

# Ownership diversity and the risk-taking channel of monetary policy transmission

This version: July 24, 2019

## Abstract

This paper joins a rapidly growing body of literature that aims to uncover the link between monetary policy and bank risk taking. We investigate the hypothesis that the ownership composition of the banking system moderates monetary policy transmission via the risk-taking channel. Borrowing measures used in ecology to quantify diversity of species within an ecosystem and first applied to the field of finance by [Michie and Oughton \(2013\)](#), this paper shows that the impact of exogenous monetary policy shocks on banks' probability of default is reduced in countries with greater ownership diversity. We also find that—*ceteris paribus*—shareholder- and stakeholder-oriented banks located in more ownership-diverse systems tend to have a lower appetite for risk than their counterparts operating in less diverse markets. These results are robust across several econometric specifications and emphasise the stabilising role played by ownership diversity in modern financial systems. At the same time, our evidence suggests that a more interdisciplinary approach, firmly grounded in the applied, empirical research methodology, can provide novel and useful insights into the implications of monetary policy for financial and economic outcomes.

*Keywords:* Ecology, Financial crisis, Monetary policy transmission, Ownership diversity, Risk-taking channel

*JEL classifications:* E52, G01, G21

# 1. Introduction

The Great Financial Crisis that erupted in 2007 has provided a vivid illustration of the potential for modern financial systems to exacerbate and spread financial distress on an international scale ([Arinaminpathy et al., 2012](#)). In the wake of the crisis, there is increasing recognition that the resilience of the financial system is affected not only by its aggregate exposure to risk, but also by the interconnections between individual institutions ([Haldane and May, 2011](#)). A case in point was the bankruptcy of Lehman Brothers in 2008, which led to an unprecedented seizure of liquidity by financial intermediaries and the ensuing collapse of the interbank lending market. These events have prompted renewed interest in the role of banks in monetary economics ([Werner, 2014](#)), including a series of articles on “Rethinking money and banking after the Great Financial Crisis” published as a special issue in the *Cambridge Journal of Economics* (e.g. [Bezemer, 2016](#); [Dow, 2016](#); [Ingham et al., 2016](#)).

A number of studies have recently focused on the implications of the ownership composition of the banking sector for the stability of the financial system and its resilience to crises (e.g. [Ayadi et al., 2009](#); [Groeneveld, 2012](#); [Michie, 2011](#)). In making a parallel between ‘financial ecosystems’ and ecology in the 1970s, [Haldane and May \(2011, p. 353\)](#) argue that “excessive homogeneity within a financial system—all the banks doing the same thing—can minimize risk for each individual bank, but maximize the probability of the entire system collapsing”. Consistent with the ecology literature ([Tilman and Downing, 1994](#)), this view predicts that diversity with respect to ownership structures, business models and corporate objectives should encourage resistance to disturbance ([Michie, 2011](#)).

Despite the increasing appreciation of the need for a systemic approach to financial stability ([May and Arinaminpathy, 2010](#)), there is a paucity of evidence on the extent to which the interactions between banks with different ownership structures impact on financial stability. This is at odds with insights from ecology, where the nature and in-

tensity of the interacting relations between individuals belonging to different species are known to have important effects on ecosystem stability (Jizhong et al., 1991). Moreover, hardly any studies have examined how the ownership composition of the banking system interacts with monetary policy in shaping financial intermediaries' risk taking. Such a void is surprising, as recent evidence indicates that ownership type has a bearing on monetary transmission via the risk appetite of banks (Drakos et al., 2016). This gap might also have significant consequences from a policy perspective, insofar as monetary intervention may have heterogeneous effects on bank stability, depending on the architecture of the financial system (Boot and Thakor, 1997).

Against this background, the aim of this paper is to shed new light on the link between the ownership composition of the banking sector and financial stability. The question we address concerns the extent to which ownership diversity moderates monetary policy transmission through the risk-taking channel (Borio and Zhu, 2012; Ioannidou et al., 2015; Jiménez et al., 2014). There are at least three theoretical arguments that may give ownership diversity a central role in the transmission of monetary policy to bank risk. First, banks located in countries with more diverse banking systems are likely to be in competition for providing better customer service instead of generating return on equity (Berry et al., 2015). This point is articulated well by Michie (2011), who contends that diversity of ownership structures in banking brings about benefits for customers in terms of increased choice, quality of service and fairness—i.e. a 'good competition' to serve customers well rather than a 'bad competition' that sparks a race to the bottom on lending standards (Independent Commission on Banking, 2011). As the competition between banks tends to be directed at serving customers and not at engaging in unduly risky activities, we would expect greater ownership diversity to translate into lower incentives for banks to take on risk in response to changes in monetary policy.<sup>1</sup> Second, enhanced

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<sup>1</sup>As pointed out by an anonymous referee, this theoretical prediction may be true provided that banks comprise the largest part of the financial system. In countries where non-bank financial intermediaries constitute the dominant players, an increase in ownership diversity may have the opposite effect. Similarly, the effects of ownership diversity and its interplay with monetary policy on bank risk taking may depend on financial regulation, which provides the framework within which competition takes place (Independent Commission on Banking, 2011). For example, the stricter and more complex regulatory

competition arising from a higher degree of diversity in the banking sector should reflect greater disciplining efforts on the part of customers and/or depositors (Kick and Prieto, 2015). To the extent that an increase in market discipline restricts banks from engaging in riskier projects, monetary policy will induce lower incentives for financial intermediaries to adopt risky balance sheets. Third, the literature suggests that—above a specific market-share threshold—the presence of non-profit-maximising banks has a positive impact on the stability of other banks within the same system (Chiaramonte et al., 2015). It follows that—*ceteris paribus*—financial intermediaries operating in countries with a multiplicity of ownership structures are likely to be more stable than their counterparts operating in less diverse markets, thereby reducing the potency of the risk-taking channel.

The remainder of the manuscript is structured as follows. Section 2 provides an overview of the literature on the risk-taking channel and develops the main hypotheses. Section 3 describes the empirical strategy and illustrates the data used in the analysis. Section 4 presents the results from the main estimations as well as from further robustness tests. Section 5 discusses the implications of the findings and concludes.

## 2. Related literature and hypothesis development

### 2.1. Risk-taking channel of monetary transmission

In the aftermath of the global financial crisis, a growing debate has ensued on whether risk-taking incentives at financial institutions are shaped by the monetary conditions prevailing in the economy. As the literature suggests (Angeloni et al., 2015; Borio and Zhu, 2012), monetary policy might affect bank risk via two primary channels. The first

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framework that has been designed for the EU banking system in the aftermath of the global financial crisis, as epitomised by the introduction of Basel III and the creation of the European Banking Union, might pose significant challenges for smaller and less systemically important institutions such as many cooperative banks (Caselli, 2018). Insofar as regulation causes excessive costs of compliance for cooperatives and other smaller banks, it might create incentives for mergers and acquisitions in an attempt to achieve economies of scale, thereby reducing the degree of competition in the banking industry (Goglio and Kalmi, 2017). In the empirical estimations, we control for the regulatory environment using four indices from the Bank Regulation and Supervision Survey by the World Bank (Barth et al., 2001, 2004, 2006, 2012).

mechanism operates through changes in the composition of the asset side of intermediaries' balance sheets (Delis et al., 2017). According to Cociuba et al. (2016), a prolonged period of low interest rates induces banks to search for yield by making riskier assets more attractive than safe bonds. As financial intermediaries alter the structure of their investments towards a riskier mix, a higher degree of procyclical risk taking is introduced into the financial system (Rajan, 2006) and a situation with weakened bank portfolios is realised (Dell'Ariccia and Marquez, 2006). This mechanism could be exacerbated by increased incentives for herding behaviour on the part of bank managers (Rajan, 2006), which might move asset prices away from fundamentals and add to the build-up of risks in the financial system. The second channel refers to the impact of monetary policy on the intermediaries' funding side. Inasmuch as an expansionary monetary environment reduces marginal funding costs, banks find more profitable to adjust the combination of capital and short-term funding by increasing leverage (Valencia, 2014). As the macroeconomic model proposed by Angeloni et al. (2015) shows, the decrease in nominal interest rates results in demand deposits becoming a cheaper form of external finance, providing an incentive for banks to substitute bank capital with demand deposits. The ensuing increase in bank leverage raises the probability of bank runs and the related risk premium, which is thus procyclical with respect to output under standard monetary policy shocks. However, theory predicts that the effects of interest rates on leverage depend on the extent to which banks can change their capital structures (Dell'Ariccia et al., 2014) and the yield curve is upward sloping (Angeloni et al., 2015). Alongside these two main channels, monetary policy might be transmitted to bank risk through a number of other mechanisms. As theorised by Borio and Zhu (2012), one set of effects deals with the impact of interest rates on valuations, incomes and cash flows. Since relatively low interest rates tend to boost asset and collateral values while reducing volatility, banks may downsize their estimates of probabilities of default and assume higher risk positions (Delis et al., 2017). Another set of effects is linked to the reaction function and communication policies of the central bank (Farhi and Tirole, 2012). For example, the degree of

transparency associated with specific policy decisions may reduce uncertainty about the future, encouraging risk taking on the part of banks (Borio and Zhu, 2012).

The theoretical inferences about the risk-taking channel seem to find support in the empirical literature. Drawing on a micro-level dataset for Spain, Jiménez et al. (2014) show that lower overnight rates lead less capitalised banks to grant more credit and higher loan volumes with fewer collateral requirements to ex ante risky borrowers. Similarly, Ioannidou et al. (2015) access the Bolivian credit register and provide evidence for a decrease in policy rates raising the probability of default on individual bank loans, while the additional risk taken by financial intermediaries does not appear to be reflected in greater loan spreads.<sup>2</sup> Findings from the US indicate that the risk ratings of banks' loan portfolios are negatively linked to changes in short-term rates (Dell'Ariccia et al., 2017) and that loan spreads for riskier firms are lower during periods of monetary easing relative to periods of monetary tightening (Paligorova and Santos, 2017). Using a factor-augmented vector autoregressive (FAVAR) model for the US over the period between 1997 and 2008, Buch et al. (2014) show that small domestic banks significantly increase the supply of new loans to high risk borrowers following an expansionary monetary policy shock. This shift in the risk composition of banks' loan portfolios does not appear to be compensated by a higher risk premium, consistent with the search-for-yield hypothesis formulated by the literature (Borio and Zhu, 2012; Rajan, 2006).

The transmission of monetary policy to bank risk is found to be particularly significant on the funding side (Angeloni et al., 2015), along with being sensitive to the measure of monetary policy innovations (Delis et al., 2017). Early evidence from the US points to the level of the Federal funds target, through its impact on the supply of credit and funding conditions in the capital market, as a major determinant of financial intermediaries' balance sheet growth (Adrian and Shin, 2008). Support for the key role of intermediaries' funding decisions in influencing the resilience of the financial system is offered by Michie

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<sup>2</sup>As is common in the literature, the loan spread is expressed by Ioannidou et al. (2015) as a mark-up over LIBOR and measures the overall cost of the loan. The same definition is used by Paligorova and Santos (2017).

and Oughton (2013), who establish that the funding gap—the difference between loans and deposits expressed as a proportion of total loans—rose sharply in the run up to the global financial crisis reflecting a move towards a riskier business model. Recent results also show that a relatively low interest rate environment might induce banks to reduce their level of credit loss provisioning and to expand their trading activities so as to become less dependent on their lending business (Bikker and Vervliet, 2018). Moreover, empirical evidence for the euro area suggests that the effects of monetary policy on lending standards are more pronounced if interest rates are kept low for an extended period (Maddaloni and Peydró, 2011). Interestingly, support is found for interest rates, together with long-term liquidity provision by the European Central Bank (ECB), leading to a softening in lending standards even after the onset of the recent crisis (Maddaloni and Peydró, 2013; Neuenkirch and Nöckel, 2018).

A number of factors have been put forward by the literature to explain the strength of the risk-taking channel. By constructing a sample of commercial, savings and co-operative banks in 16 eurozone countries, Delis and Kouretas (2011) submit that the effects of loose monetary conditions on risky assets are reduced for banks with higher equity capital and lower Off-Balance-Sheet (OBS) items. Similar findings are reached by Bonfim and Soares (2018), who collect data from the Portuguese Central Credit Register and demonstrate that the effects of policy rates on bank risk taking are stronger among banks with weaker capital ratios and larger liquidity buffers. Bonfim and Soares (2018) conclude that risk-taking behaviours within a low interest rate environment may be associated with managerial incentives for risk shifting, resulting in banks extending credit to riskier borrowers in an attempt to boost short-term profitability. According to Brissimis et al. (2014), both US and European banks with some degree of market power are able to buffer the negative effects of changes in monetary policy on credit risk, while other characteristics such as bank liquidity and capitalisation appear to be important for the potency of the risk-taking channel yet to a lesser extent. Likewise, Kick and Prieto (2015) focus on German universal banks and show that greater levels of market power (as

proxied by the Lerner index) reduce the impact of monetary policy on bank risk, which is consistent with banks endowed with more price-setting power having lower incentives to engage in riskier investments after a fall in the policy rate. In addition, there is evidence that the strength of the risk-taking channel is dampened by stricter prudential policy on either bank capital or Loan-To-Value (LTV) ratio ([Maddaloni and Peydró, 2011, 2013](#)). More recently, empirical findings from emerging economies suggest that the effects of monetary policy on bank risk taking are reduced in the presence of a more consolidated banking industry and a more transparent monetary policy ([Chen et al., 2017](#)).

## 2.2. Ownership diversity and the risk-taking channel

Recent years have witnessed renewed interest in the ownership structure of banks and its consequences for financial intermediation ([Cull and Martínez Pería, 2013](#)). A major reason behind the increased interest in bank ownership is the observation that cooperative and savings banks have been less scathed by the global financial turmoil relative to commercial banks ([Ayadi et al., 2009](#)). The key feature of cooperative and savings banks is that they seek to generate value for a wider set of stakeholders and not merely for shareholders ([Llewellyn, 2017](#)). As a result, they are not exclusively profit-oriented institutions and pursue a ‘double bottom line’, that is, a dual financial and social mission to benefit the community in which they operate ([Ayadi et al., 2009, 2010](#)). While cooperative banks are owned by their members, savings banks belong either to an organisation that is part of the government or to a private foundation ([Ferri et al., 2014](#)). Since profit distribution is limited and stakes are generally not marketable, it is unlikely that the property right structure of cooperative and savings banks encourages profit-maximising behaviour ([Amess, 2002](#)). Furthermore, the lower incentives for stakeholder banks to substitute capital with short-term funding in an attempt to boost equity returns ([Ayadi et al., 2009](#)) and the greater challenges—at least for cooperative banks—to raise external funds ([Casu and Gall, 2016](#)) may make them less inclined to risk taking than their shareholder counterparts.

In accordance with theoretical predictions, empirical evidence highlights some important differences in the risk appetite of shareholder banks vis-à-vis stakeholder banks. Early findings for the US suggest that mutually owned intermediaries tend to hold safer loan portfolios (Verbrugge and Goldstein, 1981) and lower amounts of Real Estate Owned (REO) property (O'Hara, 1981) compared with stock associations. In a similar vein, joint-stock banks are found to focus more on the lines of business and geographic areas with the greatest risk (Lamm-Tennant and Starks, 1993), along with having the propensity to implement high-risk strategies by investing in risky assets and mismatching the duration of their assets and liabilities (Esty, 1997). Additional evidence on the link between ownership type and bank risk is reported for Europe, where shareholder banks coexist with a large—sometimes predominant—stakeholder banking sector (Ferri et al., 2013). Support exists for cooperative and savings banks having better loan quality (Iannotta et al., 2007), lower insolvency risk (García-Marco and Robles-Fernández, 2008) and fewer non-performing loans (Beck et al., 2009) relative to their commercial peers. Drawing on a sample of financial intermediaries from 18 Western European countries over the 2004–2013 period, Meriläinen (2016) shows that cooperative and publicly owned savings banks partially absorbed the negative shocks to lending growth caused by the global financial crisis and the subsequent sovereign debt crisis, while cooperative banks did not contribute to excessive credit growth in the period preceding the two crises. Stakeholder banks also appear to be more stable than shareholder banks on a variety of measures, such as volatility of earnings (Casu and Gall, 2016) and distance to default (Hesse and Cihák, 2007).

Taking the literature on the ownership structure–bank risk nexus as the point of departure, a handful of studies have endeavoured to uncover the extent to which the presence of stakeholder banks has a bearing on the stability of their shareholder counterparts. By considering a sample of banks from 29 industrialised countries, Hesse and Cihák (2007) find that a higher share of cooperative banks (measured in terms of total assets) is generally associated with an increase in stability of an average bank in the

system. However, there is also evidence that a greater presence of cooperative banks in the system has a negative effect on the soundness of weaker commercial banks, i.e. commercial banks with a relatively low level of stability to start with. As [Hesse and Cihák \(2007\)](#) argue, these results concur with the view that cooperative banks may take advantage of their lower cost of capital to pursue expansion plans that leave less space for weaker commercial banks in the retail market. Similar evidence is provided by [Chiaramonte et al. \(2015\)](#), who build a panel of banks from 26 developed economies and offer support for the stabilising role played by stakeholder banks during the crisis years (yet only beyond a certain market-share threshold). Furthermore, the results by [Chiaramonte et al. \(2015\)](#) indicate that a greater presence of cooperative banks has a positive impact on the stability of large commercial banks in the system, but only in the financial crisis period. According to [Chiaramonte et al. \(2015\)](#), these results imply that episodes of financial distress may spread more slowly in more mutualised banking systems, since interconnections between cooperative and large commercial banks tend to be less strong compared with those among large commercial banks.

Consistent with these findings, a growing strand of the literature has highlighted the implications of ownership diversity for the degree of competition in the banking sector and the stability of the financial system (e.g. [Groeneveld, 2012](#); [Michie, 2017](#)). According to [Berry et al. \(2015\)](#), greater ownership diversity in the banking system may induce financial intermediaries to compete for higher customer satisfaction rather than increased equity returns. As [Michie \(2011, p. 310\)](#) puts it, diversity of ownership structures “offers wider choice for consumers through enhanced competition that derives in part from the juxtaposition of different business models”. In addition, the findings by [Kick and Prieto \(2015\)](#) point to the risk taking behaviours of banks located in less competitive markets reacting more strongly to changes in interest rates. These findings suggest that improved competition—such as one arising from a more ownership-diverse banking system—is likely to result in greater incentives for the private sector to discipline banks, possibly reducing the ability of financial intermediaries to shift their portfolios towards riskier positions.

Moreover, [Meriläinen \(2016\)](#) submits that the nature of competition (and, thus, the degree of ownership diversity) shapes banks' decisions over the relative weight given to profitability vis-à-vis social objectives.

This notwithstanding, limited have hitherto been the efforts made by the literature to link quantitative measures capturing the ownership composition of the banking system with risk-taking incentives at financial institutions. To this end, this paper builds on the work by [Michie and Oughton \(2013\)](#), who draw on the ecology literature and develop an index for diversity of ownership types, and offers novel insights into the implications of ownership diversity for financial stability. By introducing measures commonly used in ecology to quantify diversity of species within an ecosystem and first applied to the field of finance by [Michie and Oughton \(2013\)](#) into the analysis of the risk-taking channel, we add to the literature that focuses on the bank ownership–financial stability nexus (e.g. [Chiaramonte et al., 2015](#); [Hesse and Cihák, 2007](#)). Importantly, this approach also allows us to respond to recent calls “for a new, interdisciplinary research agenda on the role of banks and the central bank in particular, and the monetary system in general, which should be firmly rooted in the inductive, empirical research methodology to produce scientific economics” ([Werner, 2016](#), p. 377).

It follows from the previous arguments that ownership diversity might interact with monetary policy in determining the risk-taking incentives of banks. Support for the moderating impact of bank ownership on monetary policy transmission exists in the literature. In examining the lending policies of banks with different ownership structures, [Ferri et al. \(2014\)](#) collect data for the euro area and find that stakeholder banks curtail their loan supply to a minor extent than shareholder banks after a contractionary monetary policy. These findings are taken by [Ferri et al. \(2014\)](#) as evidence that stakeholder banks adopt less procyclical loan supply policies compared with shareholder banks, thereby smoothing financial conditions for their customers to maintain borrower-lender relationships in the longer term. Within the context of the risk-taking channel, recent evidence of the implications of ownership type for the relationship between interest rates and bank risk is

advanced by [Drakos et al. \(2016\)](#). Focusing on a sample of retail banks from 10 Central and Eastern European countries alongside Russia, they show that the risk appetite of foreign banks from the former countries is the most affected by varying short-term rates. Insofar as the ownership composition of the banking sector has a bearing on the risk decisions of banks, we would expect the strength of the risk-taking channel to be diminished in countries with more diverse banking systems. Therefore, this article proposes ownership diversity as an important factor explaining differential effects of monetary policy on bank riskiness. While joining the growing debate over the moderating impact that structural features of the market have on the monetary transmission mechanism (e.g. [Olivero et al., 2011b](#)), our contribution extends the somewhat limited literature on the role of industry-related factors in the functioning of the risk-taking channel (e.g. [Kick and Prieto, 2015](#)). These arguments lead to the following hypotheses:

**Hypothesis 1.** The higher the degree of ownership diversity in the banking system, the lower the incentives for financial intermediaries to take on risk.

**Hypothesis 2.** The higher the degree of ownership diversity in the banking system, the lower the impact of monetary policy on financial intermediaries' risk taking.

### 3. Data and methods

#### 3.1. Model and estimation method

The benchmark model is given by the following equation:

$$BR_{i,t} = \alpha + \Gamma BR_{i,t-1} + \Theta MP_{j,t} + \Upsilon OD_{j,t} + \Phi MP_{j,t} \times OD_{j,t} + \sum_{k=1}^K \Psi_k BC_{k,i,t} + \sum_{m=1}^M \Omega_m CC_{m,j,t} + \zeta_j + \eta_t + \varepsilon_{i,t} \quad (1)$$

with  $i = 1, \dots, N$ ,  $j = 1, \dots, 17$  and  $t = 1, \dots, T$ , where  $N$  is the number of banks,  $j$  is the country and  $T$  is the final year. The dependent variable,  $BR_{i,t}$ , represents the probability of default for bank  $i$  at time  $t$  and is measured by the Z-score. According to the literature (e.g. [Delis and Kouretas, 2011](#)), financial intermediaries' risk taking may persist over time and deviate from its equilibrium level in the short term. If bank risk is indeed persistent, estimates based on a static model may be biased and an econometric approach that explicitly incorporates the dynamics of bank risk should be used. Therefore, we include the first lag of the dependent variable,  $BR_{i,t-1}$ , on the right-hand side of [Equation 1](#).<sup>3</sup> Monetary policy,  $MP_{j,t}$ , is captured by Taylor rule residuals. Consistent with the literature on the risk-taking channel (e.g. [Ioannidou et al., 2015](#); [Jiménez et al., 2014](#)), we anticipate a positive sign on the coefficient  $\Theta$ . As central banks loosen monetary conditions, financial intermediaries react by lowering their distance to default (increasing their risk exposure).  $OD_{j,t}$  is one of the proxies for ownership diversity, namely the Simpson Index ([Michie and Oughton, 2013](#)), Shannon–Wiener Index or Heip Index. Following hypothesis 1, we would expect the coefficient  $\Upsilon$  to be positive. To test the extent to which the ownership composition of the banking system has a bearing on the strength of the risk-taking channel, we interact monetary policy with the ownership diversity variable.<sup>4</sup> As hypothesis 2 predicts, the coefficient  $\Phi$  should be negative. All econometric specifications include a vector of  $K$ -bank-,  $BC_{k,i,t}$ , and  $M$ -country-level,  $CC_{m,j,t}$ , control variables. Finally,  $\zeta_j$  and  $\eta_t$  are country and time fixed effects, respectively, aimed at controlling for unobservable country-specific factors and time-varying common shocks that may affect bank risk.

Several studies have recognised the potential for endogeneity when examining the risk-taking channel ([Altunbas et al., 2014](#); [Jiménez et al., 2014](#)), since monetary authorities might also respond to the financial stability of the banking sector. In econometric terms, this implies that the monetary policy variable,  $MP_{j,t}$ , may be correlated with the error

<sup>3</sup>We also experiment with further lags of the dependent variable among the regressors, but only the coefficient on the first lag is found to be statistically significant.

<sup>4</sup>To reduce multicollinearity, the monetary policy and ownership diversity variables are mean-centred before the multiplicative term is formed.

term,  $\varepsilon_{i,t}$ , and that estimates based on Ordinary Least Squares (OLS) regressions may be biased. Another source of concern is the inclusion of the lagged dependent variable as a regressor in the econometric specifications, which may cause autocorrelation in the residuals and lead to biased estimates. To address these concerns, Equation 1 is estimated with the Generalised Method of Moments (GMM) for dynamic panel data proposed by Arellano and Bover (1995) and Blundell and Bond (1998).<sup>5</sup> This estimator allows to exploit the dynamic nature of the relationships being investigated, while producing consistent and unbiased estimates under the condition that there is no second-order serial correlation and that the instruments are valid (Wintoki et al., 2012). We conduct two main tests to ensure that the econometric models are correctly specified. The first test is the Arellano–Bond test for autocorrelation of order two, with a null hypothesis of no second-order correlation in differenced residuals. The second test is the Hansen test of overidentifying restrictions, which verifies that the instruments are uncorrelated with the error term (i.e. they are exogenous). In line with existing literature on the risk-taking channel (e.g. Delis and Kouretas, 2011), we take the lagged dependent, Taylor rule residuals (as well as its interaction with ownership diversity) and all the bank-level control variables with the exception of the ownership dummy and bank size to be endogenous. This means that their second and deeper lags can be included as instruments. Moreover, the ownership diversity indices, bank size and the measures capturing the regulatory environment are treated as predetermined, implying that these variables can be instrumented with their first and longer lags. To limit the number of instruments, all the remaining variables are considered to be exogenous. We use the two-step procedure with Windmeijer (2005) standard errors corrected for finite samples and clustered at the bank level.<sup>6</sup>

<sup>5</sup>Since the GMM estimator is designed for ‘small  $T$ , large  $N$ ’ panels (Roodman, 2009), that is, panels characterised by a relatively short time dimension and a large number of units, it appears to be well suited to our empirical setup.

<sup>6</sup>We run the panel regressions with the *xtabond2* command in Stata. To reduce the instrument count, we limit lag depth and use a collapsed instrument matrix as suggested by Roodman (2009). Prior to conducting the estimations, we also perform Fisher-type (Choi, 2001) tests to verify that the continuous variables used in the analysis are stationary.

## 3.2. Variable definition

### 3.2.1. Ownership diversity

A long-held tenet in ecology is that the degree of diversity (or heterogeneity) of an ecosystem can largely influence its dynamics (Tilman and Downing, 1994). As Magurran (2004, p. 8) suggests, biological diversity—often denoted as ‘alpha diversity’ (Whittaker, 1972)—refers to “the variety and abundance of species in a defined unit of study”. While richness corresponds to the number of species within a given community (Bandeira et al., 2013), evenness captures the extent to which the abundance is equal across species (Molinari, 1989). A well-accepted definition of diversity is the effective number of types (Hill, 1973), according to which ‘true diversity’ ( $D$ ) of species ( $S$ ) is given by the inverse of the weighted generalised mean of their proportional abundances ( $p_i$ ). In formal terms:

$${}^qD = ({}^q\bar{p}_i)^{-1} = \left( {}^{q-1}\sqrt{\sum_{i=1}^S p_i p_i^{q-1}} \right)^{-1} = \left( \sum_{i=1}^S p_i^q \right)^{1/(1-q)} \quad (2)$$

where  $q$  is the order of diversity. High values ( $q > 1$ ) of this parameter emphasise abundance differences among species, whereas low values ( $q < 1$ ) assign more weight to rare species.<sup>7</sup>

Among the most commonly used measures of species diversity is the Simpson Index (Simpson, 1949). In its standard form, this index represents the probability that two individuals chosen randomly and independently from the population will belong to the same group. For this reason, the reciprocal of the Simpson Index ( $D'$ ) is recommended for general application (Peet, 1974). It is calculated as:

$$D' = \left( \sum_{i=1}^S p_i^2 \right)^{-1} \quad (3)$$

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<sup>7</sup>For  $q = 0$ , all species are considered to be equally abundant and diversity equals species richness ( ${}^0D = S$ ).

An alternative diversity indicator that has found enduring support in the literature is the Shannon–Wiener Index (Shannon and Weaver, 1949). Originally developed in the field of information theory, it measures the average degree of uncertainty in predicting the species of unknown individuals drawn from a community. Whilst the Simpson Index places greater weight on the evenness component, the Shannon–Wiener Index is more sensitive to species richness.<sup>8</sup> For ease of interpretation, expression of the Shannon–Wiener Index in terms of its antilogarithm ( $e^{H'}$ ) is suggested (Peet, 1974).<sup>9</sup> This index is given by:

$$e^{H'} = \exp \left[ - \sum_{i=1}^S p_i \ln(p_i) \right] \quad (4)$$

Besides heterogeneity indices, the literature has proposed a number of measures aimed at quantifying species evenness. The common approach is to calculate evenness as the ratio between estimated and maximum diversity for a specific number of species and sample size (Kwak and Peterson, 2007). Since evenness indicators should be independent of species richness and take lower values within contexts characterised by more unequal abundance across species, Heip (1974) proposes the following index:<sup>10</sup>

$$E' = \frac{(e^{H'} - 1)}{(S - 1)} \quad (5)$$

Similar to living organisms, firms interact with each other and the environment in which they are embedded. The outcomes of these interactions have a bearing on their profitability and probability of survival (Baschieri et al., 2015). It follows that quantitative measures used in ecology may constitute valuable instruments for banking research. The introduction of an index for diversity of ownership types in the field of finance was made in 2013 by Michie and Oughton (2013), who adapted the Simpson Index of bio-

<sup>8</sup>Hill (1973) shows that the Simpson Index and the Shannon–Wiener Index are special cases of the general index of diversity (Equation 2) with  $q = 2$  and  $q = 1$ , respectively.

<sup>9</sup>An additional advantage of the exponential form of the Shannon–Wiener Index is that it tends to be approximately normally distributed (Heip et al., 1998).

<sup>10</sup>Evidence is also found for the Heip Index ( $E'$ ) having considerably lower skewness and kurtosis relative to other evenness metrics (Heip and Engels, 1974).

logical diversity to the study of financial services. To capture diversity across ownership types—as opposed to biological species—[Michie and Oughton \(2013\)](#) estimated the ownership composition of the UK financial services sector in terms of relative market shares held by private banks limited by shares, mutual banks and building societies, and public-owned banks. Building on the seminal work by [Michie and Oughton \(2013\)](#), we treat ownership types (i.e. commercial, cooperative and savings) as analogous to species in an ecosystem and construct indices of ownership diversity for the loan and deposit markets in 17 Western European countries. Data on bank loans and deposits are collected from Bankscope and used to compute ownership diversity measures based on the Simpson Index (*SIM*) ([Michie and Oughton, 2013](#)), Shannon–Wiener Index (*SHA*) and Heip Index (*HEI*).<sup>11</sup> The three indices for the loan market are defined as follows:

$$SIM\_L_{j,t} = \left( \sum_{i=1}^{OT} MS\_L_{i,j,t}^2 \right)^{-1} \quad (6)$$

$$SHA\_L_{j,t} = \exp \left[ - \sum_{i=1}^{OT} MS\_L_{i,j,t} \ln (MS\_L_{i,j,t}) \right] \quad (7)$$

$$HEI\_L_{j,t} = \frac{(SHA\_L_{j,t} - 1)}{(OT_{j,t} - 1)} \quad (8)$$

with  $i = 1, \dots, OT$ ,  $j = 1, \dots, 17$  and  $t = 1, \dots, T$ , where  $OT$  is the number of ownership types,  $j$  is the country,  $T$  is the final year and  $MS\_L$  is the market share of loans of each ownership type. In a similar vein, the three indices for the deposit market are calculated as follows:

$$SIM\_D_{j,t} = \left( \sum_{i=1}^{OT} MS\_D_{i,j,t}^2 \right)^{-1} \quad (9)$$

$$SHA\_D_{j,t} = \exp \left[ - \sum_{i=1}^{OT} MS\_D_{i,j,t} \ln (MS\_D_{i,j,t}) \right] \quad (10)$$

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<sup>11</sup>Loans are calculated as residential mortgage loans, other mortgage loans, other retail loans, business loans and other loans minus loan loss reserves. Deposits include customer deposits, deposits from banks, money market instruments, certificates of deposits and other deposits.

$$HEI\_D_{j,t} = \frac{(SHA\_D_{j,t} - 1)}{(OT_{j,t} - 1)} \quad (11)$$

where  $MS\_D$  is the share of deposits held by each ownership type in the market.

Table 1 reports the average degree of ownership diversity over the period from 1999 to 2011 for each of the sample countries. The values for the three indices suggest important cross-country differences in the ownership composition of the banking system. Whereas countries such as Austria, Germany and Spain are characterised by relatively high levels of ownership diversity on both the loan and deposit sides of the market, much less diverse banking systems are found in Greece, Belgium and Ireland. Among non-euro-area countries, diversity in the UK loan market is almost half the corresponding value for Switzerland.

Figure 1 depicts the trend in the Simpson Index (Michie and Oughton, 2013) for the loan and deposit markets in the largest European economies.<sup>12</sup> At a first glance, we notice that Italy has enjoyed a sustained increase in ownership diversity with respect to both sides of its banks' balance sheets. By contrast, there seems to have been a considerable loss of diversity in the UK, as tested by the 13.30% decrease in the index for the loan market in the run-up to the crisis (from its 2004 peak). A marked decrease in ownership diversity towards the end of the sample period can also be observed for Spain, where the collapse of the *cajas* in the aftermath of the crisis led to a significant reduction in savings banks' market shares (Ruiz et al., 2016). Most importantly, in 2011 the diversity measure for the whole sample fell by 11.65% (loan market) and 14.32% (deposit market) relative to 1999, pointing to a general decline in ownership diversity across Western European countries.

[Insert Table 1 about here]

<sup>12</sup>Since for any given country and year the number of ownership types is bounded between 0 and 3, the rest of the analysis uses primarily the Simpson Index (Michie and Oughton, 2013). Compared with other measures, this index is shown to be more sensitive to changes in the maximum proportion among categories rather than in their number (McDonald and Dimmick, 2003) and is therefore well suited when the degree of dominance is of concern (Whittaker, 1972).

[Insert [Figure 1](#) about here]

### 3.2.2. Bank risk

We quantify the riskiness of banks through the Z-score ( $Z$ ), a measure frequently used in the literature to describe insolvency risk (e.g. [Bai and Elyasiani, 2013](#); [Chen et al., 2017](#)). One of the major advantages of this measure is that it does not require market values, a feature that is key to our analysis due to the overwhelming majority of unlisted banks in the sample. The Z-score is a proxy for distance to default and corresponds to the number of standard deviations by which bank returns have to fall before equity is wiped out and the intermediary becomes insolvent. Accordingly, higher values indicate lower default risk (greater bank stability). As the Z-score is highly skewed, we follow the literature (e.g. [Dong et al., 2014](#)) and apply its natural logarithm. Therefore, the proxy for bank risk becomes:

$$Z_{i,t} = \ln \left( \frac{ROA_{i,t} + CAR_{i,t}}{\sigma ROA_{i,T}} \right) \quad (12)$$

where  $ROA$  is the Return On Assets and  $CAR$  is the Capital-to-Asset Ratio for bank  $i$  at time  $t$ .<sup>13</sup> Summary statistics for the Z-score are presented in [Table 2](#).<sup>14</sup> Throughout the sample period, the risk measure has a mean value of 3.594 and a standard deviation of 1.090. A sharp decline in the Z-score occurred between 1999 and 2004, during which the distance to default for an average bank decreased from 3.610 to 3.536. This suggests a 2.05% rise in the average risk appetite of financial intermediaries in the first half of the 2000s. Insolvency risk experienced a slight reduction in the period near the onset of the crisis, while it increased again during the crisis years.

[Insert [Table 2](#) about here]

<sup>13</sup>Alternatively, we construct a time-varying Z-score à la [Lepetit and Strobel \(2013\)](#), which relies on mean and standard deviation estimates of  $ROA$  computed over the full sample and combines them with current values of  $CAR$ . The results of this exercise, not reported to save space but available on request, are in line with the benchmark estimations.

<sup>14</sup>To reduce the influence of outliers, all accounting variables are winsorized at the 1st and 99th percentiles of their sample distributions.

### 3.2.3. Monetary policy

Monetary conditions are proxied by a measure of monetary policy shocks often used in the literature (e.g. [Brissimis et al., 2014](#); [Delis et al., 2017](#); [Maddaloni and Peydró, 2013](#)), that is, Taylor rule residuals ( $TR$ ). This measure captures the unexplained component of fluctuations in policy rates ([Brissimis et al., 2014](#))—i.e. the difference between policy rates and those suggested by the Taylor rule ([Taylor, 1993](#))—while allowing for cross-sectional variation in monetary conditions ([Maddaloni and Peydró, 2013](#)). For this reason, Taylor rule residuals appear to be well suited to our empirical setting, which is characterised by identical monetary policy rates but different economic conditions (e.g. in terms of GDP growth and inflation) across euro-area countries. We compute the residuals by estimating the following equation:

$$OR_{j,t} = \alpha + \beta GDP_{j,t} + \gamma INFL_{j,t} + \delta_t + \varepsilon_{j,t} \quad (13)$$

where  $OR_{j,t}$  is the quarterly average of the daily overnight interbank rate (e.g. EONIA for the eurozone countries),  $GDP_{j,t}$  is the growth rate of real GDP,  $INFL_{j,t}$  is the inflation rate (measured as the percentage change in the Consumer Price Index) and  $\delta_t$  is a time trend.<sup>15</sup> We use quarterly data for the period 1999:Q1–2011:Q4 collected from Datastream and national sources (overnight interbank rate) as well as from the OECD (GDP growth and inflation). Taylor rule residuals are estimated with a Panel Least Squares (PLS) regression for the eurozone economies (i.e. Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain) and via separate Ordinary Least Squares (OLS) regressions for the other economies (i.e. Denmark, Norway, Sweden, Switzerland and the UK).<sup>16</sup> Consistent with [Olivero et al. \(2011a\)](#), we obtain our annual indicator of monetary policy shocks by summing the resid-

<sup>15</sup>The use of GDP growth instead of the output gap in the Taylor rule equation ([Equation 13](#)) is common practice in the monetary policy literature (e.g. [Brissimis et al., 2014](#); [Maddaloni and Peydró, 2011, 2013](#)). We would like to thank an anonymous referee for drawing our attention to this point.

<sup>16</sup>Following [Maddaloni and Peydró \(2011, 2013\)](#), we impose common coefficients for the euro-area countries due to the single monetary policy.

uals from the regression equation over the four quarters in each year. Positive (negative) Taylor rule residuals denote a tight (loose) monetary environment. Descriptive statistics for the monetary policy variable are reported in [Table 2](#).

[Figure 2](#) illustrates Taylor rule residuals over the period from 1999:Q1 to 2011:Q4 for the economies included in the sample.<sup>17</sup> The movements in the residuals suggest high commonality in the conduct of monetary policy among the selected countries. Taylor rule residuals declined remarkably in the period after the dot-com bust, reaching their lowest levels around 2004. Monetary policy became tighter in the period immediately preceding the start of the crisis, before moving back to approximately the 2004 levels in the quarters following the collapse of Lehman Brothers. The lowest value of Taylor rule residuals is observed for Norway in the third quarter of 2004 ( $-2.041$ ), whereas the highest is found for the UK in the third quarter of 2007 ( $2.750$ ).

[Insert [Figure 2](#) about here]

#### 3.2.4. Other explanatory variables

We attempt to mitigate omitted-variable bias by including a number of bank- and country-level controls that are deemed to influence bank risk. Among the bank-specific variables is a dummy for ownership structure (*STAKE*), which equals 1 for stakeholder banks and 0 otherwise. The inclusion of the ownership dummy is aimed at disentangling the effects of individual bank ownership on the risk-taking incentives of financial intermediaries from those associated with the ownership composition of the banking system as a whole. In light of the lower incentives for cooperative and savings banks to take on risk ([Ayadi et al., 2009](#); [Casu and Gall, 2016](#)), we predict a positive relationship between the proxy for ownership type and bank stability. To capture the potential for a ‘too-big-to-fail’ phenomenon, we account for bank size (*SIZE*) by considering the natural logarithm of real total assets. We do not have a clear a priori assumption about this variable, as

<sup>17</sup>In [Figure 2](#), Taylor rule residuals for the euro area are calculated as a weighted average based on each country’s GDP.

the literature provides conflicting evidence on the size–insolvency risk nexus (Bai and Elyasiani, 2013; García-Kuhnert et al., 2015). Furthermore, evidence exists that access to liquidity by financial intermediaries has a bearing on their risk taking (Ioannidou et al., 2015). To measure liquidity ( $LIQ$ ), we calculate the ratio of liquid assets to total assets.<sup>18</sup> Since theory points to leverage as one of the main mechanisms through which asset risk can be altered (Acharya et al., 2009), we add the ratio of liabilities to total assets as an indicator of bank leverage ( $LEV$ ). Whilst leverage might increase the target level of default risk due to the improved payoff from risky investments (Jensen and Meckling, 1976), higher leverage might reflect a lower risk-taking ability on the part of financial intermediaries and discourage them from engaging in risk behaviour (Shrieves and Dahl, 1992). Likewise, the incentives for banks to take on risk are likely to depend on their past performance (Mohsni and Otchere, 2014). For this reason, we control for the ratio of net income to average equity ( $ROE$ ). In turn, diversification away from lending might be related to reduced bank stability (Chiaramonte et al., 2015; Hesse and Cihák, 2007). To this end, we employ the measure of asset diversity ( $DIV$ ) developed by Laeven and Levine (2007), which is computed as:

$$DIV_{i,t} = 1 - \left| \frac{Net\ loans_{i,t} - Other\ earning\ assets_{i,t}}{Total\ earning\ assets_{i,t}} \right| \quad (14)$$

At the country level, we account for market concentration ( $CONC$ ), corresponding to the share of assets of the three largest banks in the system.<sup>19</sup> The literature offers little guidance on the impact of concentration on distance from insolvency, as support is found for more concentrated markets being associated with either higher or lower bank stability (Beck et al., 2006; Schaeck et al., 2009). One may argue that financial regulation has a bearing on financial institutions' incentives, for example by introducing

<sup>18</sup>Liquid assets are the sum of loans and advances to banks, reverse repos and cash collateral, securities classified as held for trading (excluding derivatives) and cash and due from banks.

<sup>19</sup>The results of the baseline estimations are confirmed if the five-bank concentration ratio is considered instead.

unnecessary complexity in the market.<sup>20</sup> To account for the regulatory environment, we derive four indices from the Bank Regulation and Supervision Survey by the World Bank (Barth et al., 2001, 2004, 2006, 2012).<sup>21</sup> Activity restrictions (*ACT*) reflects the degree to which banks are allowed to engage in securities activities, insurance activities, real estate activities and ownership of non-financial firms. Greater regulatory restrictions are shown to either reduce bank riskiness (Lee and Hsieh, 2013) or increase the fragility of the system by restraining banks from entering non-traditional lines of business (Beck et al., 2006). Capital requirements (*CAPR*) describes the stringency of regulatory capital requirements. Although we would generally expect greater oversight of bank capital to result in less risk taking on the part of financial intermediaries (Keeley and Furlong, 1990), the opposite might hold if stricter capital requirements lead banks to shift their portfolios towards riskier structures via changes in the risk–return frontier (Koehn and Santomero, 1980). Supervisory power (*SUP*) proxies for the right of the official supervisory authority to take actions aimed at changing bank behaviour, such as initiating legal action against external auditors, ordering the bank management to constitute provisions for actual or potential losses and superseding shareholder rights in case of bank restructuring. We do not have an a priori assumption about the link between supervisory power and bank risk, since the evidence available in the literature is somewhat ambiguous (Lee and Hsieh, 2013; Vallascas and Hagendorff, 2013). Private monitoring (*PRIV*) captures the incentives on the part of private investors to monitor and exert effective governance over banks. While some findings appear to indicate that greater monitoring by private agents limits risk-taking incentives at banks (Delis and Kouretas, 2011), more recent evidence uncovers a positive relationship between private monitoring and risky assets (Drakos et al., 2016). Moreover, the literature suggests that the macroeconomic environment is important in explaining the risk appetite of banks (Paligorova and Santos, 2017). Therefore, we control for general economic conditions by including the annual growth rate of real GDP (*GDP*). In a similar

<sup>20</sup>We would like to thank an anonymous referee for making this point.

<sup>21</sup>The data used to compute the regulatory variables is available at four points in time (i.e. 2001, 2003, 2007 and 2011) and spans the 1999–2011 period.

vein, we attempt to disentangle the risk-taking channel from the standard ‘financial accelerator’ (Bernanke et al., 1999), which affects bank lending decisions through financial frictions on the side of borrowers. To this purpose, our empirical setup accounts for the annual change in real stock market returns for the non-financial sector ( $MKT$ ).<sup>22</sup>

### 3.3. Sample construction

We collect banks’ balance sheet and income statement data from Bankscope, a financial database provided by Bureau van Dijk. The sample consists of a panel of banks located in the 15 economies that entered the European Union prior to the 2004 enlargement (i.e. Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and the UK) plus Norway and Switzerland. We gather annual reports covering the period from 1999 (the year corresponding to the launch of the euro) to 2011 (the latest year for which data on the regulatory variables is available).<sup>23</sup> All financial intermediaries included by Bankscope in the categories ‘commercial banks’, ‘savings banks’, ‘cooperative banks’, ‘real estate and mortgage banks’, ‘specialised governmental credit institutions’ and ‘bank holdings and holding companies’ were initially selected. To alleviate survivorship bias, we used unconsolidated statements whenever available (otherwise consolidated) for banks that were active at least one year over the 1999–2011 period.<sup>24</sup> As the analysis involves deposit-taking and loan-making institutions, we dropped banks that did not report data on either deposits or loans. Furthermore, we excluded the holding company if accounts for the bank itself were available, while we ensured that subsidiaries of banks reporting at the consolidated level were not included.

<sup>22</sup>The correlation coefficients for the variables used in the analysis are reported in Table A1 in the appendix.

<sup>23</sup>Support for the use of annual data when examining the risk-taking channel of monetary transmission is offered by Delis and Kouretas (2011) and Brissimis et al. (2014).

<sup>24</sup>While the choice of favouring unconsolidated statements finds its main justification in the predominance of unconsolidated data among the sample banks, the use of unconsolidated accounts also allows for more accurate estimations of ownership diversity for the selected countries (in that foreign subsidiaries are not included).

Although the initial ownership categories were drawn from Bankscope, we made a series of major refinements. First, we reclassified most of the Swiss cooperatives belonging to the Raiffeisen Group, given that they had been included among savings banks. Similarly, we moved a number of the German *Volksbanken* that had been categorised as savings banks to the set of cooperative institutions. Several intermediaries that were originally classified as specialised governmental credit institutions, such as Swiss *Kantonalbanken* and German *Landesbanken*, were added to the list of savings banks. In addition, the group of cooperative banks was expanded to comprise building societies from the UK and Ireland that endured the increasing trend of demutualisation and consolidation, since they are owned by their customers (Casu and Gall, 2016). As a next step, we ensure that our results are not affected by Mergers and Acquisitions (M&As) by examining the M&A history of all financial intermediaries included in the sample. To this end, we obtained information on M&As from Bankscope and supplemented it with data retrieved from Thomson Reuters' SDC Platinum. Following the literature (e.g. Claessens and van Horen, 2014), banks that had been targets of completed M&As stayed in the sample until the year preceding the takeover, whilst for the period following the transaction only the accounts of the new entity were retained.

As a result, we ended up with an unbalanced panel of 5,677 shareholder- and stakeholder-oriented banks that are located and operate in Western Europe. The final sample consists of 1,502 commercial banks, 2,954 cooperative banks and 1,221 savings banks. Table 3 details the number of banks by country and ownership type. Whilst commercial banks are largely present in Luxembourg, the Netherlands and Ireland, they are somewhat less represented in countries such as Germany, Austria and Italy. In these countries, stakeholder banks in general and cooperative banks in particular appear to be a major player.<sup>25</sup> Outside the eurozone, commercial banks are found to dominate the UK financial system, while savings banks constitute the vast majority of banking firms in Norway, Sweden and Denmark. In a nutshell, these cross-country differences seem to offer preliminary

<sup>25</sup>Since the observation period ends in 2011, the sub-sample of cooperative banks in Italy includes the largest *Banche Popolari* that were converted to joint-stock companies through the 2015 reform.

support for the need to develop measures capturing the degree of ownership diversity in the banking systems of Western Europe.

[Insert [Table 3](#) about here]

## 4. Results

### 4.1. Baseline estimations

The results of the baseline regressions are shown in [Table 4](#). In each column, a different measure of ownership diversity—i.e. the Simpson Index ([Michie and Oughton, 2013](#)), Shannon–Wiener Index and Heip Index—for the loan market is used. The validity of the selected instruments is confirmed by the Hansen test of overidentifying restrictions, Hansen  $\chi^2$  ( $p$ -value), while serial correlation of order two,  $AR(2)$ , is rejected by the Arellano–Bond test for autocorrelation in the error terms. The coefficient on the lagged dependent variable reveals that bank risk taking is highly persistent, confirming the need to account for the dynamic nature of bank risk. In line with the theoretical underpinnings of the risk-taking channel ([Angeloni et al., 2015](#); [Borio and Zhu, 2012](#)), the coefficient on  $TR$ —which captures the average impact of monetary policy shocks on banks’ probability of default among the sample countries—is positive and highly significant in all specifications. This evidence confirms that looser monetary conditions induce financial intermediaries to operate closer to default. Support for the first hypothesis is provided by the positive and strongly significant coefficients of the proxies for ownership diversity, particularly when the Simpson Index ([Michie and Oughton, 2013](#)) is considered (0.391). In a nutshell, these results suggest that—*ceteris paribus*—shareholder- and stakeholder-oriented banks located in countries with greater diversity of ownership types tend to be more stable relative to their counterparts operating in less diverse banking systems. Most importantly, we find that ownership diversity buffers the effects of exogenous monetary policy shocks on bank risk, as denoted by the negative and highly significant coefficients

on the interaction terms ( $0.017 - 0.017 = 0.000$  if ownership diversity is measured by *SIM.L*). This corroborates the second hypothesis, in that monetary transmission via the risk-taking channel appears to be less pronounced in banking systems characterised by a multiplicity of ownership structures.

Looking at the bank-level controls, the results indicate that cooperative and savings banks have on average lower insolvency risk than their commercial peers, consistent with predictions from the ownership structure literature (Ayadi et al., 2009; Llewellyn, 2017). Bank size is found to be positively related to distance to default, thereby rejecting the ‘too-big-to-fail’ hypothesis. Whereas some evidence exists that more liquid banks are likely to be more stable than their counterparts with less liquid balance sheets, ex ante greater leverage does not seem to deter financial intermediaries from taking on additional risk. As expected, past performance is found to influence risk taking by banks, with higher equity returns curtailing the incentives on the part of intermediaries to increase their risk exposure. At the country level, support is offered to the concentration–stability hypothesis (Beck et al., 2006), as banks operating in more concentrated markets tend to have less risky balance sheets than banks operating in less concentrated ones. With respect to the regulatory environment, greater restrictions on bank activities are found to discourage financial intermediaries from engaging in risk taking, while stricter capital requirements do not seem to be effective in limiting banks’ appetite for risk. Interestingly, a more stringent regulatory environment in terms of the power of the supervisory agency and private monitoring appears to have a negative impact on banks’ distance to default, possibly because of the additional constraints it exerts on financial intermediaries’ behaviour. In addition, positive economic circumstances as gauged by the growth rate of real GDP tend to be associated with higher bank stability, lending support to the view that increased economic growth is likely to lower bank risk by providing access to risk management techniques (Williams, 2014). In accordance with expectations from the literature (Altunbas et al., 2014), a boost in the value of collateral generated by an increase in borrowers’ stock market returns lowers the probability of financial intermediaries

becoming insolvent.

[Insert [Table 4](#) about here]

## 4.2. Robustness checks

The sensitivity of the results is examined in several ways. As a first robustness check, we test whether the results are stable by changing the way we measure ownership diversity. To this end, we employ the three diversity indices—i.e. the Simpson Index ([Michie and Oughton, 2013](#)), Shannon–Wiener Index and Heip Index—calculating them relative to the deposit market. Looking at both the asset and funding sides of banks’ balance sheets is important, since there is evidence that the market shares of shareholder banks vis-à-vis stakeholder banks may differ depending on whether the loan or deposit market is considered ([Michie and Oughton, 2013](#)). This is also confirmed by the values reported in [Table 1](#), which point to some important differences in the degree of ownership diversity across the sample countries according to market type. A case in point is Switzerland, where the ownership composition of the banking system is found to be considerably more diverse if the loan side rather than the deposit side is considered (e.g. 2.087 and 1.570, respectively, when ownership diversity is measured by *SIM\_L*). The results of this exercise are presented in [Table 5](#). The coefficients on the variables of interest are highly significant and qualitatively similar to those presented in [Table 4](#), leaving the findings virtually unaffected.<sup>26</sup>

[Insert [Table 5](#) about here]

A second exercise is to assess whether the use of an alternative indicator of monetary policy has an impact on the results. Following the methodology pioneered by [Bernanke and Blinder \(1992\)](#) and further developed by [Bernanke and Mihov \(1998\)](#), we build a structural vector autoregressive (SVAR) model consisting of six macroeconomic variables:

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<sup>26</sup>In unreported regressions, we use indices of ownership diversity constructed with data on either total assets or customer deposits (instead of total deposits). The results, not tabulated to save space but available on request, are again confirmed.

the short-term interest rate; the log of total credit to the private non-financial sector; the log of the monetary aggregate; the log of the price level; the log of real GDP; and the real effective exchange rate. The data used to construct these variables are collected from the OECD (short-term interest rate and monetary aggregate), BIS (total credit to the private non-financial sector) and IMF (price level, real GDP and real effective exchange rate). For each country included in the sample, we estimate a SVAR model in first differences over the longest period for which data is available (e.g. from 1979:Q1 to 2018:Q2 for Norway and Switzerland).<sup>27</sup> Since the estimations are performed with quarterly data, we sum the residuals from the interest rate equation over the four quarters to derive our alternative annual measure of monetary policy shocks (*MP-SVAR*). As in the case of Taylor rule residuals, a positive (negative) value of the residuals indicates a contractionary (expansionary) monetary policy stance. Compared with other proxies for monetary policy frequently found in the literature (e.g. the level or first difference of the short-term interest rate), this SVAR-based measure captures only interest rate changes that are independent of other macroeconomic shocks. Therefore, it is regarded as a proper indicator of exogenous monetary policy innovations (e.g. [Chen et al., 2017](#); [Gunji et al., 2009](#); [Ramos-Tallada, 2015](#)). Moreover, this indicator may allow us to capture stretches where monetary policy is loose for an extended period of time.<sup>28</sup> The results based on this alternative measure of monetary policy are reported in [Table 6](#). The coefficients on the variables of interest are qualitatively similar to those from the baseline estimations, supporting our main finding that ownership diversity buffers the impact of monetary policy shocks on banks' probability of default.

[Insert [Table 6](#) about here]

A further concern is that the baseline setup might not control for other variables that could explain bank risk. For this reason, we re-run [Equation 1](#) by including four

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<sup>27</sup>To select the optimal number of lags to be included in each model, we examine the likelihood ratio test, the Final Prediction Error (FPE), the Akaike Information Criterion (AIC), the Schwarz Bayesian Information Criterion (SBIC) and the Hannan–Quinn Information Criterion (HQIC).

<sup>28</sup>We are grateful to an anonymous referee for pointing this out.

additional explanatory variables one by one. First, we account for the ratio of customer deposits to total assets as a proxy for franchise value (*FRA*).<sup>29</sup> Given that the cost of failure to owners will be greater for financial intermediaries with higher charter value (Fortin et al., 2010), we posit that an increase in franchise value will discourage risk taking on the part of banks. Second, we control for the relative importance of banks in the country's financial system (*IMP*), estimated as the ratio of domestic credit provided by banks to GDP.<sup>30</sup> Insofar as financial intermediaries in more bank-based economies take on higher risk in an attempt to meet the more inelastic demand for credit by the private sector (Delis and Kouretas, 2011), we anticipate a negative link between the proxy for the relative importance of banks and their distance from insolvency. Third, we add a measure of institutional quality (*INST*), namely the Index of Economic Freedom by the Heritage Foundation. In line with the literature (Beck et al., 2006; Williams, 2014), we would expect improved national governance to result in greater bank stability. Fourth, we test whether monetary authorities' financial stability policies are central to the equation by conditioning the model on Central Bank Independence (*CBI*), captured by the weighted index of *de jure* CBI developed by Garriga (2016). One may argue that ownership diversity is determined at least in part by the financial stability policies adopted by central banks, given their ability to alter financial institutions' ownership together with their incentive to achieve a degree of uniformity in the financial sector. It follows that the ownership composition of the banking system may be to a certain extent the product of previous central bank interference.<sup>31</sup> Furthermore, a growing body of research suggests that the independence of central banks from political influences may have a bearing on bank soundness (Berger and Kißmer, 2013; Doumpos et al., 2015), although disagreement exists in the literature with respect to the sign of this relationship as well as the whole premise of CBI (e.g. Hartwell, 2019). Table 7 presents the results of the panel estimations when these factors are included. Consistent with a priori expectations,

<sup>29</sup>The data used to construct the measure of franchise value is collected from Bankscope.

<sup>30</sup>We gather data on the bank-credit-to-GDP ratio from the Global Financial Development Database (GFDD) maintained by the World Bank (Cihák et al., 2012).

<sup>31</sup>We are thankful to an anonymous referee for bringing this issue to our attention.

there is evidence that franchise value plays a disciplining role in banks' risk decisions. At the same time, whilst intermediaries located in countries with a greater bank-credit-to-GDP ratio are generally characterised by relatively high levels of default risk, we find somewhat limited support for a link between institutional quality and bank stability. The results are also robust to the inclusion of the proxy for CBI, while there is no evidence that greater independence of central banks from external pressures exerts a statistically significant impact on banks' probability of default. After controlling for these additional influences, the results are not materially different from the baseline estimations and leave our conclusions unchanged.

[Insert [Table 7](#) about here]

## 5. Conclusions

Since the outbreak of the global financial turmoil, many commentators have blamed the 'too-low-for-too-long' interest rates until the mid-2000s for the changes in risk perception by banks and the ensuing realisation of risks in the economy. In more recent years, a related debate has unfolded on whether continued expectations of a particularly low interest rate environment are already laying the foundation for the next financial crisis ([Dell'Ariccia et al., 2017](#)). This paper contributes to a fast-growing strand of research that endeavours to uncover the implications of bank ownership for the stability of the financial system and its resilience to crises (e.g. [Cull and Martínez Pería, 2013](#); [Ferri et al., 2014](#); [Meriläinen, 2016](#)). Borrowing measures used in ecology to capture the diversity of ecosystems and first applied to the field of finance by [Michie and Oughton \(2013\)](#), we construct indices of ownership diversity to examine how the ownership composition of the banking system affects monetary policy transmission via the risk-taking channel. Our results, based on a large panel of shareholder and stakeholder banks operating in Western Europe, suggest that ownership diversity buffers the impact of exogenous monetary policy shocks on bank risk. In addition, we find that—*ceteris paribus*—shareholder- and

stakeholder-oriented banks located in countries with greater diversity of ownership types tend to be more stable than their counterparts from less diverse markets. These results hold across several econometric specifications and point to the stabilising role played by ownership diversity in modern financial systems.

The findings of this paper have a number of implications for monetary authorities and other banking regulators. One of the major lessons from the empirical analysis is that ownership diversity emerges as an important factor accounting for differential effects of monetary policy on bank riskiness. For this reason, our evidence calls for a closer overseeing by central banks of the ownership composition characterising banking systems, as this is likely to moderate monetary transmission through the risk-taking channel. Moreover, the findings of this study are of interest to banking regulators, inasmuch as they feed into the current debate over how to design a more stable and resilient financial system (Casu and Gall, 2016; Meriläinen, 2016; Michie, 2017). In light of the positive link between ownership diversity and financial stability, regulatory initiatives could be taken to ensure that banks with different ownership structures, business models and corporate objectives are effectively represented. Our findings concur with the view that countries where stakeholder-oriented institutions play only a marginal role might consider developing a network of such institutions, for example via the creation of local cooperative banks and not-for-profit savings banks (Dow, 2017; Llewellyn, 2017; Werner, 2013). At the same time, the attainment of a more diverse banking system might hinge on the ability of regulatory authorities to measure, monitor and report the degree of ownership diversity in the banking system. We hope that this paper will contribute further to the development of such an agenda.

Future research could extend our work in a variety of ways. In light of the important role played by stakeholder banks in offsetting shocks to the credit supply of their shareholder peers (Ferri et al., 2014; Meriläinen, 2016), we would expect interactions between financial intermediaries with different types of ownership to influence monetary policy transmission through banks' loan supply. Therefore, efforts might be directed at

exploring the extent to which the degree of ownership diversity in the banking industry moderates the transmission of monetary policy via the bank lending channel (Bernanke and Blinder, 1988). In a similar vein, researchers could use diversity indices à la Michie and Oughton (2013), together with those presented in this paper, and examine how the ownership composition of the banking system interacts with banking regulations in determining the risk appetite of banks. By expanding on the literature concerned with the implications of ownership structure for the relationship between regulatory changes and bank risk (Laeven and Levine, 2009), these studies might shed new light on the factors explaining the differential impact of regulations on risk-taking incentives by banks. We are currently looking at how the spatial configuration of banks within and between bank types affects their appetite for risk and ensuing response to fluctuations in monetary policy.

## Appendix

[Insert Table A1 about here]

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**Table 1.** Ownership diversity by country and market type.

|              | Loans   |                |       | Deposits |                |       |
|--------------|---------|----------------|-------|----------|----------------|-------|
|              | Simpson | Shannon–Wiener | Heip  | Simpson  | Shannon–Wiener | Heip  |
| AT           | 2.839   | 2.912          | 0.956 | 2.835    | 2.909          | 0.955 |
| BE           | 1.057   | 1.148          | 0.074 | 1.053    | 1.142          | 0.071 |
| DE           | 2.553   | 2.720          | 0.860 | 2.608    | 2.755          | 0.877 |
| ES           | 2.119   | 2.269          | 0.634 | 2.106    | 2.267          | 0.633 |
| FI           | 1.980   | 2.166          | 0.583 | 1.778    | 2.042          | 0.521 |
| FR           | 1.896   | 1.961          | 0.480 | 1.937    | 1.976          | 0.488 |
| GR           | 1.043   | 1.111          | 0.075 | 1.076    | 1.165          | 0.109 |
| IE           | 1.093   | 1.194          | 0.194 | 1.082    | 1.176          | 0.176 |
| IT           | 1.698   | 2.058          | 0.529 | 1.595    | 1.938          | 0.469 |
| LU           | 1.170   | 1.336          | 0.168 | 1.129    | 1.273          | 0.136 |
| NL           | 1.659   | 1.799          | 0.530 | 1.709    | 1.832          | 0.561 |
| PT           | 1.168   | 1.331          | 0.165 | 1.135    | 1.290          | 0.145 |
| <i>EA-12</i> | 2.354   | 2.630          | 0.815 | 2.329    | 2.619          | 0.810 |
| DK           | 1.109   | 1.231          | 0.115 | 1.135    | 1.280          | 0.140 |
| GB           | 1.280   | 1.456          | 0.228 | 1.250    | 1.421          | 0.211 |
| SE           | 1.151   | 1.286          | 0.286 | 1.089    | 1.191          | 0.191 |
| <i>EU-15</i> | 2.090   | 2.445          | 0.723 | 2.088    | 2.445          | 0.723 |
| CH           | 2.087   | 2.353          | 0.676 | 1.570    | 1.900          | 0.450 |
| NO           | 1.830   | 1.948          | 0.569 | 1.705    | 1.850          | 0.515 |
| Whole sample | 2.092   | 2.444          | 0.722 | 2.045    | 2.412          | 0.706 |

*Notes:* The table summarises the degree of ownership diversity for the loan and deposit markets in each of the countries included in the sample. Values correspond to the annual average of the corresponding index over the whole sample period (from 1999 to 2011). Higher values denote greater ownership diversity. *Loans* are computed as residential mortgage loans, other mortgage loans, other retail loans, business loans and other loans minus loan loss reserves. *Deposits* are the sum of customer deposits, deposits from banks, money market instruments, certificates of deposits and other deposits. AT, Austria; BE, Belgium; DE, Germany; ES, Spain; FI, Finland; FR, France; GR, Greece; IE, Ireland; IT, Italy; LU, Luxembourg; NL, Netherlands; PT, Portugal; DK, Denmark; GB, United Kingdom; SE, Sweden; CH, Switzerland; NO, Norway. *EA-12* are the founding eurozone economies, namely Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain. *EU-15* are the countries that entered the European Union prior to the 2004 enlargement, i.e. the *EA-12* economies, Denmark, Sweden and the UK. *Source:* Bankscope.

Table 2. Summary statistics.

| Variable               | Notation     | Description                                                                                                                                                                                            | Source                                      | Mean   | SD     | Min     | Max    |
|------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------|--------|---------|--------|
| Bank risk              |              |                                                                                                                                                                                                        |                                             |        |        |         |        |
| Z-score                | <i>Z</i>     | Natural logarithm of the Return On Assets ( <i>ROA</i> ) plus the Capital-to-Asset Ratio ( <i>CAR</i> ) divided by the standard deviation of <i>ROA</i> .                                              | Bankscope                                   | 3.594  | 1.090  | -0.297  | 7.278  |
| Monetary policy        |              |                                                                                                                                                                                                        |                                             |        |        |         |        |
| Taylor rule residuals  | <i>TR</i>    | Residuals from a regression of the overnight interbank rate on GDP growth and inflation.                                                                                                               | Datstream; national data; OECD              | 0.534  | 3.564  | -7.197  | 9.585  |
| Ownership diversity    |              |                                                                                                                                                                                                        |                                             |        |        |         |        |
| Simpson Index          | <i>SIM_L</i> | Simpson Index of ownership diversity for the loan market (Michie and Oughton, 2013).                                                                                                                   | Bankscope                                   | 2.131  | 0.520  | 1.008   | 2.961  |
| Shannon–Wiener Index   | <i>SHA_L</i> | Shannon–Wiener Index of ownership diversity for the loan market.                                                                                                                                       | Bankscope                                   | 2.323  | 0.498  | 1.027   | 2.980  |
| Heip Index             | <i>HELL</i>  | Heip Index of ownership diversity for the loan market.                                                                                                                                                 | Bankscope                                   | 0.667  | 0.243  | 0.027   | 0.990  |
| Bank-level controls    |              |                                                                                                                                                                                                        |                                             |        |        |         |        |
| Stakeholder            | <i>STAKE</i> | Dummy that equals 1 for either cooperative or savings banks and 0 otherwise.                                                                                                                           | Bankscope                                   | 0.766  | 0.424  | 0.000   | 1.000  |
| Size                   | <i>SIZE</i>  | Natural logarithm of total assets (divided by the GDP deflator).                                                                                                                                       | Bankscope; WDI                              | 6.569  | 1.722  | 2.481   | 12.462 |
| Liquidity              | <i>LIQ</i>   | Ratio of liquid assets to total assets.                                                                                                                                                                | Bankscope                                   | 19.978 | 17.958 | 0.590   | 92.240 |
| Leverage               | <i>LEV</i>   | Ratio of liabilities to total assets.                                                                                                                                                                  | Bankscope                                   | 91.066 | 8.041  | 20.886  | 98.926 |
| Profitability          | <i>ROE</i>   | Ratio of net income to average equity.                                                                                                                                                                 | Bankscope                                   | 5.683  | 7.340  | -48.247 | 38.773 |
| Asset diversity        | <i>DIV</i>   | One minus the ratio of net loans minus other earning assets to total earning assets.                                                                                                                   | Bankscope                                   | 0.574  | 0.261  | 0.000   | 0.993  |
| Country-level controls |              |                                                                                                                                                                                                        |                                             |        |        |         |        |
| Concentration          | <i>CONC</i>  | Sum of assets of the three largest banks as a share of total assets of commercial, cooperative and savings banks in the country.                                                                       | Bankscope                                   | 41.443 | 17.383 | 21.145  | 96.671 |
| Activity restrictions  | <i>ACT</i>   | Index of the degree to which national regulatory authorities restrict banks from engaging in securities activities, insurance activities, real estate activities and ownership of non-financial firms. | Barth et al. (2001, 2004, 2006, 2012); BRSS | 6.662  | 2.755  | 2.000   | 12.000 |

**Table 2.** (*Continued*)

| Variable             | Notation    | Description                                                                                                 | Source                                      | Mean  | SD     | Min     | Max    |
|----------------------|-------------|-------------------------------------------------------------------------------------------------------------|---------------------------------------------|-------|--------|---------|--------|
| Capital requirements | <i>CAPR</i> | Index of the stringency of regulatory capital requirements.                                                 | Barth et al. (2001, 2004, 2006, 2012); BRSS | 6.148 | 1.595  | 2.000   | 9.000  |
| Supervisory power    | <i>SUP</i>  | Index of the power of the official supervisory authority to affect bank behaviour.                          | Barth et al. (2001, 2004, 2006, 2012); BRSS | 9.598 | 2.261  | 4.000   | 14.000 |
| Private monitoring   | <i>PRIV</i> | Index of the extent to which regulatory and supervisory policies encourage the private monitoring of banks. | Barth et al. (2001, 2004, 2006, 2012); BRSS | 7.946 | 0.852  | 5.000   | 10.000 |
| GDP growth           | <i>GDP</i>  | Annual growth rate of real GDP.                                                                             | WDI                                         | 1.544 | 2.387  | -8.864  | 10.201 |
| Stock market returns | <i>MKT</i>  | Annual change in the total return index for non-financial corporations (divided by the GDP deflator).       | Datastream                                  | 4.576 | 19.753 | -45.227 | 94.275 |

*Notes:* The table provides the notation, description and summary statistics for the main variables used in the analysis. The sample period goes from 1999 to 2011. BRSS, Bank Regulation and Supervision Survey; WDI, World Development Indicators.

**Table 3.** Sample composition by country and ownership type.

|              | Commercial banks | Cooperative banks | Savings banks | Total |
|--------------|------------------|-------------------|---------------|-------|
| AT           | 77               | 171               | 78            | 326   |
| BE           | 52               | 12                | 11            | 75    |
| DE           | 183              | 1607              | 598           | 2388  |
| ES           | 88               | 87                | 61            | 236   |
| FI           | 10               | 4                 | 8             | 22    |
| FR           | 186              | 165               | 13            | 364   |
| GR           | 19               | 2                 | 1             | 22    |
| IE           | 23               | 3                 | 0             | 26    |
| IT           | 220              | 592               | 47            | 859   |
| LU           | 126              | 2                 | 2             | 130   |
| NL           | 45               | 1                 | 2             | 48    |
| PT           | 39               | 4                 | 3             | 46    |
| <i>EA-12</i> | 1068             | 2650              | 824           | 4542  |
| DK           | 62               | 9                 | 64            | 135   |
| GB           | 175              | 68                | 8             | 251   |
| SE           | 19               | 0                 | 91            | 110   |
| <i>EU-15</i> | 1324             | 2727              | 987           | 5038  |
| CH           | 159              | 225               | 110           | 494   |
| NO           | 19               | 2                 | 124           | 145   |
| Total        | 1502             | 2954              | 1221          | 5677  |

*Notes:* The table specifies the number of banks by ownership type in each of the countries included in the sample. Values refer to the number of banks during the whole sample period (from 1999 to 2011). AT, Austria; BE, Belgium; DE, Germany; ES, Spain; FI, Finland; FR, France; GR, Greece; IE, Ireland; IT, Italy; LU, Luxembourg; NL, Netherlands; PT, Portugal; DK, Denmark; GB, United Kingdom; SE, Sweden; CH, Switzerland; NO, Norway. *EA-12* are the founding eurozone economies, namely Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain. *EU-15* are the countries that entered the European Union prior to the 2004 enlargement, i.e. the *EA-12* economies, Denmark, Sweden and the UK. *Source:* Bankscope.

**Table 4.** Baseline estimations.

| Independent variable               | Dependent variable: Z-score ( <i>Z</i> ) |                      |                      |
|------------------------------------|------------------------------------------|----------------------|----------------------|
|                                    | Simpson Index                            | Shannon–Wiener Index | Heip Index           |
| Lagged <i>Z</i>                    | 0.952***<br>(0.026)                      | 0.940***<br>(0.030)  | 0.906***<br>(0.028)  |
| <i>TR</i>                          | 0.017***<br>(0.006)                      | 0.016**<br>(0.008)   | 0.014***<br>(0.005)  |
| <i>SIM_L</i>                       | 0.391***<br>(0.149)                      |                      |                      |
| <i>TR</i> × <i>SIM_L</i>           | -0.017***<br>(0.002)                     |                      |                      |
| <i>SHA_L</i>                       |                                          | 0.351*<br>(0.201)    |                      |
| <i>TR</i> × <i>SHA_L</i>           |                                          | -0.017***<br>(0.002) |                      |
| <i>HELL</i>                        |                                          |                      | 0.285***<br>(0.108)  |
| <i>TR</i> × <i>HELL</i>            |                                          |                      | -0.034***<br>(0.004) |
| Bank-level controls                |                                          |                      |                      |
| <i>STAKE</i>                       | 0.151***<br>(0.040)                      | 0.114**<br>(0.058)   | 0.205***<br>(0.060)  |
| <i>SIZE</i>                        | 0.021**<br>(0.011)                       | 0.026**<br>(0.012)   | 0.031***<br>(0.010)  |
| <i>LIQ</i>                         | 0.002**<br>(0.001)                       | -0.001<br>(0.002)    | 0.001<br>(0.002)     |
| <i>LEV</i>                         | -0.007**<br>(0.003)                      | -0.008**<br>(0.004)  | -0.010***<br>(0.003) |
| <i>ROE</i>                         | 0.008***<br>(0.002)                      | 0.006***<br>(0.002)  | 0.010***<br>(0.002)  |
| <i>DIV</i>                         | 0.015<br>(0.067)                         | 0.102<br>(0.077)     | 0.049<br>(0.076)     |
| Country-level controls             |                                          |                      |                      |
| <i>CONC</i>                        | 0.012***<br>(0.002)                      | 0.011***<br>(0.001)  | 0.008***<br>(0.001)  |
| <i>ACT</i>                         | 0.037***<br>(0.006)                      | 0.036***<br>(0.006)  | 0.037***<br>(0.006)  |
| <i>CAPR</i>                        | -0.022***<br>(0.007)                     | -0.007<br>(0.007)    | 0.004<br>(0.005)     |
| <i>SUP</i>                         | -0.028***<br>(0.005)                     | -0.032***<br>(0.006) | -0.024***<br>(0.004) |
| <i>PRIV</i>                        | -0.046***<br>(0.008)                     | -0.052***<br>(0.010) | -0.047***<br>(0.009) |
| <i>GDP</i>                         | 0.016***<br>(0.003)                      | 0.016***<br>(0.003)  | 0.015***<br>(0.002)  |
| <i>MKT</i>                         | 0.001**<br>(0.000)                       | 0.000*<br>(0.000)    | 0.001**<br>(0.000)   |
| # of observations                  | 40088                                    | 40088                | 40088                |
| # of instruments                   | 58                                       | 58                   | 58                   |
| Wald $\chi^2$ ( <i>p</i> -value)   | 0.000                                    | 0.000                | 0.000                |
| <i>AR</i> (1)                      | 0.000                                    | 0.000                | 0.000                |
| <i>AR</i> (2)                      | 0.704                                    | 0.929                | 0.852                |
| Hansen $\chi^2$ ( <i>p</i> -value) | 0.117                                    | 0.112                | 0.313                |

Table 4. (Continued)

*Notes:* The table reports the results of the baseline estimations. *Z* is a proxy for distance from insolvency; *TR* are the residuals from a regression of the overnight rate on GDP growth and inflation; *SIM.L* is the Simpson Index of ownership diversity for loans (Michie and Oughton, 2013); *SHA.L* is the Shannon–Wiener Index of ownership diversity for loans; *HELL* is the Heip Index of ownership diversity for loans; *STAKE* is a dummy that equals 1 for stakeholder banks and 0 otherwise; *SIZE* is the natural logarithm of real total assets; *LIQ* is the ratio of liquid assets to total assets; *LEV* is the ratio of liabilities to total assets; *ROE* is the Return On Equity; *DIV* is a measure of asset diversification; *CONC* is the share of assets of the three largest banks in the country; *ACT* is an index of the regulatory restrictiveness on bank activities; *CAPR* is an index of the stringency of bank capital regulations; *SUP* is an index of the power of the official supervisory agency to change bank behaviour; *PRIV* is an index of the incentives for private investors to monitor banks; *GDP* is the annual growth rate of real GDP; *MKT* is the annual change in real stock market returns for non-financial corporations; Wald  $\chi^2$  (*p*-value) is the Wald  $\chi^2$  test of overall model fit; *AR*(1) is the Arellano–Bond test for first-order serial correlation; *AR*(2) is the Arellano–Bond test for second-order serial correlation; Hansen  $\chi^2$  (*p*-value) is the Hansen test of overidentifying restrictions. All regressions are estimated with the two-step system GMM for dynamic panels and include country- as well as time-specific effects. Windmeijer (2005) finite-sample corrected standard errors (clustered by bank) are reported in parentheses. The superscripts \*, \*\* and \*\*\* denote statistical significance at the 10%, 5% and 1% levels, respectively.

**Table 5.** Robustness check: alternative measure of ownership diversity.

| Independent variable          | Dependent variable: Z-score ( $Z$ ) |                      |                      |
|-------------------------------|-------------------------------------|----------------------|----------------------|
|                               | Simpson Index                       | Shannon–Wiener Index | Heip Index           |
| Lagged $Z$                    | 0.919***<br>(0.027)                 | 0.923***<br>(0.029)  | 0.936***<br>(0.026)  |
| $TR$                          | 0.021***<br>(0.006)                 | 0.020***<br>(0.007)  | 0.017***<br>(0.006)  |
| $SIM\_D$                      | 0.380***<br>(0.141)                 |                      |                      |
| $TR \times SIM\_D$            | -0.014***<br>(0.002)                |                      |                      |
| $SHA\_D$                      |                                     | 0.308**<br>(0.133)   |                      |
| $TR \times SHA\_D$            |                                     | -0.016***<br>(0.002) |                      |
| $HELD$                        |                                     |                      | 0.591***<br>(0.222)  |
| $TR \times HELD$              |                                     |                      | -0.032***<br>(0.004) |
| Bank-level controls           |                                     |                      |                      |
| $STAKE$                       | 0.188***<br>(0.042)                 | 0.145**<br>(0.060)   | 0.162***<br>(0.041)  |
| $SIZE$                        | 0.018*<br>(0.011)                   | 0.026**<br>(0.012)   | 0.020*<br>(0.011)    |
| $LIQ$                         | 0.002**<br>(0.001)                  | -0.001<br>(0.002)    | 0.002**<br>(0.001)   |
| $LEV$                         | -0.010***<br>(0.004)                | -0.010**<br>(0.004)  | -0.007**<br>(0.003)  |
| $ROE$                         | 0.006**<br>(0.002)                  | 0.006**<br>(0.003)   | 0.007***<br>(0.002)  |
| $DIV$                         | -0.027<br>(0.064)                   | 0.086<br>(0.077)     | 0.026<br>(0.066)     |
| Country-level controls        |                                     |                      |                      |
| $CONC$                        | 0.011***<br>(0.001)                 | 0.010***<br>(0.001)  | 0.010***<br>(0.001)  |
| $ACT$                         | 0.044***<br>(0.007)                 | 0.040***<br>(0.007)  | 0.042***<br>(0.007)  |
| $CAPR$                        | -0.015**<br>(0.008)                 | -0.008<br>(0.008)    | -0.009<br>(0.010)    |
| $SUP$                         | -0.027***<br>(0.004)                | -0.027***<br>(0.004) | -0.024***<br>(0.004) |
| $PRIV$                        | -0.052***<br>(0.009)                | -0.055***<br>(0.010) | -0.050***<br>(0.009) |
| $GDP$                         | 0.013***<br>(0.003)                 | 0.015***<br>(0.003)  | 0.013***<br>(0.003)  |
| $MKT$                         | 0.001**<br>(0.000)                  | 0.001**<br>(0.000)   | 0.001***<br>(0.000)  |
| # of observations             | 40088                               | 40088                | 40088                |
| # of instruments              | 58                                  | 58                   | 58                   |
| Wald $\chi^2$ ( $p$ -value)   | 0.000                               | 0.000                | 0.000                |
| $AR(1)$                       | 0.000                               | 0.000                | 0.000                |
| $AR(2)$                       | 0.443                               | 0.637                | 0.720                |
| Hansen $\chi^2$ ( $p$ -value) | 0.106                               | 0.207                | 0.136                |

Table 5. (Continued)

*Notes:* The table presents the results of the empirical estimations with ownership diversity calculated for the deposit market. *Z* is a proxy for distance from insolvency; *TR* are the residuals from a regression of the overnight rate on GDP growth and inflation; *SIM.D* is the Simpson Index of ownership diversity for deposits (Michie and Oughton, 2013); *SHA.D* is the Shannon–Wiener Index of ownership diversity for deposits; *HELD* is the Heip Index of ownership diversity for deposits; *STAKE* is a dummy that equals 1 for stakeholder banks and 0 otherwise; *SIZE* is the natural logarithm of real total assets; *LIQ* is the ratio of liquid assets to total assets; *LEV* is the ratio of liabilities to total assets; *ROE* is the Return On Equity; *DIV* is a measure of asset diversification; *CONC* is the share of assets of the three largest banks in the country; *ACT* is an index of the regulatory restrictiveness on bank activities; *CAPR* is an index of the stringency of bank capital regulations; *SUP* is an index of the power of the official supervisory agency to change bank behaviour; *PRIV* is an index of the incentives for private investors to monitor banks; *GDP* is the annual growth rate of real GDP; *MKT* is the annual change in real stock market returns for non-financial corporations; Wald  $\chi^2$  (*p*-value) is the Wald  $\chi^2$  test of overall model fit; *AR*(1) is the Arellano–Bond test for first-order serial correlation; *AR*(2) is the Arellano–Bond test for second-order serial correlation; Hansen  $\chi^2$  (*p*-value) is the Hansen test of overidentifying restrictions. All regressions are estimated with the two-step system GMM for dynamic panels and include country- as well as time-specific effects. Windmeijer (2005) finite-sample corrected standard errors (clustered by bank) are reported in parentheses. The superscripts \*, \*\* and \*\*\* denote statistical significance at the 10%, 5% and 1% levels, respectively.

**Table 6.** Robustness check: alternative measure of monetary policy.

| Independent variable          | Dependent variable: Z-score ( $Z$ ) |                      |                      |
|-------------------------------|-------------------------------------|----------------------|----------------------|
|                               | Simpson Index                       | Shannon–Wiener Index | Heip Index           |
| Lagged $Z$                    | 0.906***<br>(0.027)                 | 0.907***<br>(0.028)  | 0.941***<br>(0.030)  |
| $MP\_SVAR$                    | 0.049***<br>(0.017)                 | 0.052***<br>(0.018)  | 0.058***<br>(0.019)  |
| $SIM\_L$                      | 0.241**<br>(0.117)                  |                      |                      |
| $MP\_SVAR \times SIM\_L$      | -0.036**<br>(0.014)                 |                      |                      |
| $SHA\_L$                      |                                     | 0.330**<br>(0.139)   |                      |
| $MP\_SVAR \times SHA\_L$      |                                     | -0.045***<br>(0.015) |                      |
| $HELL$                        |                                     |                      | 0.969**<br>(0.419)   |
| $MP\_SVAR \times HELL$        |                                     |                      | -0.125**<br>(0.064)  |
| Bank-level controls           |                                     |                      |                      |
| $STAKE$                       | 0.177***<br>(0.048)                 | 0.177***<br>(0.049)  | 0.138***<br>(0.050)  |
| $SIZE$                        | 0.020*<br>(0.011)                   | 0.021*<br>(0.011)    | 0.009<br>(0.010)     |
| $LIQ$                         | 0.002**<br>(0.001)                  | 0.002**<br>(0.001)   | 0.002*<br>(0.001)    |
| $LEV$                         | -0.002<br>(0.003)                   | -0.002<br>(0.003)    | -0.001<br>(0.003)    |
| $ROE$                         | 0.008***<br>(0.002)                 | 0.007***<br>(0.002)  | 0.008***<br>(0.002)  |
| $DIV$                         | -0.019<br>(0.070)                   | -0.014<br>(0.071)    | -0.089<br>(0.087)    |
| Country-level controls        |                                     |                      |                      |
| $CONC$                        | 0.009***<br>(0.002)                 | 0.009***<br>(0.002)  | 0.010***<br>(0.002)  |
| $ACT$                         | -0.025***<br>(0.005)                | -0.026***<br>(0.005) | -0.018***<br>(0.005) |
| $CAPR$                        | -0.024***<br>(0.006)                | -0.023***<br>(0.007) | -0.021***<br>(0.007) |
| $SUP$                         | -0.020***<br>(0.006)                | -0.019***<br>(0.006) | -0.026***<br>(0.007) |
| $PRIV$                        | 0.038***<br>(0.008)                 | 0.039***<br>(0.008)  | 0.024***<br>(0.007)  |
| $GDP$                         | 0.008***<br>(0.003)                 | 0.008***<br>(0.003)  | 0.008***<br>(0.003)  |
| $MKT$                         | -0.000<br>(0.000)                   | -0.000<br>(0.000)    | -0.000<br>(0.000)    |
| # of observations             | 40088                               | 40088                | 40088                |
| # of instruments              | 58                                  | 58                   | 58                   |
| Wald $\chi^2$ ( $p$ -value)   | 0.000                               | 0.000                | 0.000                |
| $AR(1)$                       | 0.000                               | 0.000                | 0.000                |
| $AR(2)$                       | 0.358                               | 0.363                | 0.441                |
| Hansen $\chi^2$ ( $p$ -value) | 0.383                               | 0.433                | 0.133                |

**Table 6.** *(Continued)*

*Notes:* The table presents the results of the empirical estimations with monetary policy constructed in line with [Bernanke and Mihov \(1998\)](#). *Z* is a proxy for distance from insolvency; *MP\_SVAR* are the residuals from the interest rate equation in a six-variable SVAR model; *SIM.L* is the Simpson Index of ownership diversity for loans ([Michie and Oughton, 2013](#)); *SHA.L* is the Shannon–Wiener Index of ownership diversity for loans; *HEI.L* is the Heip Index of ownership diversity for loans; *STAKE* is a dummy that equals 1 for stakeholder banks and 0 otherwise; *SIZE* is the natural logarithm of real total assets; *LIQ* is the ratio of liquid assets to total assets; *LEV* is the ratio of liabilities to total assets; *ROE* is the Return On Equity; *DIV* is a measure of asset diversification; *CONC* is the share of assets of the three largest banks in the country; *ACT* is an index of the regulatory restrictiveness on bank activities; *CAPR* is an index of the stringency of bank capital regulations; *SUP* is an index of the power of the official supervisory agency to change bank behaviour; *PRIV* is an index of the incentives for private investors to monitor banks; *GDP* is the annual growth rate of real GDP; *MKT* is the annual change in real stock market returns for non-financial corporations; Wald  $\chi^2$  (*p*-value) is the Wald  $\chi^2$  test of overall model fit; *AR*(1) is the Arellano–Bond test for first-order serial correlation; *AR*(2) is the Arellano–Bond test for second-order serial correlation; Hansen  $\chi^2$  (*p*-value) is the Hansen test of overidentifying restrictions. All regressions are estimated with the two-step system GMM for dynamic panels and include country- as well as time-specific effects. [Windmeijer \(2005\)](#) finite-sample corrected standard errors (clustered by bank) are reported in parentheses. The superscripts \*, \*\* and \*\*\* denote statistical significance at the 10%, 5% and 1% levels, respectively.

**Table 7.** Robustness check: additional control variables.

| Dependent variable: Z-score (Z) |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
|---------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Independent variable            | Simpson Index        |                      |                      |                      | Shannon–Wiener Index |                      |                      |                      | Heip Index           |                      |                      |                      |
|                                 | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  | (7)                  | (8)                  | (9)                  | (10)                 | (11)                 | (12)                 |
| Lagged Z                        | 0.970***<br>(0.027)  | 0.949***<br>(0.029)  | 0.953***<br>(0.026)  | 0.953***<br>(0.026)  | 0.933***<br>(0.026)  | 0.898***<br>(0.030)  | 0.936***<br>(0.032)  | 0.947***<br>(0.028)  | 0.941***<br>(0.030)  | 0.922***<br>(0.030)  | 0.904***<br>(0.028)  | 0.906***<br>(0.028)  |
| TR                              | 0.010***<br>(0.005)  | 0.021**<br>(0.009)   | 0.018***<br>(0.006)  | 0.016***<br>(0.006)  | 0.010***<br>(0.005)  | 0.018**<br>(0.008)   | 0.017**<br>(0.008)   | 0.015**<br>(0.008)   | 0.008**<br>(0.004)   | 0.015***<br>(0.007)  | 0.014***<br>(0.005)  | 0.014***<br>(0.005)  |
| SIM_L                           | 0.142*<br>(0.074)    | 0.430***<br>(0.112)  | 0.379**<br>(0.152)   | 0.404***<br>(0.154)  |                      |                      |                      |                      |                      |                      |                      |                      |
| TR × SIM_L                      | -0.013***<br>(0.002) | -0.018***<br>(0.002) | -0.017***<br>(0.002) | -0.017***<br>(0.002) |                      |                      |                      |                      |                      |                      |                      |                      |
| SHA_L                           |                      |                      |                      |                      | 0.264***<br>(0.082)  | 0.279***<br>(0.098)  | 0.368*<br>(0.202)    | 0.421*<br>(0.220)    |                      |                      |                      |                      |
| TR × SHA_L                      |                      |                      |                      |                      | -0.014***<br>(0.002) | -0.018***<br>(0.002) | -0.017***<br>(0.003) | -0.017***<br>(0.002) |                      |                      |                      |                      |
| HELL                            |                      |                      |                      |                      |                      |                      |                      |                      | 0.397***<br>(0.110)  | 0.312***<br>(0.118)  | 0.285***<br>(0.107)  | 0.286***<br>(0.108)  |
| TR × HELL                       |                      |                      |                      |                      |                      |                      |                      |                      | -0.030***<br>(0.004) | -0.034***<br>(0.005) | -0.035***<br>(0.004) | -0.034***<br>(0.004) |
| Bank-level controls             |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| STAKE                           | 0.094**<br>(0.043)   | 0.137***<br>(0.046)  | 0.153***<br>(0.040)  | 0.148***<br>(0.039)  | 0.138***<br>(0.045)  | 0.145***<br>(0.056)  | 0.120**<br>(0.059)   | 0.112**<br>(0.055)   | 0.137**<br>(0.056)   | 0.119**<br>(0.057)   | 0.216***<br>(0.061)  | 0.208***<br>(0.061)  |
| SIZE                            | 0.033***<br>(0.011)  | 0.004<br>(0.012)     | 0.022***<br>(0.011)  | 0.020*<br>(0.011)    | 0.031***<br>(0.012)  | 0.005<br>(0.012)     | 0.030**<br>(0.013)   | 0.023*<br>(0.012)    | 0.042***<br>(0.011)  | 0.004<br>(0.013)     | 0.032***<br>(0.010)  | 0.031***<br>(0.010)  |
| LIQ                             | -0.001<br>(0.001)    | 0.003***<br>(0.001)  | 0.002**<br>(0.001)   | 0.002**<br>(0.001)   | 0.000<br>(0.002)     | -0.001<br>(0.002)    | -0.002<br>(0.002)    | -0.000<br>(0.002)    | 0.000<br>(0.002)     | -0.001<br>(0.002)    | 0.002<br>(0.002)     | 0.002<br>(0.002)     |
| LEV                             | -0.010**<br>(0.005)  | -0.004<br>(0.004)    | -0.007**<br>(0.003)  | -0.007*<br>(0.003)   | -0.010***<br>(0.004) | -0.009***<br>(0.004) | -0.011***<br>(0.004) | -0.007***<br>(0.003) | -0.009**<br>(0.004)  | -0.008*<br>(0.005)   | -0.011***<br>(0.003) | -0.010***<br>(0.003) |
| ROE                             | 0.008***<br>(0.002)  | 0.005**<br>(0.002)   | 0.008***<br>(0.002)  | 0.008***<br>(0.002)  | 0.009***<br>(0.002)  | 0.008***<br>(0.002)  | 0.006***<br>(0.002)  | 0.007***<br>(0.002)  | 0.010***<br>(0.002)  | 0.006***<br>(0.002)  | 0.010***<br>(0.002)  | 0.010***<br>(0.002)  |
| DIV                             | 0.022<br>(0.063)     | -0.022<br>(0.067)    | 0.014<br>(0.067)     | 0.015<br>(0.067)     | 0.012<br>(0.071)     | 0.038<br>(0.076)     | 0.119<br>(0.075)     | 0.094<br>(0.077)     | 0.046<br>(0.077)     | 0.016<br>(0.077)     | 0.044<br>(0.076)     | 0.048<br>(0.076)     |
| FRA                             | 0.001*<br>(0.001)    |                      |                      |                      | 0.001**<br>(0.000)   |                      |                      |                      | 0.001**<br>(0.001)   |                      |                      |                      |

Table 7. (Continued)

| Independent variable      | Dependent variable: Z-score (Z) |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
|---------------------------|---------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                           | Simpson Index                   |                      |                      |                      | Shannon–Wiener Index |                      |                      |                      | Heip Index           |                      |                      |                      |
|                           | (1)                             | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  | (7)                  | (8)                  | (9)                  | (10)                 | (11)                 | (12)                 |
| Country-level controls    |                                 |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| CONC                      | 0.007***<br>(0.001)             | 0.012***<br>(0.001)  | 0.012***<br>(0.002)  | 0.013***<br>(0.002)  | 0.008***<br>(0.001)  | 0.010***<br>(0.001)  | 0.011***<br>(0.001)  | 0.011***<br>(0.001)  | 0.008***<br>(0.001)  | 0.009***<br>(0.001)  | 0.007***<br>(0.001)  | 0.008***<br>(0.001)  |
| ACT                       | 0.026***<br>(0.005)             | 0.066***<br>(0.011)  | 0.038***<br>(0.006)  | 0.038***<br>(0.006)  | 0.021***<br>(0.003)  | 0.061***<br>(0.010)  | 0.038***<br>(0.006)  | 0.040***<br>(0.006)  | 0.036***<br>(0.005)  | 0.055***<br>(0.010)  | 0.038***<br>(0.006)  | 0.037***<br>(0.006)  |
| CAPR                      | -0.005<br>(0.004)               | 0.005<br>(0.006)     | -0.022***<br>(0.007) | -0.022***<br>(0.007) | 0.004<br>(0.004)     | 0.007<br>(0.005)     | -0.006<br>(0.007)    | -0.007<br>(0.007)    | 0.002<br>(0.004)     | 0.007<br>(0.005)     | 0.004<br>(0.004)     | 0.004<br>(0.005)     |
| SUP                       | -0.018***<br>(0.003)            | -0.034***<br>(0.005) | -0.027***<br>(0.005) | -0.028***<br>(0.005) | -0.027***<br>(0.004) | -0.038***<br>(0.005) | -0.034***<br>(0.006) | -0.033***<br>(0.007) | -0.026***<br>(0.005) | -0.035***<br>(0.005) | -0.024***<br>(0.004) | -0.024***<br>(0.005) |
| PRIV                      | -0.031***<br>(0.006)            | -0.066***<br>(0.013) | -0.047***<br>(0.009) | -0.047***<br>(0.009) | -0.057***<br>(0.006) | -0.071***<br>(0.011) | -0.058***<br>(0.011) | -0.053***<br>(0.010) | -0.051***<br>(0.009) | -0.064***<br>(0.012) | -0.048***<br>(0.009) | -0.047***<br>(0.010) |
| GDP                       | 0.014***<br>(0.002)             | 0.008***<br>(0.002)  | 0.016***<br>(0.003)  | 0.015***<br>(0.003)  | 0.011***<br>(0.002)  | 0.009***<br>(0.002)  | 0.017***<br>(0.003)  | 0.017***<br>(0.003)  | 0.014***<br>(0.002)  | 0.009***<br>(0.002)  | 0.016***<br>(0.003)  | 0.015***<br>(0.002)  |
| MKT                       | 0.000*<br>(0.000)               | 0.000<br>(0.000)     | 0.001**<br>(0.000)   | 0.001*<br>(0.000)    | 0.000<br>(0.000)     | 0.000<br>(0.000)     | 0.000<br>(0.000)     | 0.000<br>(0.000)     | 0.000*<br>(0.000)    | 0.000<br>(0.000)     | 0.000*<br>(0.000)    | 0.001**<br>(0.000)   |
| IMP                       | -0.002***<br>(0.001)            | -0.002***<br>(0.001) | -0.001<br>(0.002)    | -0.001<br>(0.112)    | -0.002***<br>(0.000) | -0.002***<br>(0.001) | -0.001<br>(0.002)    | -0.001<br>(0.002)    | -0.002***<br>(0.001) | -0.002***<br>(0.001) | -0.004**<br>(0.001)  | -0.004**<br>(0.001)  |
| INST                      |                                 |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| CBI                       |                                 |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| # of observations         | 39648                           | 39502                | 40088                | 40088                | 39648                | 39502                | 40088                | 40088                | 39648                | 39502                | 40088                | 40088                |
| # of instruments          | 59                              | 59                   | 59                   | 59                   | 59                   | 59                   | 59                   | 59                   | 59                   | 59                   | 59                   | 59                   |
| Wald $\chi^2$ (p-value)   |                                 |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| AR(1)                     | 0.000                           | 0.000                | 0.000                | 0.000                | 0.000                | 0.000                | 0.000                | 0.000                | 0.000                | 0.000                | 0.000                | 0.000                |
| AR(2)                     | 0.449                           | 0.635                | 0.696                | 0.731                | 0.587                | 0.500                | 0.774                | 0.839                | 0.908                | 0.992                | 0.806                | 0.857                |
| Hansen $\chi^2$ (p-value) | 0.171                           | 0.238                | 0.120                | 0.056                | 0.088                | 0.288                | 0.086                | 0.064                | 0.151                | 0.148                | 0.353                | 0.186                |

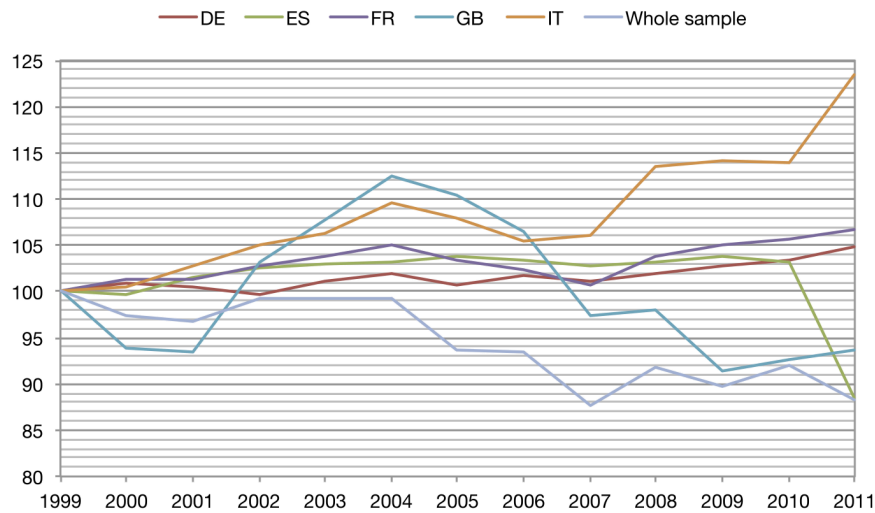
**Table 7.** (*Continued*)

*Notes:* The table presents the results of the empirical estimations after the inclusion of additional control variables.  $Z$  is a proxy for distance from insolvency;  $TR$  are the residuals from a regression of the overnight rate on GDP growth and inflation;  $SIM\_L$  is the Simpson Index of ownership diversity for loans (Michie and Oughton, 2013);  $SHA\_L$  is the Shannon–Wiener Index of ownership diversity for loans;  $HEL\_L$  is the Heip Index of ownership diversity for loans;  $STAKE$  is a dummy that equals 1 for stakeholder banks and 0 otherwise;  $SIZE$  is the natural logarithm of real total assets;  $LIQ$  is the ratio of liquid assets to total assets;  $LEV$  is the ratio of liabilities to total assets;  $ROE$  is the Return On Equity;  $DIV$  is a measure of asset diversification;  $FRA$  is the ratio of customer deposits to total assets;  $CONC$  is the share of assets of the three largest banks in the country;  $ACT$  is an index of the regulatory restrictiveness on bank activities;  $CAPR$  is an index of the stringency of bank capital regulations;  $SUP$  is an index of the power of the official supervisory agency to change bank behaviour;  $PRIV$  is an index of the incentives for private investors to monitor banks;  $GDP$  is the annual growth rate of real GDP;  $MKT$  is the annual change in real stock market returns for non-financial corporations;  $IMP$  is the ratio of domestic credit provided by banks to GDP;  $INST$  is the Index of Economic Freedom by the Heritage Foundation;  $CBI$  is the weighted index of *de jure* Central Bank Independence by Garriga (2016); Wald  $\chi^2$  ( $p$ -value) is the Wald  $\chi^2$  test of overall model fit;  $AR(1)$  is the Arellano–Bond test for first-order serial correlation;  $AR(2)$  is the Arellano–Bond test for second-order serial correlation; Hansen  $\chi^2$  ( $p$ -value) is the Hansen test of overidentifying restrictions. All regressions are estimated with the two-step system GMM for dynamic panels and include country- as well as time-specific effects. Windmeijer (2005) finite-sample corrected standard errors (clustered by bank) are reported in parentheses. The superscripts \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5% and 1% levels, respectively.

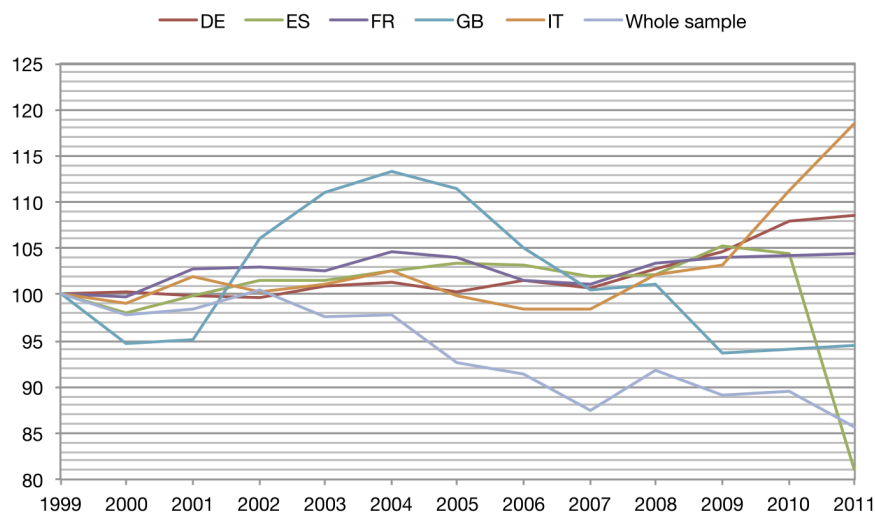
Table A1. Correlation matrix.

|       | Z      | TR     | SIM_L  | SHA_L  | HELL   | STAKE  | SIZE   | LIQ    | LEV    | ROE    | DIV    | CONC   | ACT    | CAPR   | SUP    | PRIV   | GDP   | MKT   |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|
| Z     | 1.000  |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |       |       |
| TR    | 0.032  | 1.000  |        |        |        |        |        |        |        |        |        |        |        |        |        |        |       |       |
| SIM_L | 0.332  | 0.096  | 1.000  |        |        |        |        |        |        |        |        |        |        |        |        |        |       |       |
| SHA_L | 0.353  | 0.093  | 0.984  | 1.000  |        |        |        |        |        |        |        |        |        |        |        |        |       |       |
| HELL  | 0.351  | 0.093  | 0.977  | 0.990  | 1.000  |        |        |        |        |        |        |        |        |        |        |        |       |       |
| STAKE | 0.440  | 0.059  | 0.363  | 0.397  | 0.401  | 1.000  |        |        |        |        |        |        |        |        |        |        |       |       |
| SIZE  | -0.155 | -0.016 | -0.087 | -0.125 | -0.128 | -0.240 | 1.000  |        |        |        |        |        |        |        |        |        |       |       |
| LIQ   | -0.237 | -0.029 | -0.226 | -0.231 | -0.241 | -0.444 | 0.002  | 1.000  |        |        |        |        |        |        |        |        |       |       |
| LEV   | 0.086  | 0.052  | 0.241  | 0.232  | 0.229  | 0.263  | 0.284  | -0.255 | 1.000  |        |        |        |        |        |        |        |       |       |
| ROE   | 0.005  | 0.012  | -0.144 | -0.150 | -0.143 | -0.153 | 0.099  | 0.081  | 0.016  | 1.000  |        |        |        |        |        |        |       |       |
| DIV   | 0.073  | 0.044  | 0.231  | 0.231  | 0.224  | 0.198  | -0.029 | 0.044  | 0.122  | -0.083 | 1.000  |        |        |        |        |        |       |       |
| CONC  | -0.097 | -0.057 | -0.442 | -0.480 | -0.451 | -0.222 | 0.049  | -0.029 | -0.140 | 0.075  | -0.340 | 1.000  |        |        |        |        |       |       |
| ACT   | -0.234 | -0.020 | -0.522 | -0.464 | -0.464 | -0.090 | -0.018 | 0.059  | -0.170 | 0.114  | -0.115 | 0.035  | 1.000  |        |        |        |       |       |
| CAPR  | 0.097  | -0.064 | 0.241  | 0.214  | 0.188  | -0.018 | 0.129  | -0.038 | 0.062  | -0.004 | -0.078 | 0.174  | -0.400 | 1.000  |        |        |       |       |
| SUP   | 0.046  | -0.093 | 0.216  | 0.216  | 0.196  | -0.041 | -0.007 | -0.047 | 0.054  | -0.029 | -0.112 | 0.197  | -0.276 | 0.463  | 1.000  |        |       |       |
| PRIV  | 0.038  | -0.018 | -0.125 | -0.133 | -0.126 | 0.018  | 0.103  | -0.047 | -0.034 | -0.056 | 0.006  | 0.101  | 0.056  | 0.108  | -0.280 | 1.000  |       |       |
| GDP   | 0.022  | 0.058  | -0.035 | -0.055 | -0.046 | -0.082 | -0.005 | 0.086  | 0.006  | 0.150  | -0.045 | 0.036  | 0.008  | -0.030 | -0.060 | -0.149 | 1.000 |       |
| MKT   | 0.041  | -0.202 | 0.051  | 0.041  | 0.043  | 0.024  | -0.012 | -0.031 | 0.003  | 0.085  | 0.011  | -0.001 | 0.137  | -0.030 | -0.174 | 0.057  | 0.585 | 1.000 |

Notes: The table shows the correlation coefficients for the main regression variables. Z is a proxy for distance from insolvency; TR are the residuals from a regression of the overnight rate on GDP growth and inflation; SIM\_L is the Simpson Index of ownership diversity for loans (Michie and Oughton, 2013); SHA\_L is the Shannon–Wiener Index of ownership diversity for loans; HELL is the Heip Index of ownership diversity for loans; STAKE is a dummy that equals 1 for stakeholder banks and 0 otherwise; SIZE is the natural logarithm of real total assets; LIQ is the ratio of liquid assets to total assets; LEV is the ratio of liabilities to total assets; ROE is a measure of asset diversification; CONC is the share of assets of the three largest banks in the country; ACT is an index of the regulatory restrictiveness on bank activities; CAPR is an index of the stringency of bank capital regulations; SUP is an index of the power of the official supervisory agency to change bank behaviour; PRIV is an index of the incentives for private investors to monitor banks; GDP is the annual growth rate of real GDP; MKT is the annual change in real stock market returns for non-financial corporations.

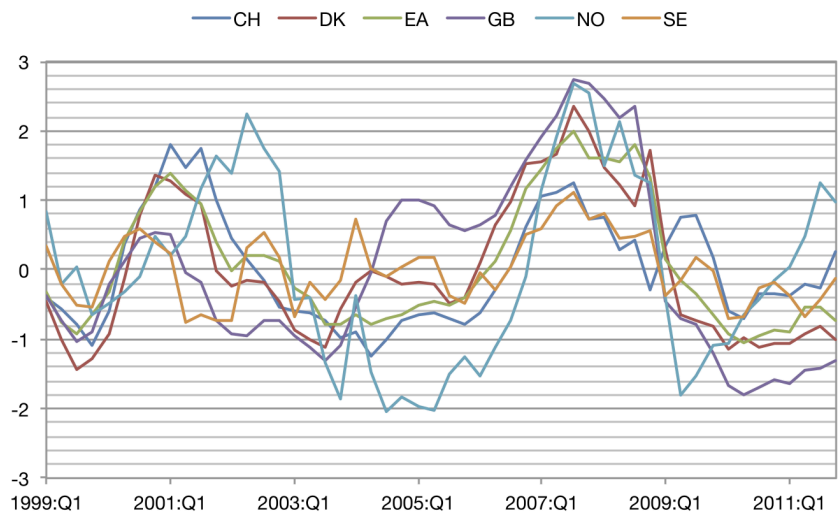


(a) Loans



(b) Deposits

**Fig. 1.** Ownership diversity in selected countries. *Notes:* The charts illustrate the evolution of the Simpson Index (Michie and Oughton, 2013) for the loan and deposit markets, respectively, over the period from 1999 to 2011 (with 1999 = 100) in the major European economies. DE, Germany; ES, Spain; FR, France; GB, United Kingdom; IT, Italy. *Source:* Bankscope.



**Fig. 2.** Taylor rule residuals. *Notes:* The figure depicts Taylor rule residuals in the period from 1999:Q1 to 2011:Q4. Taylor rule residuals are the residuals from a regression of the overnight interbank rate on GDP growth and inflation. The residuals are estimated with a Panel Least Squares (PLS) regression for the euro-area countries (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain) and with separate Ordinary Least Squares (OLS) regressions for the other countries (Denmark, Norway, Sweden, Switzerland and the UK). For the euro area, a weighted average is computed using each country’s GDP. Positive (negative) Taylor rule residuals denote a contractionary (expansionary) monetary policy. CH, Switzerland; DK, Denmark; EA, euro area; GB, United Kingdom; NO, Norway; SE, Sweden. *Sources:* Datastream; national data; OECD.