external audit a compulsory obligation for banks? (3) Are auditors licensed or certified? (4) Does accrued, though unpaid, interest/principal enter the income statement while the loan is still performing? (5) Does accrued, though unpaid, interest/principal enter the income statement while the loan is still nonperforming? (6) Are financial institutions required to produce consolidated accounts covering all bank and any non-bank financial subsidiaries (including affiliates of common holding companies)? (7) Are off-balance-sheet items disclosed to the public? (8) Must banks disclose their risk management procedures to the public? (9) Are bank directors legally liable if information disclosed is erroneous or misleading? (10) Is there an explicit deposit insurance protection system? (11) Were insured depositors wholly compensated (to the extent of legal protection) the last time a bank failed?	BRSS; Barth et al. (2001, 2004, 2006, 2012); authors' calculations
Macroeconomic		
Institutions	Simple average of six country-level governance indicators, namely 'voice and accountability', 'political stability and absence of violence', 'government effectiveness', 'regulatory quality', 'rule of law' and 'control of corruption'.	WGI; Kaufmann et al. (2010); authors' calculations
GDP growth	Annual growth rate of real GDP.	WDI
Inflation	Annual change in the Consumer Price Index.	WDI
Volatility	Annual average of the daily historical volatility of the country's stock market index with a 30-day window.	Bloomberg; authors' calculations
Housing prices	Annual change in the residential property price index (divided by the GDP deflator).	BIS; ECB; authors' calculations

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