Essays on Bank Risk-Taking, Diversification, and Ethics during the Financial Crisis

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To Miguel, Miki and Martín

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Resumen

La presente Tesis Doctoral analiza el riesgo bancario, la diversificación de ingresos y la ética de las instituciones financieras en el contexto de la última crisis financiera y ha sido estructurada en base a tres ensayos que guardan una conexión entre ellos.

El primer ensayo analiza los determinantes del riesgo en la banca. Se examinan tanto variables específicas como macroeconómicas sobre una amplia muestra de bancos comerciales de la zona euro. Las principales conclusiones que se obtienen son que la capitalización, rentabilidad, eficiencia y liquidez se encuentran inversa y significativamente relacionadas con el riesgo bancario, mientras que un incremento en la financiación mayorista lo aumenta significativamente. Los resultados muestran también que el riesgo bancario aumenta en economías con mercados más competitivos, tipos de interés bajos y altas tasas de inflación, en un contexto de crisis económica.

El segundo ensayo estudia el efecto de la diversificación de los ingresos sobre el ratio de morosidad, utilizando una muestra de cajas de ahorro, cooperativas de crédito y bancos comerciales de la zona euro. Como *proxy* de la diversificación de ingresos se emplea un índice Herfindahl–Hirschman index (HHIRD). Dicho índice incluye los diferentes tipos de ingresos recogidos en los estados financieros de las entidades analizadas, tales como los intereses, las comisiones netas, las operaciones de trading, y otros ingresos. Las principal conclusión de este ensayo es que los bancos europeos pueden reducir significativamente su tasa de morosidad incrementando su diversificación. Además, esta relación es especialmente significativa en períodos de crisis, lo que sugiere que aquellos bancos más diversificados en cuanto a las mencionadas fuentes de ingresos se encuentran mejor preparados para afrontar situaciones macroeconómicas adversas.

Finalmente, el tercer ensayo estudia los factores relacionados con el gobierno corporativo que pueden explicar la reputación ética (aproximada mediante el índice EthicalQuote publicado por Covalence) sobre una muestra de las mayores instituciones financieras a nivel internacional. En este tercer ensayo se concluye que aquéllas instituciones financieras con consejos de administración que reflejan un control más estricto cuentan con una mayor reputación ética. En concreto, el tamaño del consejo de administración, la experiencia y la diversidad de género de sus miembros se encuentran

positiva y significativamente ligadas a la reputación ética; mientras que existe una relación negativa y significativa entre el número de otros consejos de administración en los que participan y la reputación ética de las entidades.

Palabras clave: bancos sistémicos, consejo de administración, diversificación de ingresos, instituciones financieras sistémicas, ratio de morosidad, reputación ética, riesgo bancario, sistema bancario europeo, sistema bancario internacional, Z-Score.

Abstract

This thesis analyzes bank risk-taking, revenue diversification and the ethical behavior of financial institutions in the context of the last financial crisis by three essays.

The first essay examines bank-specific and macroeconomic determinants of bank risk for a large sample of commercial banks operating in the euro area. The main findings are that capitalization, profitability, efficiency and liquidity are inversely and significantly related to bank risk, whereas wholesale funding increases bank risk. We also find that less concentrated markets, lower interest rates, higher inflation rates, and economic crises (with e.g., falling GDPs) increase bank risk.

The second essay focuses on the effect of revenue diversification on non-performing loans of Eurozone banks. The main conclusion is that European banks can significantly reduce their non-performing loan ratios by increasing revenue diversification. This relationship is enhanced during the crisis period, suggesting that revenue-diversified banks are better prepared for adverse macroeconomic conditions.

Finally, the third essay studies the corporate governance factors that explain ethical reputation (proxied by the Covalence EthicalQuote index) using an international sample of large financial institutions. This essay concludes that financial institutions with board characteristics that reflect more stringent monitoring have better ethical reputations. Specifically, the results show a statistically positive relationship between ethical reputation and board size, experience, and gender diversity but a negative relationship between ethical reputation and the busyness of the board members.

Keywords: Bank risk; Board of directors; Board characteristics; Board monitoring; Corporate governance; Ethical reputation; European banking system; Non-performing loans; Revenue diversification; SIFI; G-SIB Z-score.

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Part 1: Dissertation Introduction

1. **INTRODUCTION**

2. **THEORETICAL BACKGROUND**

3. **THE BANKING INDUSTRY AND THE GLOBAL FINANCIAL CRISIS**

4. **SUMMARY OF THE ESSAYS**

1. Introduction

The most recent economic and financial crisis has called into question the foundations of capitalism, and the ethics of the banking industry are often cited as a primary cause of the crisis. The laxity in lending operations combined with the abuse of derivative products in a climate of euphoria and abundance contributed greatly to the creation of a bubble that began to deflate in 2008, when the fourth-largest investment bank in the world announced its bankruptcy; this event led to the worst global recession in history. The global financial crisis highlighted the importance of the early identification of riskier banks because early identification would allow problems to be solved at a lower cost. The cost of bank bailouts associated with the current global financial crisis and the large output losses suffered by several European countries clearly indicate the need for a better understanding of the determinants of bank risk. In addition, in the aftermath of the financial crisis, politicians, banking supervisors, and central bankers have alleged and acknowledged that flaws in the corporate governance mechanisms and ethical cultures of financial institutions played a central role in the in the development of the crisis (see, e.g., Basel Committee on Banking Supervision, 2010; Board of Governors of the Federal Reserve System, 2009, 2010; Haldane, 2012).

Due to the severe consequences of the most recent financial crisis, which originated in the financial industry but quickly spread to other sectors and caused great harm to the real economy, this doctoral dissertation addresses both bank risk and ethical behavior determinants.

The general conclusion of this dissertation is that bank-specific variables that are closely related to capable management contribute significantly to the reduction of bank risk-taking; in addition, effective information systems such as well-monitored boards of directors, lead to better ethical reputation for financial institutions. Moreover, these indicators exert a similar or greater effect under crisis macroeconomic conditions.

More specifically, this dissertation shows that an increase in several bank-specific factors, such as capitalization, profitability, efficiency and liquidity, can significantly

contribute to the reduction of bank risk. Conversely, recourse to wholesale funding seems to increase bank risk. Our results further indicate that different sources of revenue diversification contribute significantly to the reduction of non-performing loans held by banks in the euro area; moreover, the amplification of this relationship during the financial crisis implies that diversified banks are better prepared than their non-diversified counterparts are and thus the impact of the crisis on the quality of loan portfolios held by diversified banks is relatively small. Additionally, we find that bank risk is significantly affected by external factors that do not directly depend on bankers' managerial qualities and skills; for example, less concentrated markets, lower interest rates, higher inflation rates and economic crises (with a falling GDP) increase bank risk. We further find that financial institutions with board characteristics that indicate more effective monitoring and oversight have better ethical reputations. In particular, we demonstrate that ethical reputation is positively associated with the size, experience, and gender diversity of the board and with CEO duality but negatively related to board busyness and to a composite index that indicates poor monitoring by boards of directors. Finally, we demonstrate that the adverse influence of the global financial crisis on the ethical reputations of financial institutions is less pronounced for institutions with boards that demonstrate stronger monitoring practices.

This dissertation is structured in two parts. The first part is an introductory chapter that provides a theoretical background to support our empirical findings and contextualizes the macroeconomic conditions of the banking industry during the financial crisis. The second part of this dissertation comprises three empirical essays on bank risk-taking, revenue diversification and ethical behavior during the financial crisis.

2. Theoretical background

In this section, we provide the theoretical background that supports the empirical findings of this dissertation.

2.1. Moral hazard and risk transfer: The Agency Theory

The Agency Theory states that an agency problem occurs when there is a relationship, in which one party (the principal) delegates work to another (the agent) and between this two cooperating parties there are different goals or different attitudes towards risk (Jensen and Meckling, 1976; Ross, 1973). Therefore, the agency problem emerges from two main sources: i) when the goals of principal and agent are in conflict and it is difficult or expensive for the principal to verify the agent actions; and /or ii) when principal and agent have different attitudes towards risk-taking (Eisenhardt, 1989).

The key assumptions from this theory regarding to human behavior are that people act and take decisions pursuing their self-interest; rationality is bounded due asymmetrical information; and people are naturally risk averse. Concerning information, it is assumed to be limited, asymmetrical and purchasable as a commodity.

The Agency Theory has developed into two streams: positivists and principal-agent. The main differences between these two lines of research are that Positivist Agency Theory is less mathematical and more focused on the relationship between owners and managers of public corporations while the Principal-Agent view is more abstract and applies for any relationship under a contract (Berle and Means, 1932).

The most relevant contributions of the Agency Theory lay on the idea that self-interest guides most organizational decisions and therefore information and risk aversion are key elements for the principal to control. First contribution is that, information is seen as a commodity that can be purchased (e.g.: information systems, boards of directors, etc.), and the second one would be that uncertainty is viewed in terms of risk/reward trade-offs, instead of in terms of inability to preplan (Eisenhardt, 1989). However,

detractors of this theory claim it to be trivial, dehumanizing and dangerous (Perrow, 1986).

The Agency theory is reflected in all the three essays. Particularly, in Essay 1 where risk taking determinants are analyzed, we hypothesize, following Uhde and Heimeshoff (2009), and De Jonghe (2010) that larger entities may be more attracted to amplifying risk taking, reducing market discipline and creating competitive distortions as they know they will be bailed out. Another similar example of risk transfer is described in the bank capitalization section, where we state that capital requirements play an important role as a disincentive to risk-taking by bank shareholders, who may be conditioned by limited liability (Behr *et al.*, 2010). In general, the bank specific characteristics that depend on managerial and shareholders decisions can be all related with this theory.

Perhaps, the most obvious agency relationship example is described in the third essay where the board of directors is empirically tested as an effective monitoring system to dissuade managers from taking unethical decisions.

2.2. Diversification: The Markowitz Portfolio Theory

Markowitz Portfolio theory (1952) states that a portfolio is well diversified if there is no portfolio, which has, at the same time, lower risk and at least, as much expected return.

Analytically, it is described as follows: Considering a portfolio with n different assets where asset number i will give the return R_i. Let μ_i and δ^2_i be the corresponding mean and variance and let $\delta_{i,j}$ be the covariance between R_i and R_j . Suppose the relative amount of the value of the portfolio invested in asset i is xi. If R is the return of the whole portfolio, then:

$$\mu = E[R] = \sum_{i=1}^{n} \mu_i x_i \qquad [1]$$

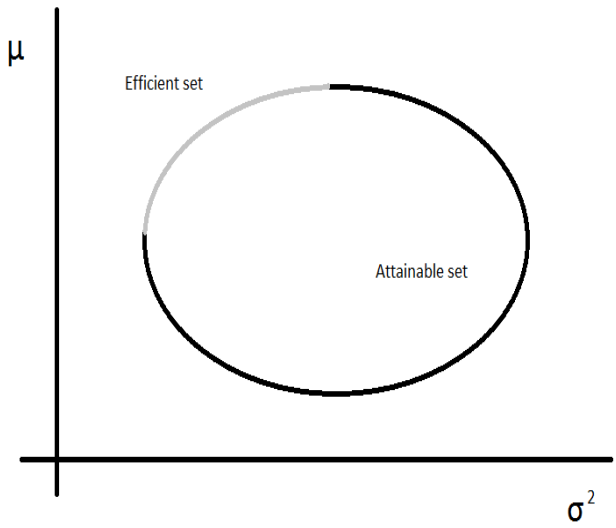
$$\delta^2 = \mathrm{Var}[R] = \sum_{i=1}^{n} \sum_{j=1}^{n} \delta_{i,j} x_i x_j \qquad [2]$$

$$\sum_{i=1}^{n} x_i = 1 \qquad [3]$$

$$x_i \geq 0; i = 1, 2, \ldots, n \qquad [4]$$

The set of total obtainable combinations **(** δ^2, μ*)* is called *attainable set*. Those portfolio combinations **(** δ^2, μ*)* with a minimum δ^2 for a given μ or more and maximum μ for a given δ^2or less are called the *efficient frontier*.

Figure 1: Efficient and Attainable sets



Source: Markowitz, 1952

Two conditions are necessary to apply efficient surfaces: first, i) the investor must desire to act according to the (μ, δ^2) maxim; and second ii) reasonable μ i and δ i,j are required.

Traditional financial intermediation literature (e.g. Diamond, 1984; Ramakrishnan and Thakor, 1984; Boyd and Prescott, 1986) applies Markowitz's findings to banks and other financial institutions showing diversification to reduce the likelihood of bank default. Recent banking literature assesses different sources of diversification (industry, geographical and revenue diversification) and its impact on bank performance, however showing not consensus in their results. The controversy lies in if diversification, by providing low correlated sources of income, macroeconomic conditions, etc.; provides enough economies of scale to offset the costs of increasing traditional banking complexity.

Some authors like Acharya *et al.* (2006), Hayden *et al.* (2007) or Bebczuk and Galindo (2008) focus on diversification across industries, however, finding differing results.

According to Acharya *et al.* (2006) and Hayden *et al.* (2007) asset diversification does not produce superior return performance and/or greater safety neither for Italian nor for German banks while Bebczuk and Galindo (2008) show positive industry diversification effects on both risk and profitability.

Literature also provides both supporting and contradicting arguments of geographical diversification. Proponents of geographical diversification allude to economies of scale as these banks may get a better access to capital markets in other regions and countries (Deng and Elysiani, 2008) greater market power (Iskandar-Datta and McLaughlin, 2007) and reduced tax liabilities from low tax areas; while advocates of the geographically focused strategies state that agency costs may not offset diversification benefits (Berger *et al.*, 2010, Deng and Elyasiani, 2008).

Finally, literature on revenue diversification is widely addressed in our second Essay, where we study the effect of revenue diversification on bank non-performing loan ratios (*NPLR*). Our findings show that all forms of revenue diversification contribute to reduce bank distress in banks of the euro area, therefore providing support to traditional banking and Markowitz theories.

3. The banking industry and the global financial crisis

The deregulation trend that started in the late 1980s by progressively breaking the Banking Act known as the Glass-Steagall Act, 1933 (GSA) enabled financial companies to increase their complexity and size.[1] It also allowed banks to diversify their asset portfolio and to significantly increase their profits by fostering the emergence of numerous alternative sources of income such as underwriting and trading securities, brokerage and investment banking as well as other non traditional banking activities (Wilmarth, 2010; Meslier *et al.*, 2014). This deregulated scenario alongside with an expansionary monetary policy (with low interest rates and loan ease) that was aimed to alleviate an economic drastic fall from the burst of the Dotcom bubble in the beginning of the 21st Century are blamed as the main causes of the Subprime mortgage and Financial crisis (2007-2009) that started in the US and rapidly spread to Europe evolving in a Debt Crisis, and finally resulting in the so called "Great Recession" (Altunbas *et al.*, 2011). This crisis was stimulated with substantial "ethical problems" in the financial industry related to conflicts of interest, handling of confidential information, quality of financial reporting, lending practices, antitrust compliance, compensation schemes, insider abuse, insider trading, and money laundering (Mitchell *et al.*,1992).

Since the beginning of the financial crisis, regulators and policy makers are agreeing on new international banking guidelines (e.g. Basel III Accords, definition and control of systematically important financial institutions, etc.) to boost global financial stability. Some of them are briefly described in the following sections.

[1] The GSA-1933 restricts the securities activities of commercial banks (Carpenter and Murphy, 2010).

3.1. Basel III and bank risk taking

In 2010 the Basel Committee on Banking Supervision (BCBS) agreed on new international banking guidelines as a response to the financial crisis of 2008.[2] This Accord, known as Basel III, tries to improve financial stability and strengthen the solvency and liquidity of banks without diminishing the flow of money from the credit market. The new framework also aims to improve risk management and governance as well as strengthen banks' transparency and disclosures, learning from the financial crisis. However, unlike Basel II (2004), Basel III does not imply a major change in the previous Capital Accord but rather they complement each other; it simplifies and strengthens the numerator of the capital ratio and introduces some macroprudential components to the regulatory framework. Among the main elements proposed by Basel III are the following: first, it substantially raises the quality and quantity of capital, with a greater focus on common equity.[3] Capital needs to be of the highest quality to better absorb losses from shocks that could emanate from anywhere; second, Basel III also introduces a simple leverage ratio, which will act as a backstop to the risk-based measure. Such a measure is critical to underpinning the whole regime and will provide a simple, easy to understand sanity check of the results produced by the risk-based framework. Third, Basel III discusses capital buffers. The conservation buffer provides a strong incentive for banks to build up capital in good times while the countercyclical buffer should help protect banks against the dangers of rapid credit growth. Finally, sound liquidity risk management principles and global liquidity standards will help

[2] The Basel Committee's oversight body - the Group of Central Bank Governors and Heads of Supervision (GHOS) - agreed on the broad framework of Basel III in September 2009 and the Committee set out concrete proposals in December 2009. These consultative documents formed the basis of the Committee's response to the financial crisis and are part of the global initiatives to strengthen the financial regulatory system that have been endorsed by the G20 Leaders. The GHOS subsequently agreed on key design elements of the reform package at its July 2010 meeting and on the calibration and transition to implement the measures at its September 2010 meeting.

[3] The minimum Common Equity Tier 1 and Tier 1 requirements will be phased in between 1 January 2013 and 1 January 2015. On 1 January 2013, the minimum Common Equity Tier 1 requirement will rise from the current 2% level to 3.5%. The Tier 1 capital requirement will rise from 4% to 4.5%. On 1 January 2014, banks will have to meet a 4% minimum Common Equity Tier 1 requirement and a Tier 1 requirement of 5.5%. On 1 January 2015, banks will have to meet the 4.5% Common Equity Tier 1 and the 6% Tier 1 requirements. The total capital requirement remains at the existing level of 8.0% and so does not need to be phased in.

ensure that banks more effectively manage their risk and maintain adequate liquidity buffers.

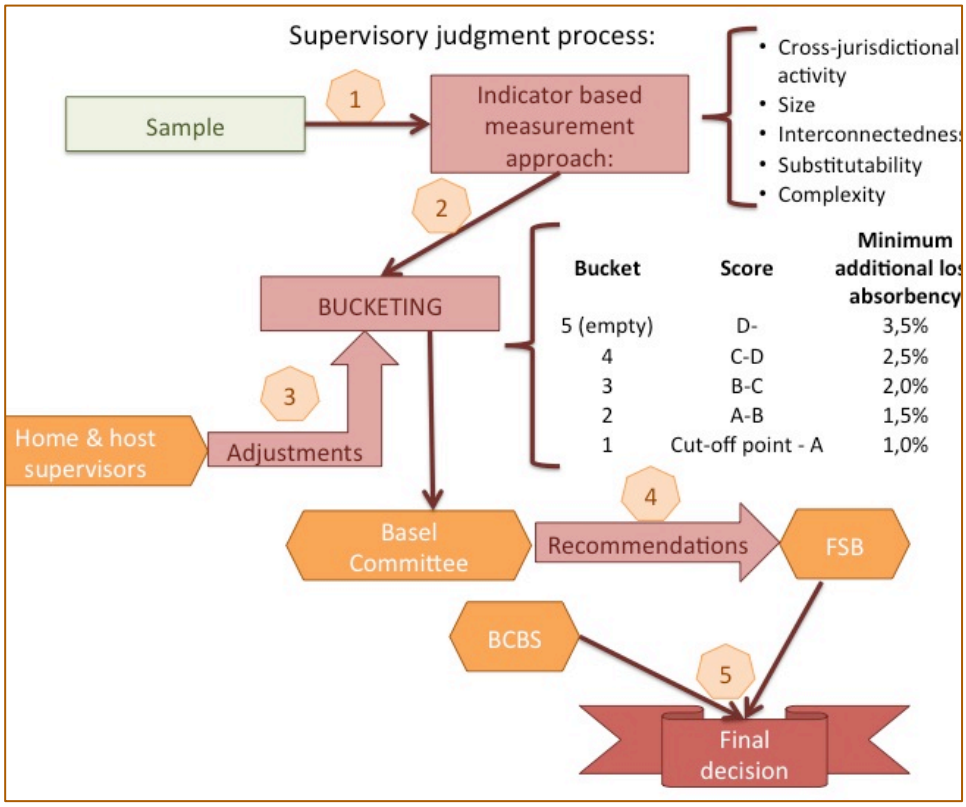
In addition, the new Capital Accord pays special attention to the systemic risk; it has dramatically increased its presence from Basel II to Basel III; even when it was a known issue last crisis made the Committee more aware about it. In words of Caruana, 2010 (General Manager of the BIS): "*The international financial crisis has made us all think much harder, not only about what systemic risk means, but also what it means for policy. Systemic risk was underestimated across the board before the crisis. We were faced with the unthinkable when a number of very large institutions failed, despite their previous reputation for balance sheet strength and leadership in risk management. Coming to grips with systemic risk is vital because the aggregate risk facing the system is much higher than the simple sum of the individual risks attending financial institutions, products and markets.*"

3.2. Global Systemically Important Banks

In November 2011 the Financial Stability Board (FSB) published an integrated set of policy measures to address the systemic and moral hazard risks associated with systemically important financial institutions (SIFIs). SIFIs have been defined as entities that could endanger the entire financial system because of their size, contagion potential effects, correlation, concentration and context (Thomsom, 2009). SIFI is a wide concept that comprises markets infrastructures, insurance companies and other bank and non-bank financial institutions. As banks are the financial institutions more likely to induce risk to the system, given that their business models have generally placed greater emphasis on trading and capital market activities, Basel Committee has focused its regulations in Systemically Important Banks (G-SIBs) and how to reduce their likelihood of failure. GSIBs could be defined as banks that are not being allowed to fail due their size, interconnectedness, complexity, lack of substitutability or global scope (BIS, 2011). This "too big-interconnected-complex-unsubstitutable-global to fail" condition could tempt them to behave in their private benefits, taking sub-optimal outcomes from a system wide level. For this reason, Basel Committee has the challenge to identify these institutions and to require more restrictive policies for them. In order

to do that, a process to identify and assess SIBs has been developed (BIS, 2011): first, a set of categories and indicators have been defined (cross jurisdictional activity, size, interconnectedness, substitutability and complexity) and equally weighed so as to distribute SIBs in different buckets with minimal additional loss absorbency according to the range of systemic risk obtained (from 1 to 5). Following these criteria, 28 financial institutions were designed as G-SIBs form a sample of the 73 biggest banks, in January 2011. The methodology developed by the Basel Committee on Banking Supervision (BCBS) is described in figure 2. The current list of GSIBs is provided in table 1.

Figure 2: G-SIBs process



Source: Bank for International Settlements

Table 1: *List of GISBs (updated on November 2014).*

Entity	Country	Total capital ratio requirement (% of RWA)
Mizuho FG	Japan	11.5%(CET1=min.8%)
Sumitomo Mitsui	Japan	11.5%(CET1=min.8%)
Mitsubishi UFJ FG	Japan	12.0%(CET1=min.8.5%)
Bank of China	China	11.5%(CET1=min.8%)
ICBC	China	11.5%(CET1=min.8%)
Agricultural Bank of China	China	11.5%(CET1=min.8%)
Dexia Group	Belgium	-
BNP Paribas	France	12.5%(CET1=min.9%)
Crédit Agricole	France	11.5%(CET1=min.8%)
Banque Populaire CE	France	11.5%(CET1=min.8%)
Société Générale	France	11.5%(CET1=min.8%)
Commerzbank	Germany	10.5%(CET1=min.7%)
Deutsche Bank	Germany	12.5%(CET1=min.9%)
Unicredit Group	Italy	11.5%(CET1=min.8%)
ING Bank	Netherlands	11.5%(CET1=min.8%)
Banco Bilbao Vizcaya Argentaria	Spain	11.5%(CET1=min.8%)
Santander	Spain	11.5%(CET1=min.8%)
Nordea	Sweden	11.5%(CET1=min.8%)
Credit Suisse	Switzerland	12.0%(CET1=min.8.5%)
UBS	Switzerland	11.5%(CET1=min.8%)
Royal Bank of Scotland	United Kingdom	12.0%(CET1=min.8.5%)
Barclays	United Kingdom	12.5%(CET1=min.9%)
HSBC	United Kingdom	13.0%(CET1=min.9.5%)
Lloyds Banking Group	United Kingdom	10.5%(CET1=min.7%)
Standard Chartered	United Kingdom	11.5%(CET1=min.8%)
Bank of America	USA	12.0%(CET1=min.8.5%)
Bank of New York Mellon	USA	11.5%(CET1=min.8%)
Citigroup	USA	12.5%(CET1=min.9%)
Goldman Sachs	USA	12.0%(CET1=min.8.5%)
JP Morgan Chase	USA	13.0%(CET1=min.9.5%)
Morgan Stanley	USA	12.0%(CET1=min.8.5%)
State Street	USA	11.5%(CET1=min.8%)
Wells Fargo	USA	11.5%(CET1=min.8%)

Source: Financial Stability Board, 2014

One of the main risks of G-SIBs is the moral hazard associated with the government support: systemic banks may be more attracted to amplify risk-taking, reduce market discipline and create competitive distortions which could increase the probability of distress in the future as they know they will be bail out. On the other hand, G-SIBs failure could have cross-border repercussion and harm other countries' institutions and even the global economy at large.

Although it is almost impossible to solve G-SIBs externalities completely, the broad aims for the regulatory community are to reduce the probability of failure by increasing their going-concern loss absorbency and to reduce their extent impact by improving global recovery and resolution frameworks. Nevertheless, this financial crisis has shown that not only a G-SIB bankruptcy could have systemic consequences; an evidence of this is the large investment that different governments have spent in rescuing their banks: Spain has spent more than €41 billion in the last restructuration of its saving banks, while the cost of bailed out banks in Europe between 2007 and 2011 raises to €440 billion plus €1.1 trillion in guarantees; and the US, has invested $204.8 billion between 2008 and 2009 in banks rescues.[4]

3.3. Stress-testing

A macro stress-testing framework is often used to assess in a forward-looking manner the resilience of the banking sector to (adverse) macroeconomic and financial developments (Henry and Kok 2013). Supervisory authorities, such as the European Central Banks and the Federal Reserve, carry out annual stress test to their largest banks as part of their regulatory oversight of the banking sector; to analyze whether a bank has enough capital to resist the impact of adverse macroeconomic conditions (i.e. falling economic output, rising unemployment and declining house prices) and prevent possible systemic future consequences.

The last stress tests from the Euro area, released last October 2014, were conducted to 130 banks that were required a minimum of 5.5 per cent of common equity tier one

[4] Sources: European Commission, US Department of Treasury.

after the test was conducted. The results showed that 25 banks failed the tests.[5] Regarding the US, 25 of the to the 30 largest banking conglomerates that were examined in 2014 succeeded, only one of them (Zions Bancorporation) failed due capital shortfalls (less than 5% Tier 1 common capital ratio), while the other four financial institutions (Citigroup Inc., HSBC Holdings plc, The Royal Bank of Scotland Group plc , and Santander, S.A.) were rejected based on ambiguities in their risk management practices and flaws in their capital distribution plans.[6]

Given the role of the financial institutions in the financial crisis, the adverse consequences it has brought to the global economy; as well as the changes in banking regulations that it has generated; it is of actual interest to analyze the possible factors that may have lead to that extreme situation.

[5] Source ECB: Nine of the failed institutions were from Italy, 3 three form Cyprus and Greece respectively, two from Belgium and Slovenia; and one bank form Austria, France, Germany, Ireland, Portugal and Spain respectively.
[6] Source: Federal Reserve

4. Summary of the Essays

4.1. Essay 1: Factors Influencing Bank Risk in Europe: Evidence from the Financial Crisis

Essay 1 examines bank-specific and macroeconomic determinants of bank risk-taking. We use a dynamic panel data model to analyze determinants of bank risk for a large sample of commercial banks operating in the euro area from 2001 to 2012. The selected time span considers the impact of the on-going financial and economic crisis on the Eurozone banking system.

This Essay contributes to the existing literature in various ways. First, this work complements the previous literature by analyzing the factors (bank-specific and macro) that influence bank risk in euro area commercial banks. The selected time span, from 2001 to 2012, considers the impact of the on-going financial and economic crisis on the Eurozone banking system. To the best of our knowledge, little research has been conducted on the effects of both bank-specific and macroeconomic variables on the risk of European commercial banks in the context of the on-going financial crisis. Second, we use the generalized method of moments (GMM) estimator, also referred to as the system-GMM estimator, developed for dynamic panel models by Arellano and Bover (1995) and Blundell and Bond (1998). It allows us to control for unobserved heterogeneity as well as for endogeneity. This new technique has only been used in recent studies on the determinants of bank risk (e.g., Delis and Staikouras, 2011; Haq and Heaney, 2012; Louzis *et al.*, 2012).

4.2. Essay 2: How Revenue Diversification Affects Non-Performing Loans of European Banks

In Essay 2, we focus on the effects of revenue diversification on non-performing loans held by banks in 14 European countries. We consider a maximum of more than 2,000 Eurozone institutions, including commercial banks, saving banks and credit

cooperatives, from 1998 to 2012. We use the general method of moments (GMM) estimator, also referred to as the system GMM estimator, which was developed by Arellano and Bover (1995) and Blundell and Bond (1998) for dynamic panel data models. This method allows us to control for unobserved heterogeneity and endogeneity by means of suitable instruments.

This essay contributes to the existing body of banking literature on revenue diversification in the following respects. First, studies addressing the relationship between the quality of loan portfolios and revenue diversification are relatively scarce, and those that do exist are inconclusive (e.g., Louzis *et al.*, 2012 and Chaibi and Ftiti, 2015). Second, similar to Elsas *et al.* (2010), we proxy revenue diversification with an adjusted Herfindahl-Hirschman index (HHIRD) that considers different types of revenue rather than with less specific revenue diversification measures that consider only interest and non-interest income (e.g., Lepetit *et al.*, 2008; Demirgüç-Kunt and Huizinga, 2010; Sawada, 2013). Third, we consider the different effects of revenue diversification on NPLR between commercial banks and savings and cooperative banks and between bank- and market-oriented institutions. Fourth, we control for possible differences in bank regulatory schemes by including four indicators (capital stringency, official supervisory power, private monitory index and activity restrictions index) obtained from the World Bank database on Bank Regulation and Supervision developed by Barth *et al.* (2001).

4.3. Essay 3: Ethical Reputation of Financial Institutions: Do Board Characteristics Matter?

Essay 3 examines the association between board characteristics and the ethical reputation of financial institutions. Our sample includes 43 large publicly traded large financial institutions from 13 different countries from 2005 to 2010. We utilize the Covalence EthicalQuote index to measure the ethical reputation of these institutions. Given the pivotal governance role of the board of directors and the value-relevance of ethical corporate behavior, we postulate a positive relationship between ethical reputation and board features that foster more effective monitoring and oversight. We run several alternative panel regressions of ethical reputation on board characteristics and firm-specific controls.

To the best of our knowledge, this essay is the first attempt to examine the association between ethical reputation and the board of directors in the financial industry.

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Part 2: Empirical essays

ESSAY 1: DETERMINANTS OF BANK RISK IN EUROPE: EVIDENCE FROM THE FINANCIAL CRISIS.

ESSAY 2: EFFECTS OF REVENUE DIVERSIFICATION ON NON-PERFORMING LOANS IN EUROPE.

ESSAY 3: BOARD CHARACTERISTICS AND ETHICAL REPUTATION OF FINANCIAL INSTITUTIONS.

Essay 1: Determinants of Bank Risk in Europe: Evidence from the Financial Crisis

Abstract

In this essay we use a dynamic panel data model to analyze bank-specific and macroeconomic determinants of bank risk for a large sample of commercial banks operating in the euro area. The selected time span, from 2001 to 2012, considers the impact of the on-going financial and economic crisis on the Eurozone banking system. Our results indicate that capitalization, profitability, efficiency and liquidity are inversely and significantly related to bank risk. However, the recourse to wholesale funding by banks seems to increase their risk. We also find that less concentrated markets, lower interest rates, higher inflation rates and a context of economic crisis (with a falling GDP) increase bank risk.

1 Introduction

The recent financial crisis has demonstrated the need for a better regulation and supervision of the EU financial sector, particularly in the euro area. Although banking regulation in the EU was initially harmonized following successive directives (specially after the Financial Services Action Plan of 1999), most policy instruments in the Eurozone remained at the national level. As the financial crisis progressed and turned into the Eurozone debt crisis in 2010/2011, it became clear that the greater interdependency for those countries sharing the euro required a deeper integration of the banking system. Contradictory national solutions led to fragmentation of the single market in financial services, which in turn contributed to disruptions in lending to the real economy. This effect on the real economy, triggered by the problems in the banking sector, was extremely severe, producing record levels of unemployment and giving way to what is now referred to as the Great Recession (Altunbas *et al.*, 2011).

Consequently, in 2012, EU authorities agreed to the creation of an integrated financial framework (the so-called banking union) to restore confidence in banks and in the euro. The banking union relies on common rules that all financial institutions in the EU must comply with. These rules include the establishment of more adequate capital requirements (the EU Capital Requirements Directive was approved in 2013), better protection for all EU depositors (the EU Directive on Deposit Guarantee Schemes was

adopted in 2014), and common tools to deal effectively with failing credit institutions (the EU Directive on Bank Recovery and Resolution was published in 2014). Moreover, in 2013, the EU adopted the regulations establishing the Single Supervisory Mechanism (SSM), which places the European Central Bank (ECB) as the central prudential supervisor of financial institutions in the euro area. The ECB will directly supervise the largest banks, while the national supervisors will continue to monitor the remaining banks. Lastly, to ensure an orderly resolution of failing banks with minimal costs for taxpayers and to the real economy, a Single Resolution Mechanism (SRM) will be applied to banks covered by the SSM. By moving responsibility for potential financial support —and the associated banking supervision— to a shared level, the banking union would reduce financial fragmentation and weaken the vicious circle of rising sovereign and bank borrowing costs in many countries (Goyal *et al.*, 2013).

This essay analyzes several factors that the literature suggests influence bank risk, including bank-specific variables (Arena, 2008; Poghosyan and Čihak, 2011) and macroeconomic variables (Borio and Lowe, 2002; Festic *et al.*, 2011). The global financial crisis has highlighted the importance of the early identification of riskier banks, as this allows solving the problems at a lower cost. The bank bailout costs associated with the current global financial crisis and the large output losses experienced in several European countries clearly indicate the need for a better understanding of the determinants of bank risk. We focus on the Eurozone because these countries must coordinate their economic and fiscal policies closely – much more so than other EU member states. As stated by Poghosyan and Čihak (2011), an important motivation in favor of a more centralized banking regulation in the EU is the notion that risks in the banking sectors of EU members have become increasingly homogenous. An improved understanding of the determinants of bank risk in the euro area is important for regulators and supervisors concerned about benchmarking and validation issues related to the new EU banking rules, but they may also be of interest to a wide range of financial market participants, including borrowers, shareholders and bondholders.

The non-performing loan ratio (NPLr), defined as the proportion of non-performing loans to gross loans, has been commonly used in the literature as a measure of bank soundness (Berger and De Young, 1997; Delis and Kouretas, 2011; Festic *et al.*, 2011). Because NPLr expresses the quality of a loan portfolio, we may expect that a

higher (lower) value for this ratio will denote a higher (lower) probability of default. There is broad consensus concerning the inverse relationship of asset quality to bank risk. Poghosyan and Čihak (2011) go even further and advocate considering asset quality in addition to bank capitalization when designing pan-European benchmarks for sound banking conduct. These authors conclude that bank earnings and asset quality have a greater economic impact on bank distress than capitalization, which reinforces our choice of the NPLr as a measure of bank risk.

As a complementary indicator, we use the Z-score, which has also been frequently used to analyze the determinants of bank risk in the recent literature (Laeven and Levine, 2009; Demirgüç-Kunt and Huizinga, 2010; Köhler, 2015). This metric is defined as the number of standard deviations that a bank's return on assets must fall below the mean for the bank to become insolvent. The Z-score is considered a better measure of bank risk than the NPLr because non-performing loans are traditionally backward looking and highly procyclical (Laeven and Majnoni, 2003; Bikker and Metzemakers, 2005). In addition, NPLr only measures credit risk, while the Z-score is an overall measure of bank risk that captures not only credit risk but also liquidity and market risk, which arises primarily from non-lending activities (Köhler, 2015).

This essay contributes to the existing literature in various ways. First, this work complements the previous literature by analyzing the factors (bank-specific and macro) that influence bank risk in euro area commercial banks. The selected time span, from 2001 to 2012, considers the impact of the on-going financial and economic crisis on the Eurozone banking system. To the best of our knowledge, little research has been conducted on the effects of both bank-specific and macroeconomic variables on the risk of European commercial banks in the context of the on-going financial crisis.[7] Second, we use the generalized method of moments (GMM) estimator, also referred to as the

[7] Cipollini and Fiordelisi (2012) analyze the effect of liquidity, size, income diversification, market power, concentration and GDP growth on bank financial distress using a sample of 308 European commercial banks (from both Eurozone and non-Eurozone countries) between 1996 and 2009. Haq and Heaney (2012) examine the impact of bank capital, charter value, off-balance sheet activities, dividend payout ratio, size, operating leverage, regulation, industry concentration and GDP growth on risk for 117 listed banks (bank holding companies, commercial banks, savings banks and credit cooperatives) across 15 European countries (10 Eurozone and 5 non-Eurozone countries) over the period 1996-2010.

system-GMM estimator, developed for dynamic panel models by Arellano and Bover (1995) and Blundell and Bond (1998). It allows us to control for unobserved heterogeneity as well as for endogeneity. This new technique has only been used in recent studies on the determinants of bank risk (e.g., Delis and Staikouras, 2011; Haq and Heaney, 2012; Louzis *et al.*, 2012).

The essay is structured as follows. Section 2 reviews the most significant empirical studies and presents our research hypotheses. Section 3 describes the data and methodology employed in the empirical research and defines the explanatory variables. Section 4 presents and discusses the results obtained. Section 5 summarizes the results obtained and the conclusions drawn.

2 Literature review and research hypotheses

According to the literature, the factors that influence bank risk fall into two main groups. First, there is a group of risk determinants that are specific to each bank and that, in many cases, are the direct result of managerial decisions. These determinants include asset structure, capitalization, non-deposit funding, profitability, efficiency, revenue diversification and size. The second group of determinants includes factors that relate bank risk to the industry structure and to the macroeconomic environment within which the banking system operates, such as industry concentration, economic growth, inflation, unemployment and interest rates.

2.1 Asset structure

One of the most criticized practices in banking has been the ease with which it has provided loans in times of economic expansion. The share of loans to the private sector in total banking assets is considered an important driver of credit risk. Many studies have found that the relative percentage of loans to total assets is positively correlated with banking problems, increasing NPL and insolvency as a result of long-term bank mismanagement (De Nicoló *et al.*, 2003; Blasco and Sinkey, 2006; Männasoo and Mayes, 2009; among others). This greater relative proportion of loans in the portfolio of the bank is usually coupled with a greater liquidity risk arising from the banks' inability to accommodate decreases in liabilities or to fund increases on the asset

side of the balance sheet (Trujillo-Ponce, 2013). Consequently, a bank holding a high proportion of loan assets is more likely to also have lower Z-score ratios.[8]

Therefore, we hypothesize the following relationship:

Hypothesis 1: There is a positive relationship between the relative percentage of loans in the assets of a bank and its risk.

2.2 Capitalization

The need to regulate bank capital is based, among other reasons, on the important role of capital requirements as a disincentive to risk-taking by bank shareholders, who may be conditioned by limited liability (Behr *et al.*, 2010), as well as the well-known moral hazard problem that often accompanies the deposit insurance system or the expectation of a bailout with public funds (Santos, 2001; Demirgüç-Kunt *et al.*, 2013). Therefore, Capital Accords (i.e., Basel I, II and III) were primarily designed to reduce bank risk. By investing their own money, bank shareholders assume part of the risk caused by an inappropriate investment strategy. However, both the theoretical and empirical literature provides conflicting results about the effect of capital on bank risk.

Theoretical models by Koenh and Santomero (1980) and Kim and Santomero (1988) state, with incomplete market settings, that regulators introducing flat capital requirements force banks to reduce leverage, and bankers may choose a riskier portfolio to compensate the loss in utility caused by this reduction. Furlong and Keeley (1989) and Keeley and Furlong (1990) conclude that increased capital standards reduce bank risk-taking, improving the moral hazard generated by deposit insurance systems. Gennotte and Pyle (1991) find that, most of the time, required increases in bank capital reduce the probability of default. Santos (1999) also concludes that more stringent capital requirements reduce banks' risk of insolvency. Blum (1999) and Calem and Rob (1999) rely on dynamic models. Blum (1999) concludes that capital requirements may increase bank risk. However, Calem and Rob (1999) conclude that the relationship between capital and bank risk-taking is U-shaped. When capital is lower than the

[8] However, banks with higher liquid assets (e.g., cash, government securities) may also be less profitable, and therefore, high liquidity may be associated with lower Z-scores (Delis and Staikouras, 2011).

regulatory minimum, banks choose a very risky loan portfolio to maximize the risk-shifting benefits of deposit insurance. As capital increases and future default become less likely, the incentives to be riskier decrease in order to preserve bank charter value. Lastly, overcapitalized banks take more risk because their portfolio choices ensure a very low probability of insolvency. More recently, Kopecky and VanHoose (2006) find that the imposition of regulatory capital requirements has an initially ambiguous effect on aggregate loan quality, although once such requirements are in place, further increases in required capital ratios cause the overall credit quality in the banking system to increase. Behr *et al.* (2010) conclude that capital regulation is only effective in mitigating risk taking in markets with a low degree of concentration.

We test the following two hypotheses about the influence of capital on bank risk:

Hypothesis 2a: There is a negative relationship between bank capitalization and risk.

Hypothesis 2b: There is a positive relationship between bank capitalization and risk.

2.3 Non-deposit funding

When a firm relies on short-term wholesale funds to support long-term illiquid assets, it becomes vulnerable to runs by its creditors. The recent financial crisis has clearly exposed the risks of a bank´s excessive reliance on non-deposit funding, as many firms experienced an outflow of wholesale funds following the failure of Lehman Brothers in September 2008. Huang and Ratnovski (2011), for example, state that wholesale financiers could have lower incentives to conduct costly monitoring and may thus withdraw their funds precipitately based on a noisy public signal on bank solvency. The price of wholesale funding could also adjust more quickly to reflect a bank's riskiness (Demirgüç-Kunt and Huizinga, 2010). Customer deposits, in contrast, are slower to be re-priced and are more stable, not least because they are protected by deposit insurance systems (Shleifer and Vishny, 2010; Köhler, 2015).

We hypothesize the following relationship:

Hypothesis 3: There is a positive relationship between the share of non-deposit funds in the liabilities of a bank and its risk.

2.4 Profitability

More profitable banks may be more likely to have high franchise value, which could influence their risk-taking behavior (Behr *et al.*, 2010). There is widespread consensus about the negative relationship between bank performance and risk. Poghosyan and Čihak (2011) show how European banks with good earnings profiles are less likely to experience distress in the upcoming year. Louzis *et al.* (2012) state that worse performance may be a proxy for lower-quality skills with respect to lending activities. Furthermore, these authors provide empirical evidence that performance may serve as a leading indicator of future problem loans.

Based on these findings, we expect to find a negative relationship between bank profitability and risk.

Hypothesis 4: There is a negative relationship between a bank's returns and its risk.

2.5 Efficiency

Many studies show that inefficiency is a source of bank risk. Recent studies use the cost-to-income ratio (CIR) as a proxy for efficiency or managerial quality (Mänasoo and Myers, 2009; Poghosyan and Čihak, 2011; Louzis *et al.*, 2012; among others). In their Bad Management I Hypothesis, Louzis *et al.* (2012) state that low cost efficiency is positively associated with increases in future NPLs, as long as bad management leads to poor skills in credit scoring, appraisal of pledged collaterals and monitoring of borrowers. Other authors, focusing either on cost efficiency (Berger and De Young, 1997; Williams, 2004) or on profit or revenue efficiency (Berger and Bonaccorsi di Patti, 2006; Fiordelisi *et al.*, 2011), report similar findings.

Our fourth hypothesis is, therefore, the following:

Hypothesis 5: There is a negative relationship between bank efficiency and bank risk.

2.6 Revenue diversification

Bank activity has evolved over the last few decades, resulting in a more diversified balance sheet. There are various activities that provide non-interest income, such as fees, commissions and trading. The greater the proportion of these activities in a bank's portfolio, the more diversified the bank is. There is plenty of literature about

how diversification influences bank risk, and the conclusions differ, in several cases, from the recommendations of the traditional portfolio and banking theories (Deng *et al.*, 2007).

Portfolio theory, as well as the traditional arguments based on Diamond (1984), suggests that diversification effects contribute to the reduction of risk in all types of firms, including financial intermediaries. In this vein, Lee *et al.* (2014) conclude that non-interest income activities play a strong role in reducing risk of Asian banks. Similarly, Köhler (2015) states that retail-oriented banks are significantly more stable if they increase their share of non-interest income in total operating income, indicating that substantial benefits are to be gained from revenue diversification. However, many authors support the idea that diversification not only does not reduce bank risk but may, in fact, encourage it. One such author is De Jonghe (2010), who states that traditional banking activities are less risky. He concludes that the banks that profitably focus on lending activities contribute more to banking system stability than diversified banks. In this vein, Stiroh (2002) finds that during the period from the late 1970s to 2001, a greater reliance on non-interest income by U.S. banks, particularly on trading revenue, was associated with higher risk and lower risk-adjusted profits at the individual bank level. Lastly, Demirgüç-Kunt and Huizinga (2010) analyze a sample of international banks for the 1995-2007 period. They conclude that although expansion into non-interest income-generating activities such as trading could offer some risk diversification benefits, banking strategies that rely prominently on generating non-interest income are very risky, consistent with the demise of the US investment banking sector.

The ambiguity of the results on this subject leads us to propose hypotheses 6a and 6b:

Hypothesis 6a: There is a negative relationship between the revenue diversification of a bank and its risk.

Hypothesis 6b: There is a positive relationship between the revenue diversification of a bank and its risk.

2.7 Size

Bank size has become a popular research topic, particularly during this financial crisis, as indicated by the dramatic increase in the number of studies related to too-big-to-fail entities and systemic important banks (SIBs). There is a widespread theory that larger banks tend to be riskier due to a moral hazard problem (Uhde and Heimeshoff, 2009; De Jonghe, 2010). According to this theory, larger entities may be more attracted to amplifying risk taking, reducing market discipline and creating competitive distortions because they know they will be bailed out. Paradoxically, there is also a view that supports the idea that larger banks are less prone to risk because of their managerial capacity and efficiency. This view is expressed by Boyd and Prescott (1986) and Salas and Saurina (2002) among others. These authors state that larger banks may be able to diversify loan portfolio risks more efficiently due to greater economies of scale and scope. Thus, we formulate two hypotheses of different signs.

Hypothesis 7a: There is a positive relationship between size and bank risk.

Hypothesis 7b: There is a negative relationship between size and bank risk.

2.8 Industry concentration

There has been a tendency over the last few decades toward concentration in the financial sector, a tendency that has increased substantially in recent years. We are experiencing the greatest era of mergers and acquisitions in European history, especially since the beginning of the financial crisis. Empirical research shows that the influence of concentration on bank risk could be positive or negative. According to the so-called concentration stability view, a less concentrated banking sector with many banks is more prone to financial crises than a concentrated banking sector with a few banks (Allen and Gale, 2000). First, monopolistic banks in concentrated banking systems may enhance profits and thus reduce financial fragility by providing higher capital buffers that increase their charter value and thus reduce incentives for bank owners and managers to take excessive risks (Keeley, 1990; Park and Peristiani, 2007). Second, bank supervision will be more effective in concentrated banking systems because they are substantially easier to monitor, and thus, systemic crises will be less pronounced (Allen and Gale, 2000). Contrary to this viewpoint, there is also a

concentration fragility view that is supported, among others, by Boyd and De Nicoló (2005). Their findings postulate that large entities with monopoly power can charge higher interest to their clients, who then need to engage in riskier investments to meet their financing costs. This situation results in more loan defaults, which increases the likelihood of bank failure. Again, we propose two opposing hypotheses to be tested.

Hypothesis 8a: There is a negative relationship between industry concentration and bank risk.

Hypothesis 8b: There is a positive relationship between industry concentration and bank risk.

2.9 Economic growth

With few exceptions, the banking sector has exhibited a clearly cyclical behavior.[9] Most of the literature states that higher rates of growth are associated with a more stable macroeconomic environment and a relatively low likelihood of bank distress (e.g., Borio and Lowe, 2002, Festic *et al.*, 2011; Pophosyan and Cihak, 2011; among others). Marcucci and Quagliariello (2008) analyze the behavior of the default rates of Italian bank borrowers over the last two decades and confirm that the default rates follow a cyclical pattern. It was observed that the rates decrease during good macroeconomic times and increase during downturns. Similarly, Borio and Lowe (2002) analyze a sample of 35 countries and state that, since 1970, there has been a risk of greater amplitude in financial cycles going hand-in-hand with more disruptive booms and busts in real economic activity.

Therefore, we expect a negative association between economic growth and bank risk.

Hypothesis 9: There is a negative relationship between economic growth and bank risk.

[9] These exceptions refer to the Australian market over the 1990-1999 period (Arpa *et al.,* 2001) and to Canadian banks over the 1982-2009 period (Guidara *et al.,* 2013).

2.10 Inflation

Arpa *et al.* (2001) conclude that the share of risk provisions in the total loans of the banking sector varies directly with inflation (both consumer price index (CPI) and real estate price inflation). Likewise, Baboucek and Jancar (2005) show that increasing inflation ratios deteriorate the NPLr. Uhde and Heimeshoff (2009) state that the effect of changes in inflation rates depends on whether inflation is anticipated by banks and whether it coincides with general economic fragility.

Therefore, we expect a positive association between inflation and bank risk.

Hypothesis 10: There is a positive relationship between inflation and bank risk.

2.11 Unemployment

Some researchers also use the unemployment rate to explain bank risk. Bofondi and Ropele (2011), for example, state that increasing unemployment had a significantly adverse effect on loan portfolio quality for a sample of Italian banks during the period 1990 to 2010. Similarly, Louzis *et al.* (2012) find that unemployment has a direct and significant impact on all NPL categories (business loans, consumer loans and mortgages), with mortgages being the least sensitive NPL type.

Therefore, we hypothesize a positive relationship between unemployment and bank risk.

Hypothesis 11: There is a positive relationship between unemployment and bank risk.

2.12 Interest rates

Lastly, there is considerable research that supports the view that interest rates have a strong influence on bank risk. Hoggarth *et al.* (2005) find that the important factors indirectly influencing financial stability and loan portfolio quality are the dynamics of inflation and interest rates. Furthermore, there is a recent line of research that shows how the low-interest-rate environment of the last decade has encouraged bank risk taking in search of yield (e.g., Delis and Kouretas, 2011; Agur and Demertzis, 2012).

Therefore, we formulate the following hypothesis:

Hypothesis 12: There is a negative relationship between interest rates and bank risk.

3 Data and Methodological Aspects

3.1 Sample

Our sample consists of 204 commercial banks operating in 14 European countries over the period 2001 to 2012. We focus on countries that belong to the EU and that have adopted the Euro as their common currency (Eurozone).[10] By sharing the same currency, euro area countries must coordinate their economic and fiscal policies closely. We also limit our analysis to commercial banks, as different bank types (e.g., commercial banks, savings banks, cooperative banks, investment banks) have singular characteristics that may affect bank risk-taking (see, for example, Delgado *et al.*, 2007; Iannotta *et al.*, 2007, among others).

We chose banks based on the availability of data from the Bankscope database maintained by Bureau Van Dijk in order to implement the system-GMM estimator described in Section 3.2. We require sample banks to have information for all of the variables analyzed over at least five consecutive years during the period considered (to test for the absence of second-order serial correlation). Indicators are calculated on a non-consolidated basis, meaning that banking subsidiaries and foreign branches are considered separate credit institutions. This reduces the possibility of introducing aggregation bias in the results (Delis and Staikouras, 2011). Merged banks are considered separate entities before the merger and a single entity subsequently. All of the ratios capturing bank-specific characteristics are calculated based on the standardized global accounting format. Those entities that present abnormal ratios or extreme values were eliminated from the sample as outliers. After completing this filtering, we obtain a final dataset consisting of an unbalanced panel with 1,423 observations.[11] In contrast to other studies that examine only listed banks (e.g.,

[10] We restrict the analysis to countries that have adopted the Euro during the sample period and thus have a common monetary policy. We exclude the cases of Cyprus, Estonia and Malta because we do not have at least five consecutive years of data after these countries adopted the Euro. Slovakia is included in the sample because its currency has been pegged to the Euro since 2008.

[11] The number of observations (banks) was reduced from 1,423 (204) to 1,132 (181) when the Z-score was used as the bank risk proxy.

Altunbas *et al.*, 2011; Haq and Heaney, 2012), most banks in our sample are unlisted (approximately 73 percent), which gives a more representative picture of the EU banking sector, as unlisted banks account for the majority of banks in Europe (Köhler, 2015). However, this implies the use of accounting measures of bank risk, and these measures have some limitations. As Altunbas *et al.* (2007) state, managers could make use of some timing discretion over these metrics to minimize regulatory costs. They are also backward looking.

Table 1 shows the number of banks and observations in the sample by country.

Table 1. *Commercial banks in the sample by country*

Country	Commercial banks	Observations
Austria	6	51
Belgium	4	29
Finland	3	19
France	58	426
Germany	8	56
Greece	7	50
Ireland	7	51
Italy	53	367
Luxembourg	3	19
Netherlands	8	56
Portugal	9	63
Slovakia	6	30
Slovenia	12	68
Spain	20	138
Total Eurozone	204	1,423

3.2 Methodology

The bank-specific factors that influence bank risk may be endogenous. For instance, banks could have incentives to increase their stock of liquid assets if they become more risky in order to protect themselves against premature withdrawals of funds (Köhler, 2015), and influences on risk could also cause banks to adjust their fee income and non-deposit funding shares (Demirgüç-Kunt and Huizinga, 2010). In addition, some characteristics that affect bank risk (e.g., managerial ability) are difficult to measure or identify in an equation (the so-called unobserved heterogeneity). If the influence of such characteristics is not considered, then one could observe correlations

between some of the coefficients of the explanatory variables and the error terms that bias these coefficients. Lastly, the persistence of bank risk is well documented in the literature (e.g., Delis and Kouretas, 2011). To address these concerns, we use the GMM estimator developed for dynamic panel models by Arellano and Bover (1995) and Blundell and Bond (1998), also referred to as the system-GMM estimator. We employ the two-step estimation procedure with finite-sample corrected standard errors as proposed by Windmeijer (2005). This provides less biased coefficient estimates and more accurate standard errors.

The system-GMM estimator addresses endogeneity by means of suitable instruments. We treat all bank characteristics as endogenous covariates by employing lagged first differences of the bank-specific explanatory variables as instruments for the equation in levels and the lagged values of the explanatory variables in levels as instruments for the equation in differences (in line with Arellano and Bover, 1995, and Blundell and Bond, 1998). Industry concentration and macroeconomic variables are treated as strictly exogenous. Similar to Delis and Staikouras (2011), we assume that banks and regulators choose their strategy when they observe economic conditions at the beginning of the period. We verify that the instruments are statistically valid using a Hansen *J*-test of overidentifying restrictions.

Our baseline equation is as follows:

$$Y_{i,j,t} = \alpha + \delta \cdot Y_{i,j,t-1} + \beta \cdot BS_{i,j,t} + \gamma \cdot M_{j,t} + \theta \cdot R_{j,t-1} + \eta \cdot L_{i,j,t} + \varepsilon_{i,j,t} \quad (1)$$

where Y denotes the variable used to measure the risk of bank i in country j at year t; $Y_{i,j,t-1}$ represent its lagged value; δ measures the speed of mean reversion (a value of δ that is not significantly different from 0 implies that bank risk is characterized by a high speed of adjustment, whereas a value that is not significantly different from 1 means the adjustment is very slow); $BS_{i,j,t}$ and $M_{j,t}$ denote, respectively, the bank-specific and the industry and macroeconomic variables considered in our study; $R_{j,t-1}$ refers to several bank regulation and supervision control variables; $L_{i,j,t}$ represents a dummy variable controlling for the public status of the bank (it takes value 1 for listed banks and 0 otherwise); and β, γ, and θ are vectors of coefficient estimates. Lastly, $\varepsilon_{i,t}$ is the disturbance term that contains the unobserved bank-specific effect (η_i) and the idiosyncratic error ($\nu_{i,t}$).

As previously stated, we proxy bank risk using two complementary metrics that are intuitive and easily measured: the NPLr and the Z-score. We take natural logarithms to control for the skewness exhibited by the two original variables. The Z-score is calculated as the sum of the return on assets (ROA) and the equity-to-assets ratio (Eq/TA) divided by the standard deviation of the return on assets (σ (ROA)):

$$\mathrm{Z-score}_t = \frac{\mathrm{ROA}_t + \mathrm{Eq/TA}_t}{\sigma(\mathrm{ROA})_t} \tag{2}$$

ROA is computed as pre-tax profits divided by total assets. Following Agoraki *et al.* (2011) and Delis and Staikouras (2011), we use data from the two previous years (i.e., t -1, t -2) to calculate σ (ROA) at time t. We also verify that using three or four years gives similar results.

The Z-score indicates the number of standard deviations below the expected value of a bank's ROA at which equity is depleted and the bank is insolvent (Boyd *et al.*, 1993; Boyd and Runkle, 1993). Therefore, this index can be interpreted as an inverse measure of the probability of insolvency, i.e., a higher Z-score implies that a bank incurs fewer risks and is more stable (Köhler, 2015).

Table 2. *Explanatory variables*

Classification	Explanatory variable	Notation	Hypotheses and Expected signs	Data Source	References
Bank-specific variables					
Asset structure	Loans/Total Assets (%)	Loan/TA	H1 (+)	Bankscope	Männasoo and Mayes (2009)
Capitalization	Equity/Total Assets (%)	Eq/TA	H2a (-); H2b (+)		Poghosyan and Čihak (2011) Louzis *et al.* (2012)
Non-deposit funding	Non-deposit Funds/Total Liabilities (%)	NonDep/TL	H3 (+)		Köhler (2015)
Profitability	Return on Assets (%)	ROA	H4 (-)		Poghosyan and Čihak (2011)
Efficiency	Cost-to-Income Ratio (%)	CIR	H5 (+)		Männasoo and Mayes (2009) Louzis *et al.* (2012)
Revenue diversification	Herfindahl–Hirschman Index	HHIRD	H6a (-); H6b (+)		Stiroh and Rumble (2006)
Size	Natural Log of Total Assets	Size	H7a (+), H7b (-)		Louzis *et al.* (2012)
Industry and macroeconomic variables					
Industry concentration	Herfindahl–Hirschman Index	HHIIC	H8a (-), H8b (+)	ECB	Uhde and Heimeshoff (2009) Männasoo and Mayes (2009)
Economic growth	Annual Real GDP Growth Rate (%)	GDP	H9 (-)	Eurostat	Uhde and Heimeshoff (2009)
Inflation	Annual Average Rate Change in CPI (%)	Inflation	H10 (+)		Männasoo and Mayes (2009)
Unemployment	Unemployment Rate (%)	UR	H11 (+)		Bofondi and Ropele (2011)
Interest rates	Interest Rate on the MRO of the ECB (%)	Interest	H12 (-)	ECB	Uhde and Heimeshoff (2009)

Table 2 summarizes the explanatory variables considered in the current study and their expected signs for bank risk. To analyze the effect of asset structure on bank risk (H1), we use the ratio of loans to total assets (Loan/TA). To examine whether the level of capitalization is a determining factor in bank risk (H2a, H2b), we use the Eq/TA. Similar to Köhler (2015), we use the share of non-deposit funding in total liabilities (NonDep/TL) to test the effect of wholesale funds on bank risk (H3). To measure the effect of profitability on bank risk (H4), we choose the ROA. Following the example of other researchers, we use the CIR as a proxy for operational efficiency (H5). This ratio measures the overhead or running costs (the largest proportion of which is normally salaries) of a bank as a percentage of income generated before provisions. To analyze the effect of income diversification on bank risk (H6a, H6b), we use an adjusted Herfindahl–Hirschman index (HHIRD). This variable is calculated as follows:

$$HHIRD = 1 - \left[\left(\frac{INT}{TOR} \right)^2 + \left(\frac{COM}{TOR} \right)^2 + \left(\frac{TRAD}{TOR} \right)^2 + \left(\frac{OTH}{TOR} \right)^2 \right] \tag{3}$$

where INT denotes the gross interest income; COM denotes the gross commission and fee revenue; TRAD denotes the trading revenue; OTH denotes all other gross operating income; and TOR denotes the total operating revenue and is equal to the sum of the absolute values of INT, COM, TRAD and OTH.

Lastly, because the effect of size on bank risk appears to be non-linear, we use the natural logarithm of bank assets to accommodate this relationship (H7a, H7b).

With respect to the variables that are exogenous to the banks, industry concentration (H8a, H8b) is also measured in terms of a Herfindahl–Hirschman index (HHIIC), which is calculated as the sum of the squares of all credit institutions' market shares within a country in terms of total assets (in percentage). This index more accurately reflects the entry of new and smaller banks and the impact of a single bank with a very large market share. It is often said that a market is highly concentrated when the index exceeds 1,800 (or 0.18, if we use units instead of percentages) and is unconcentrated when the index is below 1,000 (or 0.1). The data on the HHIIC in the euro area countries were obtained from the Banking Structural Financial Indicators

database of the European Central Bank (ECB).[1] We use the annual growth rate of the real gross domestic product (GDP) of the country to explore the association between economic growth and bank risk (H9). We measure the effect of inflation on bank profitability (H10) through the consumer price index (CPI) annual average rate of change. To assess the effect of unemployment on bank risk (H11), we use the annual average unemployment rate from Eurostat, which represents unemployed persons (aged 15 to 74) as a percentage of the labor force of the country. We lastly take the interest rate of the main refinancing operations (MRO) of the ECB, which provides the bulk of the liquidity to the European banking system, as a proxy for interest rates (H12).

3.3 Control variables

Despite Eurozone members sharing similar banking rules, some differences in the regulatory and supervisory environment still exist between each country's banking system during the analyzed period (these differences should tend to disappear after the banking union comes into force). We use four indicators from the World Bank database on Bank Regulation and Supervision developed by Barth *et al.* (2001) to control for this circumstance in our empirical specification, as the literature suggests that they may affect bank risk.[2] The first indicator, capital stringency, evaluates the regulatory approach to assessing and verifying the degree of capital at risk in a bank (Laeven and Levine, 2009).[3] The second indicator is an index of official supervisory

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[1] Updated values are available from the ECB website at http://sdw.ecb.europa.eu/browse.do?node=bbn2869.

[2] This approach has also been followed by Agoraki *et al.* (2011) and Delis *et al.* (2012), among others. This database is based on four surveys conducted by the World Bank. Survey I was released in 2001, and, for most of the countries, the information corresponds to 1999. Survey II describes the regulatory situation at the end of 2002. Survey III describes the regulatory environment in 2005-2006. Lastly, Survey IV provides information on bank regulation and supervision in 125 countries for 2011 (with some corrections in 2012) (Barth *et al.*, 2013). This database is available from the World Bank website at http://go.worldbank.org/SNUSW978P0.

[3] The capital stringency index is built by adding two measures of capital stringency: overall and initial capital stringency. Overall capital stringency indicates whether risk elements and value losses are considered while calculating the regulatory capital. It is based on the following questions: (i) Is the minimum capital-asset ratio requirement risk weighted in line with the Basel guidelines? (ii) Does the minimum ratio vary as a function of credit risk? (iii) Does the minimum ratio vary as a function of market risk? (iv) Are market values of loan losses not realized in accounting books deducted from capital? (v) Are unrealized losses in securities portfolios deducted from capital? (vi) Are unrealized foreign exchange losses deducted from capital? (vii) What fraction of revaluation gains is allowed as

power that reflects the degree to which the country's bank supervisory agency has the authority to take specific actions (e.g., force a bank to change its internal organizational structure).[4] The third indicator, private monitory index, shows the degree to which banks are forced to disclose accurate information to the public and whether there are incentives to increase market discipline.[5] We lastly add a composite index of regulatory restrictions on bank activities (activity restrictions). This index measures

part of capital? Initial capital stringency refers to whether certain funds may be used to initially capitalize a bank and whether they are officially verified. It is based on the following questions: (viii) Are the sources of funds to be used as capital verified by the regulatory or supervisory authorities? (ix) Can the initial disbursement or subsequent injections of capital be performed with assets other than cash or government securities? (x) Can the initial disbursement of capital be performed with borrowed funds? We assign a value of 1 if the answer to questions (i), (ii), (iii), (iv), (v), (vi) and (viii) is yes and 0 otherwise, while the opposite holds in the case of questions (ix) and (x). In addition, we assign a value of 1 if the fraction of revaluation gains that is allowed to count as regulatory capital (question (vii)) is less than 0.75. Otherwise, we assign a value of 0. By adding all these values together, we create the variable capital stringency index, which ranges in value from 0 to 10, with higher values indicating greater stringency.

[4] This index is a measure of the power of supervisory agencies, indicating the extent to which these authorities can take specific actions against bank management and directors, shareholders and bank auditors. This variable is determined by adding 1 if the answer is yes and 0 otherwise for each of the following 14 questions: (i) Does the supervisory agency have the right to meet with external auditors to discuss their report without the approval of the bank? (ii) Are auditors legally required to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse? (iii) Can supervisors take legal action against external auditors for negligence? (iv) Can the supervisory authorities force a bank to change its internal organizational structure? (v) Does the institution disclose off-balance-sheet items to supervisors? (vi) Can the supervisory agency order the bank's directors or management to constitute provisions to cover actual or potential losses? (vii) Can the supervisory agency suspend directors' decisions to distribute dividends? (viii) Can the supervisory agency suspend directors' decisions to distribute bonuses? (ix) Can the supervisory agency suspend directors' decisions to distribute management fees? (x) Can the supervisory agency supersede bank shareholder rights and declare the bank insolvent? (xi) Does banking law allow a supervisory agency or any other government agency (other than a court) to suspend some or all ownership rights at a problem bank? (xii) Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency (other than a court) supersede shareholder rights? (xiii) Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency (other than a court) remove and replace management? (xiv) Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency (other than a court) remove and replace directors? This index takes values between 0 and 14, with higher values indicating more supervisory power.

[5] To control for market discipline, we use the private monitoring index. This index examines the degree to which regulatory and supervisory policies encourage the private monitoring of banks, and it is composed of information on (i) whether bank directors and officials are legally liable for the accuracy of information disclosed to the public, (ii) whether banks must publish consolidated accounts, (iii) whether banks must be audited by certified international auditors, (iv) whether 100 percent of the largest 10 banks are rated by international rating agencies, (v) whether off-balance sheet items are disclosed to the public, (vi) whether banks must disclose their risk management procedures to the public, (vii) whether accrued, though unpaid, interest/principal enters the income statement while the loan is still non-performing, (viii) whether subordinated debt is allowable as part of capital and (ix) whether there is no explicit deposit insurance system and no insurance was paid the last time a bank failed. The maximum value of the private monitoring index is 12, and the minimum value is 0, where larger values indicate greater regulatory empowerment of the monitoring of banks by private investors.

the degree to which banks face regulatory restrictions on their activities in securities markets, insurance, and real estate and on owning shares in nonfinancial firms, with higher values indicating greater restrictions (Demirgüç-Kunt and Huizinga, 2010).[6] Because regulatory initiatives are unlikely to affect the risk-taking behavior of banks in the immediate term, we use the first lag of the corresponding indices (Agoraki *et al.*, 2011; Delis and Staikouras, 2011). We also assume that regulators may change banking rules to prevent financial turbulence if they observe excess risk-taking; therefore, similar to Delis and Staikouras (2011), these indicators are treated as endogenous in our regression.

We also control for the public status of the bank, as previous studies (e.g., Nichols *et al.*, 2009) report that market discipline exerted by the stock market might affect bank risk-taking. However, the effect of market exposure on bank risk is unclear (Barry *et al.*, 2011). Although market discipline should impose strong incentives on banks to conduct their business in a safe, sound and efficient manner, this greater control may also force the managers of listed banks to expand into more risky non-interest income activities, such as securitization, in order to generate a higher return, particularly if a bank underperformed its peers and if this is controlled by institutional investors (Köhler, 2015). The public status of the bank is considered endogenous in our baseline equation, as banks may choose to become listed or not based on the expected future changes in risk.

4 Results

4.1 Determinants of bank risk in the euro area

Table 3 provides an initial outline of the Eurozone banking situation from 2001 to 2012. The financial crisis has had a significant effect on bank risk. The deteriorating loan quality in the euro area's commercial banking sector has been perceptible in a steady and broad-based increase in non-performing loans since 2008. While the US

[6] The score for this variable is determined based on the level of regulatory restrictiveness for bank participation in: (i) securities activities, (ii) insurance activities, (iii) real estate activities and (iv) bank ownership of non-financial firms. These activities can be unrestricted, permitted, restricted, or prohibited and can receive values of 1, 2, 3, or 4, respectively. We create an overall index by calculating the summation value of the four categories. This index ranges from 4 to 16, with higher values indicating higher restrictions.

economy has shown increasing signs of recovery following the 2008-2009 sub-prime crisis period, the European banking sector has faced a second, more euro-area-focused, phase of the global financial crisis that includes a weak economic environment in many countries. The Z-score index also worsens in the crisis period, with the lowest average Z-score being reported in 2012. Regarding bank-specific variables, the proportion of total loans in euro area commercial banks' assets remains broadly unchanged on an aggregated level, despite drops in individual countries. However, the weakening macroeconomic conditions and increased pressure on banks to deleverage may have reduced the Loan/TA ratio in 2011 and 2012. This may also be due to transfers of distressed loans to asset management companies or bad banks. On the other hand, euro area commercial banks continue to reduce their dependence on wholesale funding, with the average share of non-deposit funding in liabilities falling to 44% from 49% in 2007. We also observe an increase in capital ratios until 2010. Profitability levels have remained low since the onset of the crisis in 2008 and have been characterized by a high degree of heterogeneity, with negative mean values for ROA in 2011 and 2012. The worsening in asset quality, which called for increases in impairment charges and provisions, and restructuring costs mainly drove this decline in profitability. The average CIR for the euro area commercial banking sector declined from 73% in 2008 to 65% in 2012. Given the drop in revenue, this improvement reveals considerable cost-cutting efforts by banks in general. Table 3 also reports a drop in income diversification during the crisis period, whereas the average size of commercial banks remains stable. Lastly, the evolution of macroeconomic variables shows the deterioration of the economic situation in the Eurozone after 2007. The decline in the number of credit institutions, especially in the crisis period, has increased market concentration in the euro area.

Table 3. *Summary statistics for Eurozone commercial banks*

	Bank risk proxies		Bank-specific variables						
	NPLr	**Z-score**	**Loan/TA**	**Eq/TA**	**NonDep/TL**	**ROA**	**CIR**	**HHIRD**	**Size**
2001	8.22	3.84	61.99	5.55	32.37	0.67	64.45	0.61	15.06
	(4.84)	(1.36)	(15.78)	(1.89)	(25.45)	(0.47)	(12.46)	(0.07)	(2.94)
2002	7.67	3.70	59.95	5.35	35.45	0.61	68.81	0.61	15.39
	(4.41)	(0.87)	(20.06)	(2.41)	(23.07)	(0.54)	(12.18)	(0.07)	(2.92)
2003	6.93	3.87	55.87	5.78	38.93	0.58	72.40	0.62	15.18
	(3.64)	(1.13)	(22.16)	(2.90)	(23.91)	(0.59)	(19.59)	(0.06)	(2.64)
2004	4.30	3.95	61.46	6.45	44.57	0.67	66.07	0.60	16.13
	(3.28)	(1.33)	(18.60)	(3.07)	(20.05)	(0.36)	(14.87)	(0.11)	(2.39)
2005	3.58	3.73	57.68	6.88	49.39	0.80	63.98	0.61	16.46
	(2.76)	(1.40)	(20.68)	(4.28)	(21.15)	(0.68)	(13.43)	(0.08)	(2.21)
2006	3.19	3.86	59.03	6.96	49.16	0.90	62.62	0.59	16.29
	(2.58)	(1.37)	(22.03)	(4.00)	(21.56)	(0.97)	(17.03)	(0.12)	(2.26)
2007	3.43	4.08	59.53	7.36	49.26	0.80	64.35	0.53	16.10
	(3.24)	(1.30)	(21.37)	(5.55)	(21.78)	(0.89)	(22.63)	(0.44)	(2.33)
2008	4.25	3.92	61.26	7.50	48.41	0.39	72.77	0.31	15.94
	(3.72)	(1.25)	(22.03)	(6.38)	(23.62)	(1.21)	(45.58)	(0.46)	(2.29)
2009	5.92	3.66	61.55	8.12	47.03	0.31	64.80	0.16	15.97
	(4.73)	(1.43)	(21.30)	(6.72)	(22.69)	(1.39)	(23.40)	(4.75)	(2.25)
2010	6.87	3.41	62.44	8.18	46.83	0.23	65.33	0.47	15.98
	(6.56)	(1.53)	(20.98)	(7.09)	(22.46)	(2.01)	(22.69)	(0.75)	(2.26)
2011	8.63	3.27	61.73	7.94	46.74	-0.14	67.27	0.17	15.99
	(8.84)	(1.56)	(21.36)	(6.37)	(21.92)	(1.89)	(37.71)	(5.21)	(2.24)
2012	9.76	3.19	61.45	7.76	44.53	-0.17	64.77	(0.46	16.06
	(8.96)	(1.61)	(21.66)	(5.95)	(21.22)	(1.56)	(31.31)	(0.28)	(2.25)
Total	6.01	3.73	61.15	7.60	47.11	0.34	67.38	0.25	16.04
	(6.34)	(1.45)	(21.35)	(5.99)	(22.22)	(1.48)	(29.69)	(4.46)	(2.28)

Table 3. *(Continued)*

	Industry and macroeconomic variables				
	HHIC	**GDP**	**Inflation**	**UR**	**Interest**
2001	506.44	1.77	1.71	8.60	3.25
	(197.55)	(0.15)	(0.15)	(0.40)	
2002	434.60	0.65	1.77	8.63	2.75
	(187.42)	(0.44)	(0.24)	(0.05)	
2003	506.87	0.64	1.79	8.27	2.00
	(173.34)	(0.53)	(0.47)	(1.68)	
2004	606.22	2.64	2.26	8.68	2.00
	(298.67)	(0.82)	(0.49)	(2.25)	
2005	651.38	1.92	2.15	8.11	2.25
	(502.60)	(1.28)	(0.58)	(1.55)	
2006	626.14	2.93	2.19	7.49	3.50
	(492.49)	(1.09)	(0.74)	(1.56	
2007	702.83	2.90	2.16	6.85	4.00
	(483.53)	(1.41)	(0.83)	(1.52)	
2008	725.70	0.22	3.44	7.19	2.50
	(548.73)	(1.60)	(0.80)	(1.89)	
2009	715.63	-4.48	0.22	9.24	1.00
	(530.96)	(1.50)	(1.04)	(3.39)	
2010	753.61	1.38	1.58	10.07	1.00
	(532.79)	(1.59)	(0.79	(3.96)	
2011	760.67	0.93	2.66)	10.43	1.00
	(544.78)	(1.88)	(0.57)	(4.61)	
2012	735.50	-1.28	2.46	11.85	0.75
	(499.19)	(1.68)	(0.52)	(5.55)	
Total	712.04	0.34	2.09	9.04	1.88
	(513.33)	(2.79	(1.19	(3.83)	(1.14)

Notes: This table reports the means and standard deviations (in parentheses) for the entire sample for each year. The sample comprises 204 commercial banks (1,423 observations). Z-score and Size are in logarithmic form. See Table 2 for a description of the variables.

Table 4 reports the results of the empirical estimation of Equation (1) for both measures of bank risk (NPLr and Z-score) in the Eurozone during the period from 2001 through 2012 using the system-GMM estimator suggested by Arellano and Bover (1995) and Blundell and Bond (1998). The high levels of significance for the lagged risk variables confirm the dynamic character of the model specification. The values of δ indicate a strong persistence in bank risk, as found in previous studies of the European banking sector (e.g., Delis and Kouretas, 2011).

Table 4. *Determinants of bank risk in the euro area*

Variables	(1) NPLr	(2) Z-score
Lagged dependent	0.797***	0.410***
	(0.028)	(0.086)
Loan/TA	0.004***	-0.001
	(0.001)	(0.002)
Eq/TA	-0.004*	0.023***
	(0.003)	(0.010)
NonDep/TL	0.003*	-0.004*
	(0.002)	(0.003)
ROA	-0.070***	0.341***
	(0.011)	(0.068)
CIR	0.001	-0.007***
	(0.001)	(0.002)
HHIRD	-0.004	0.001
	(0.004)	(0.005)
Size	-0.007**	0.025*
	(0.003)	(0.014)
HHIIC	-0.001**	0.002**
	(0.000)	(0.001)
GDP	-0.037***	0.001***
	(0.006)	(0.000)
Inflation	0.003**	-0.119***
	(0.001)	(0.038)
UR	0.005	-0.001
	(0.004)	(0.020)
Interest	-0.055***	0.079*
	(0.015)	(0.043)
Capital stringency index	-0.027***	0.055*
	(0.008)	(0.032)
Supervisory power index	-0.011**	0.065*
	(0.005)	(0.035)
Private monitoring index	-0.010**	0.111*
	(0.004)	(0.059)
Activity restrictions index	-0.010	0.018
	(0.008)	(0.037)
Listed	0.027	-0.151
	(0.073)	(0.245)
Constant	-0.088	1.919
	(0.282)	(1.359)
z_1	235.03 (18, 203)	13.16 (18, 180)
m_1	-3.12	-6.00
m_2	-0.60	-0.35
Hansen	191.41 (426)	165.44 (359)
Number of obs.	1,423	1,132
Number of banks	204	181

*Notes: This table presents the determinants of bank risk in the Eurozone during the period 2001–2012 using the system-GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). See Table 2 for a description of the independent variables. Except for HHIIC, GPD, Inflation, UR and Interest, all variables are considered endogenous in our model. We report heteroskedasticity-consistent asymptotic standard errors in parentheses, and significance levels are indicated as follows: ***=*

*significant at the 1% level; **= significant at the 5% level; and *= significant at the 10% level. z_1 is a Wald test of the joint significance of the reported coefficients, asymptotically distributed as F under the null hypothesis of no significance, with degrees of freedom in parentheses. m_i is a serial correlation test of order i using residuals in first differences, asymptotically distributed as N(0,1) under the null hypothesis of no serial correlation. Hansen is a test of the over-identifying restrictions, asymptotically distributed as χ^2 under the null hypothesis of no correlation between the instruments and the error term, with degrees of freedom in parentheses.*

We confirm our first hypothesis, in which we predicted a positive relationship between the relative percentage of loans in the assets of a bank and its risk, based on the literature that finds that laxity in lending may be a source of banking problems (e.g., De Nicoló *et al.*, 2003; Männasoo and Mayers, 2009; Festic *et al.*, 2011). Notwithstanding, this variable does not become significant when the Z-score is used as a risk proxy, which may be attributable to the fact that liquidity risk is not fully reflected in the proportion of loans over assets. Consistent with previous studies (e.g., Lehar, 2005; Poghosyan and Čihak, 2011), a negative relationship between bank capitalization and risk may be expected due to the potential danger of leverage. Our results confirm this hypothesis (H2a): the lower the capitalization, the higher the bank risk. Berger and DeYoung (1997) state that low-capital banks respond to moral hazard incentives by increasing the riskiness of their loan portfolios, which results in a higher number of non-performing loans, on average, in the future. Mehran and Thakor (2011) argue that higher levels of capital lead to a more intensive screening of borrowers, thus reducing bank risk. We also report that a greater dependence on wholesale funding may negatively affect commercial banks' risk, i.e., higher levels of non-deposit funding result in higher bank risk (H3). The financial crisis has clearly exposed the risk of wholesale funding, especially after the bankruptcy of Lehman Brothers in 2008. When a bank relies on short-term wholesale funds to support long-term illiquid assets, it becomes vulnerable to runs by its creditors. Recent empirical studies report similar results on the effect of non-deposit funding on bank risk. Demirgüç-Kunt and Huizinga (2010) find that although banks, at low levels of non-deposit funding, may have some risk diversification benefits from increasing those funds, at higher levels of wholesale funding further increases result in higher bank risk. Köhler (2015) also conclude that retail-oriented banks (savings and cooperative banks) are significantly less stable if they increase their share of non-deposit funds. Investment banks, in contrast, are more stable, supporting the disciplining effect that comes from sophisticated wholesale

financiers.[7] We find an inverse relationship between bank profitability and risk, supported by the high levels of significance for ROA in the equations. This finding proves our fourth hypothesis, in which we state that more profitable banks tend to be more stable, a statement broadly agreed upon in the literature (e.g., Köhler, 2015). Similarly, inefficiency (CIR) is shown to increase bank risk as measured by the Z-score (H5). As stated previously, cost efficiency is negatively associated with bank risk, linking 'bad' management with poor skills in credit scoring, the appraisal of pledged collateral and the monitoring of borrowers (Louzis *et al.*, 2012). This finding is in accordance with recent empirical studies such as Uhde and Heimeshoff (2009) and Delis *et al.* (2012). Income diversification is statistically insignificant in both specifications, confirming the results of, e.g., Weiß *et al.* (2014). Larger banks appear to be less risky compared with smaller banks (Hypothesis 7b), in agreement with other authors (e.g., Agoraki *et al.*, 2011; Delis and Staikouras, 2011). This finding may be explained by the better diversification of larger banks (Boyd and Prescott, 1986; Salas and Saurina, 2002; among others). Furthermore, because larger banks have better access to the capital markets, they may have more flexibility to manage unexpected liquidity shortfalls (Konishi and Yasuda, 2004). Additionally, these banks are argued to have comparative advantages in providing credit monitoring services (Uhde and Heimeshoff, 2009).

Industry concentration has an inverse relationship with bank risk, corroborating hypothesis 8a, which states that the less concentrated the banking sector, the higher the risk tends to be. It has been argued that monopolistic banks in concentrated banking systems may enhance profits, reducing financial fragility. Reduced concentration may have also a positive impact on financial system stability by improving bank supervision. This result is in line with the empirical evidence provided by Beck *et al.* (2006) and Caprio *et al.* (2014), who find that crises are less likely to occur in economies with more concentrated banking systems. Among the macroeconomic variables, GDP and inflation are highly significant in our equations, exhibiting positive and negative relationships, respectively, to risk. These findings confirm hypotheses 9 and 10 regarding the abundant support in the literature for the

[7] Calomiris and Kahn (1991) conclude that wholesale funding may reduce bank risk through a better monitoring of banks by sophisticated financiers and a better diversification of funding sources.

view that bank risk exhibits clear cyclical behavior (Marcucci and Quagliariello, 2008; Uhde and Heimeshoff, 2009). As suggested by Delis *et al.* (2012), these results are expected because in economies with high growth rates and stable monetary conditions, bank failure problems are less frequent, fewer resources are employed by banks to forecast the future levels of inflation and loan demand is stronger. We also reveal a negative relationship between bank risk and interest rates. Thus, a low-interest-rate environment increases risk-related bank assets and alters the composition of Eurozone bank portfolios toward a more risky position, as we anticipated in hypothesis 12. This finding coincides with the results reported on euro area banks over the period 2001–2008 by Delis and Kouretas (2011). The unemployment rate is found not to be significant in our model. Most of the recent literature that shows a relationship between unemployment and bank risk focuses on countries that have been strongly affected by the financial crisis, such as Italy (Bofondi and Ropele, 2011) and Greece (Louzis *et al.*, 2012).

Lastly, regarding control variables, we do not find a significant difference in risk between listed and non-listed banks, suggesting that market forces do not strongly influence the risk behavior of listed banks in a specific way. This result is in accordance with Barry *et al.* (2011). We report a negative and significant association between the capital requirement index and bank risk, a finding consistent with Barth *et al.* (2004), Kopecky and VanHoose (2006) and Agoraki *et al.* (2011), among others. The supervisory power index shows a negative association with bank risk, suggesting that more banking supervision implies less risk taking (in line with Delis and Staikouras, 2011). We also observe that financial disclosures and other incentives that improve market discipline may be an effective tool for reducing bank risk, as suggested by previous studies (e.g., Barth *et al.*, 2004; Fernández and González, 2005; Agoraki *et al.*, 2011). However, we donot find that bank activity restrictions have an impact on risk.

4.2 Robustness checks

To confirm the aforementioned findings, we conduct a number of robustness checks. First, we evaluate the method of estimation used in the analysis by using simpler statistical methodologies. Second, we consider four alternative measures of bank risk. Third, we re-estimate our equation, changing some of the variables used as regressors.

As a final robustness check, we divide the sample into a pre-crisis and relatively economically stable period and a crisis period.

4.2.1 Alternative estimation models

Similar to earlier studies on bank risk (e.g., Williams, 2004), we employ an ordinary least squares (OLS) regression to estimate our equations. The results obtained do not differ substantially from those obtained previously; most of the explanatory variables retain both their signs and their statistical significance (see Table 5). However, we find that the revenue diversification variable shows a statistically significant positive relationship with the Z-score index (meaning, therefore, that a greater diversification may reduce bank risk). This result is in line with the empirical evidence shown by Köhler (2015), who states that a larger share of non-interest income will make retail-oriented banks more stable. Additionally, the OLS regression reports a statistically significant inverse association between the NPLr and the unemployment rate. Because panel data are used, we can also re-estimate the models using either fixed or random effects. Hausman tests suggest that the fixed effects estimator is more appropriate in our case. This methodology has similarly been applied in previous studies to test bank risk determinants (e.g., Festic *et al.,* 2011). We assume that the omitted variables (e.g., corporate governance) may potentially correlate with the existing regressors. Again, our findings do not change substantially from those obtained for the baseline equations, except that larger banks now appear to be riskier compared with smaller banks, as indicated by the statistically significant negative relationship between size and the Z-score index. This result is in line with the work of Haq and Heaney (2012), which analyzes 15 European countries (10 Eurozone and 5 non-Eurozone countries) over the period 1996-2010. This may be explained by a moral hazard problem coherent with the too-big-to-fail policy, where large banks have greater incentive to take higher risks, as they know they will likely be bailed out.

Table 5. *Robustness checks (I): Alternative model specifications*

Variables	(1) Pool OLS NPLr	(2) Fixed-effects NPLr	(3) Pool OLS Z-score	(4) Fixed-effects Z-score
Loan/TA	0.012***	0.007*	-0.004	-0.009
	(0.003)	(0.004)	(0.003)	(0.007)
Eq/TA	-0.008**	-0.004	0.020***	0.070***
	(0.003)	(0.012)	(0.007)	(0.026)
NonDep/TL	0.010***	0.006*	-0.001	-0.011*
	(0.003)	(0.003)	(0.003)	(0.006)
ROA	-0.183***	-0.097***	0.311***	0.315***
	(0.031)	(0.002)	(0.058)	(0.059)
CIR	0.001	0.001*	-0.007***	-0.007*
	(0.002)	(0.001)	(0.002)	(0.004)
HHIRD	-0.004	0.003	0.006**	0.007
	(0.008)	(0.005)	(0.003)	(0.009)
Size	-0.001*	-0.104	0.025	-0.129***
	(0.001)	(0.149)	(0.031)	(0.036)
HHIIC	-0.000	-0.000*	0.002**	0.000*
	(0.000)	(0.000)	(0.001)	(0.000)
GDP	-0.007*	-0.004	0.005	0.006
	(0.004)	(0.005)	(0.018)	(0.018)
Inflation	0.041**	0.003	-0.151***	-0.125***
	(0.019)	(0.012)	(0.034)	(0.035)
UR	0.030***	0.106*	-0.002	-0.040
	(0.007)	(0.054)	(0.019)	(0.026)
Interest	-0.204***	-0.152***	0.053	0.166***
	(0.035)	(0.023)	(0.052)	(0.056)
Capital stringency index	-0.073***	-0.007	0.033	0.017
	(0.022)	(0.120)	(0.028)	(0.047)
Supervisory power index	-0.025	-0.024**	0.060*	0.069*
	(0.020)	(0.011)	(0.031)	(0.035)
Private monitoring index	-0.071*	-0.083***	0.056**	0.115*
	(0.041)	(0.029)	(0.025)	(0.069)
Activity restrictions index	0.045*	0.021	-0.006	0.029
	(0.023)	(0.022)	(0.031)	(0.082)
Listed	0.070	-0.309	-0.016	-0.033
	(0.117)	(0.324)	(0.121)	(0.412)
Constant	2.425***	-0.265	3.142***	-3.163
	(0.677)	(2.326)	(1.094)	(4.186)
R^2	0.3295	0.5359 (within)	0.2522	0.3045 (within)
Hausman	-	925.18 (17)	-	48.81 (17)
Number of obs.	1,423	1,423	1,132	1,132
Number of banks	204	204	181	181

Notes: This table presents alternative model specifications for our baseline equations. The models in columns (1) and (3) are estimated using an ordinary least squares (OLS) regression with robust standard errors clustered by bank (reported in parentheses). The models in columns (2) and (4) use fixed-effects (within) regressions, with robust standard errors clustered by bank (reported in parentheses). See Table 2 for a description of the independent variables. R^2 is the proportion of variation in the dependent variable explained by the model. Hausman is a test that compares the fixed versus random effects, asymptotically distributed as χ^2 under the null hypothesis that the individual effects are uncorrelated with the other regressors in the model, with degrees of freedom in parentheses.

4.2.2 Alternative proxies of bank risk

We now consider four alternative measures of bank risk (see Table 6). The first of these metrics, the stock of NPLs, which has also been used in recent studies (e.g., García-Herrero *et al.,* 2009), yields the expected signs and significance, which are similar to those of our original models. We also use the reserve for losses, expressed as a percentage of total loans (LLR/GL) (Barry *et al.*, 2011). This ratio indicates how much of the total loan portfolio is covered by the bank's current reserves. Given a similar charge-off policy, a higher ratio corresponds to a lower-quality loan portfolio. Again, the significance and the signs agree with the baseline models. Another metric used to proxy bank risk is the loan loss provision (as a percentage of net interest revenue) ratio (e.g., Williams, 2004). Using this metric, results similar to those for the initial models are obtained for all variables. We lastly employ the Sharpe ratio to represent bank risk. The Sharpe ratio is a risk-adjusted rate of return that is calculated as the mean ROE divided by the standard deviation of this return (Demirgüç-Kunt and Huizinga, 2010). Once again, the results obtained using the Sharpe ratio mostly agree with those for our original model except that size has a negative impact on the Sharpe ratio, in line with the results reported previously for the Z-score fixed-effects regression.

Table 6. *Robustness checks (II): Alternative proxies of bank risk*

	(1)	(2)	(3)	(4)
Variables	**NPLs**	**LLR/GL**	**LLP/NIR**	**Sharpe**
Lagged dependent	0.589***	0.820***	0.425***	0.342***
	(0.171)	(0.055)	(0.049)	(0.076)
Loan/TA	0.006**	0.003**	0.010***	-0.016*
	(0.003)	(0.001)	(0.003)	(0.008)
Eq/TA	-0.005*	-0.001	-0.007*	0.062*
	(0.004)	(0.004)	(0.004)	(0.032)
NonDep/TL	0.002	0.000*	0.006***	-0.002
	(0.004)	(0.000)	(0.002)	(0.003)
ROA	-0.117***	-0.094***	-0.201***	0.445**
	(0.039)	(0.020)	(0.047)	(0.180)
CIR	0.000	0.002***	0.000	-0.020**
	(0.002)	(0.000)	(0.001)	(0.008)
HHIRD	-0.006	-0.004	-0.003	-0.003
	(0.004)	(0.004)	(0.009)	(0.004)
Size	-0.042*	-0.014	-0.035	-0.189***
	(0.021)	(0.015)	(0.029)	(0.070)
HHIIC	-0.000*	-0.000*	-0.000*	0.001**

Variables	(1) NPLs	(2) LLR/GL	(3) LLP/NIR	(4) Sharpe
	(0.000)	(0.000)	(0.000)	(0.000)
GDP	-0.028***	-0.020***	-0.071***	0.041*
	(0.010)	(0.006)	(0.011)	(0.025)
Inflation	0.014*	-0.010	0.000*	-0.080*
	(0.007)	(0.008)	(0.000)	(0.043)
UR	0.013	0.007**	0.002	-0.035**
	(0.009)	(0.004)	(0.007)	(0.017)
Interest	-0.094**	-0.023*	-0.048*	0.167**
	(0.037)	(0.013)	(0.029)	(0.067)
Capital stringency index	-0.037**	-0.014**	-0.016*	0.067**
	(0.015)	(0.006)	(0.009)	(0.033)
Supervisory power index	-0.015*	-0.020**	-0.039***	0.047
	(0.009)	(0.008)	(0.015)	(0.035)
Private monitoring index	-0.041	-0.018	-0.020**	0.101*
	(0.044)	(0.017)	(0.009)	(0.057)
Activity restrictions index	0.026	0.159**	-0.005	-0.004
	(0.016)	(0.007)	(0.017)	(0.040)
Listed	-0.035	0.007	0.156	0.072
	(0.151)	(0.074)	(0.128)	(0.317)
Constant	-1.730**	-0.096	-0.082	4.477***
	(0.869)	(0.324)	(0.648)	(1.490)
z_1	74.83 (18, 203)	88.35 (18, 203)	41.21 (18, 197)	7.80 (18, 168)
m_1	-1.23	-3.98	-5.83	-5.42
m_2	0.97	0.48	1.79	-0.88
Hansen	188.74 (426)	192.26 (426)	179.88 (404)	146.56 (339)
Number of obs.	1,423	1,423	1,367	1,086
Number of banks	204	204	198	181

*Notes: This table presents the regressions for alternative measures of bank risk using the system-GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). The dependent variables are as follows: (column 1) stocks of non-performing loans (NPLs) (in logarithmic form), (column 2) loan loss reserve divided by gross loans (LLR/GL) (in logarithmic form), (column 3) loan loss provisions divided by net interest revenue (LLP/NIR) (in logarithmic form), and (column 4) the Sharpe ratio (in logarithmic form). See Table 2 for a description of the independent variables. Except for HHIIC, GPD, Inflation, UR, and Interest, all variables are considered endogenous in our model. We report heteroskedasticity-consistent asymptotic standard errors in parentheses, and significance levels are indicated as follows: ***= significant at the 1% level; **= significant at the 5% level; and *= significant at the 10% level. z1 is a Wald test of the joint significance of the reported coefficients, asymptotically distributed as F under the null hypothesis of no significance, with degrees of freedom in parentheses. mi is a serial correlation test of order i using residuals in first differences, asymptotically distributed as N(0,1) under the null hypothesis of no serial correlation. Hansen is a test of the over-identifying restrictions, asymptotically distributed as $\chi 2$ under the null hypothesis of no correlation between the instruments and the error term, with degrees of freedom in parentheses.*

4.2.3 Alternative explanatory variables

We also re-estimate our equations by changing some of the variables used as regressors (see Table 7). First, because size seems to be a controversial variable, we include the square of the logarithm of total assets to control for a potential non-linear relationship between size and risk. However, neither linear terms nor quadratic terms

enter the regression significantly, which suggests that our findings about size should be taken with caution. We also consider non-interest income as a percentage of total operating income (NonII/TOR) as a revenue diversification measure (De Jonghe, 2010) instead of HHIRD, although, in line with the previously reported results for the HHIRD, this variable is not found to be significant. Because liquidity has been identified as an important issue in banking during the recent European financial crisis, we replace the ratio of loans to total assets with the ratio of liquid to total assets to analyze the effect of the asset structure on bank risk.[8] As expected, the most liquid banks are also those with lower risk. This finding is in accordance with the greater importance given to liquidity standards in the recent set of reforms developed by the Basel Committee on Banking Supervision to promote a more resilient banking sector (commonly known as Basel III). We lastly remove Eq/TA and ROA from the explanatory variables in the Z-score regression, as these variables take also part in the Z-score equation. Once again, our results do not change substantially, as most of the coefficients (both signs and statistical significances) are not affected.

Table 7. *Robustness checks (III): Alternative explanatory variables*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	**NPLr**	**NPLr**	**NPLr**	**Z-score**	**Z-score**	**Z-score**	**Z-score**
Lagged dependent	0.798***	0.805***	0.802***	0.393***	0.417***	0.413***	0.477***
	(0.026)	(0.025)	(0.026)	(0.096)	(0.056)	(0.076)	(0.063)
Loan/TA	0.004***	0.004***		-0.001	-0.002		-0.001
	(0.001)	(0.001)		(0.004)	(0.005)		(0.004)
Liq/TA			-0.511***			0.048**	
			(0.162)			(0.022)	
Eq/TA	-0.003*	-0.004*	-0.002*	0.024**	0.017**	0.023*	
	(0.002)	(0.003)	(0.001)	(0.012)	(0.008)	(0.012)	
NonDep/TL	0.002*	0.002*	0.003*	-0.006**	-0.004*	-0.004*	-0.006**
	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
ROA	-0.070***	-0.068***	-0.066***	0.329***	0.355***	0.331***	
	(0.011)	(0.013)	(0.011)	(0.076)	(0.083)	(0.068)	
CIR	0.001	0.000	0.000	-0.006***	-0.007***	-0.007***	-0.011***
	(0.001)	(0.000)	(0.000)	(0.001)	(0.002)	(0.002)	(0.001)
HHIRD	-0.004		-0.004	0.005		0.001	0.003
	(0.004)		(0.004)	(0.007)		(0.005)	(0.006)

[8] Another source of potential liquidity risk (as well as interest rate risk) for a bank is the maturity mismatch between its assets and its liabilities (i.e., long-term loans are granted using short-term deposits). The loan to deposit ratio is used for this purpose (the higher the ratio, the greater the risk). Our results (not reported) corroborate the inverse relationship between liquidity and bank risk.

Variables	(1) NPLr	(2) NPLr	(3) NPLr	(4) Z-score	(5) Z-score	(6) Z-score	(7) Z-score
NonII/TOR		-0.000			0.003		
		(0.000)			(0.003)		
Size	-0.051	-0.008*	-0.006*	0.102	0.030	0.038*	0.095*
	(0.128)	(0.004)	(0.003)	(0.690)	(0.031)	(0.020)	(0.056)
$Size^2$	0.001			-0.003			
	(0.003)			(0.021)			
HHIIC	-0.000*	-0.000**	-0.000**	0.001*	0.000*	0.002*	0.000*
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
GDP	-0.038***	-0.038***	-0.040***	0.005*	0.001**	0.002***	0.007**
	(0.006)	(0.006)	(0.006)	(0.003)	(0.000)	(0.000)	(0.004)
Inflation	0.003**	0.001*	0.000	-0.126***	-0.115***	-0.116***	-0.118***
	(0.001)	(0.001)	(0.001)	(0.040)	(0.039)	(0.040)	(0.042)
UR	0.005	0.006	0.004	-0.003	-0.008	-0.004	-0.011
	(0.004)	(0.004)	(0.004)	(0.020)	(0.020)	(0.021)	(0.019)
Interest	-0.053***	-0.051***	-0.043***	0.091*	0.079*	0.085*	0.132*
	(0.015)	(0.016)	(0.015)	(0.048)	(0.041)	(0.043)	(0.069)
Capital stringency index	-0.026***	-0.026***	-0.024***	0.055*	0.055*	0.051*	0.074**
	(0.008)	(0.009)	(0.008)	(0.032)	(0.033)	(0.031)	(0.036)
Supervisory power index	-0.012**	-0.011*	-0.009*	0.066*	0.067*	0.065*	0.063*
	(0.005)	(0.006)	(0.005)	(0.036)	(0.037)	(0.036)	(0.033)
Private monitoring index	-0.011**	-0.010*	-0.015*	0.059	0.076*	0.071	0.044
	(0.005)	(0.005)	(0.008)	(0.030)	(0.039)	(0.046)	(0.049)
Activity restrictions index	-0.011	-0.011	-0.009	0.040	0.008	0.022	0.029
	(0.009)	(0.008)	(0.008)	(0.037)	(0.041)	(0.041)	(0.039)
Listed	0.057	-0.006	0.024	-0.110	-0.187	-0.120	-0.193
	(0.074)	(0.079)	(0.074)	(0.246)	(0.242)	(0.271)	(0.277)
Constant	0.443	-0.147	0.358	2.535	2.271	2.242	3.704***
	(1.060)	(0.275)	(0.287)	(5.383)	(1.466)	(1.185)	(1.289)
z1	233.73	230.79	221.37	12.91	13.38	12.12	10.30
	(19, 203)	(18, 203)	(18, 203)	(19, 180)	(18, 180)	(18, 180)	(16, 180)
m1	-3.12	-3.13	-3.15	-6.01	-5.99	-5.93	-5.74
m2	-0.58	-0.66	-0.72	-0.39	-0.34	-0.37	-0.31
Hansen	190.97	197.75	196.67	164.43	174.69	164.34	168.20
	(457)	(426)	(426)	(382)	(359)	(359)	(313)
Number of obs.	1,423	1,423	1,423	1,132	1,132	1,132	1,132
Number of banks	204	204	204	181	181	181	181

*Notes: This table presents the results for our baseline equations after changing some of the explanatory variables. The models in columns (1) and (4) include $Size^2$ (the square of ln (assets)). The models in columns (2) and (5) consider NonII/TOR (non-interest income as a percentage of total operating revenue) in place of HHIRD. The models in columns (3) and (6) consider Liq/TA (liquid to total assets ratio) in place of Loan/TA. The model in column (7) excludes Eq/TA and ROA. The rest of the variables remain the same (see Table 2). Regressions use the system-GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). Except for HHIIC, GPD, Inflation, UR, and Interest, all variables are considered endogenous in our model. We report heteroskedasticity-consistent asymptotic standard errors in parentheses, and significance levels are indicated as follows: ***= significant at the 1% level; **= significant at the 5% level; and *= significant at the 10% level. z_1 is a Wald test of the joint significance of the reported coefficients, asymptotically distributed as F under the null hypothesis of no significance, with degrees of freedom in parentheses. m_i is a serial correlation test of order i using residuals in first differences, asymptotically distributed as N(0,1) under the null hypothesis of no serial correlation. Hansen is a test of the over-identifying restrictions, asymptotically distributed as χ^2 under the null hypothesis of no correlation between the instruments and the error term, with degrees of freedom in parentheses.*

4.2.4 Pre-crisis and crisis period

As a final robustness check, we now divide the sample into two periods: a pre-crisis and relatively economically stable period (2001 to 2007) and a crisis period (2008 to 2012).[9] We use this approach to examine possible differences in our regression due to the impact of both the 2008 financial crisis and the sovereign debt crisis starting in 2010 in the European banking sector. Although the results obtained using this approach resemble those of our baseline models, we notice certain differences between the two periods (before the crisis and during the crisis) with respect to certain explanatory variables (see Table 8). We observe that during the pre-crisis period, the Eq/TA ratio loses its statistical significance, although it maintains the anticipated sign in its relationship to NPLr. This finding coincides with that reported by Haq and Heaney (2012), and it seems to indicate that a greater capitalization further reduces bank risk during the crisis period. Similarly, the NonDep/TL ratio becomes non-significant in the pre-crisis period, which means the recourse to wholesale funding seems to be associated with significantly higher risk in the banking industry only during crisis. Most of the industry and macroeconomic variables retain their signs and statistical significance. However, when the NPLr is used as the bank risk proxy, a higher unemployment rate is related to increased bank risk in the crisis period. Lastly, our control variable results suggest that a greater incentive for private sector monitoring may only reduce bank risk in periods of economic instability.

Table 8. *Robustness checks (IV): Pre-crisis and crisis period*

	Pre-crisis period (2001-2007)		**Crisis period (2008-2012)**	
Variables	**NPLr**	**Z-score**	**NPLr**	**Z-score**
Lagged dependent	0.717***	0.361***	0.770***	0.422***
	(0.050)	(0.089)	(0.057)	(0.064)
Loan/TA	0.003*	-0.003	0.006**	-0.014*
	(0.002)	(0.006)	(0.003)	(0.007)
Eq/TA	0.019	0.011*	-0.012**	0.014**
	(0.039)	(0.006)	(0.005)	(0.006)
NonDep/TL	0.002	-0.001	0.006**	-0.011*
	(0.002)	(0.007)	(0.002)	(0.006)

[9] Similar to Haq and Heaney (2012), we chose 2008 as the start of the financial and economic crisis in Europe. Our data also show a change in the trend of bank risk proxies (as well as in the macroeconomic variables) coinciding with that year.

	Pre-crisis period (2001-2007)		Crisis period (2008-2012)	
Variables	**NPLr**	**Z-score**	**NPLr**	**Z-score**
ROA	-0.135***	0.120**	-0.067***	0.334***
	(0.041)	(0.064)	(0.016)	(0.094)
CIR	0.002	-0.010***	0.000	-0.007***
	(0.002)	(0.003)	(0.001)	(0.003)
HHIRD	-0.015	0.003	-0.003	-0.020
	(0.017)	(0.015)	(0.003)	(0.036)
Size	0.029	-0.154*	-0.055*	0.057
	(0.030)	(0.088)	(0.029)	(0.085)
HHIIC	-0.000**	0.000	-0.001**	0.001*
	(0.000)	(0.000)	(0.000)	(0.001)
GDP	-0.106***	0.001*	-0.037***	0.029*
	(0.020)	(0.001)	(0.006)	(0.017)
Inflation	0.076	-0.79*	0.003*	-0.230***
	(0.051)	(0.041)	(0.002)	(0.074)
UR	0.007	-0.001	0.022**	-0.013
	(0.009)	(0.037)	(0.011)	(0.030)
Interest	-0.086*	0.026	-0.002*	0.528
	(0.044)	(0.151)	(0.001)	(0.757)
Capital stringency index	-0.019*	0.053	-0.037**	0.089*
	(0.010)	(0.058)	(0.008)	(0.048)
Supervisory power index	-0.056**	0.053*	-0.008*	0.063*
	(0.022)	(0.029)	(0.005)	(0.034)
Private monitoring index	-0.024	0.103	-0.034*	0.139*
	(0.029)	(0.105)	(0.018)	(0.072)
Activity restrictions index	-0.004	0.002	-0.049	0.096
	(0.020)	(0.071)	(0.050)	(0.078)
Listed	-0.077	0.342	0.155	-0.695
	(0.130)	(0.379)	(0.198)	(0.461)
Constant	0.752	2.438	0.827	-1.811
	(0.443)	(1.959)	(0.547)	(2.565)
z_1	131.54 (18, 111)	8.31 (18, 80)	138.09 (18, 117)	8.54 (18, 90)
m_1	-3.09	-3.00	-3.96	-3.16
m_2	-1.48	-0.48	-0.97	-0.21
Hansen	99.64 (129)	66.70 (109)	106.03 (129)	81.21 (113)
Number of obs.	560	405	590	455
Number of banks	112	81	118	91

*Notes: This table presents the results of our regressions for the pre-crisis (2001-2007) and crisis (2008-2012) periods using the system-GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). See Table 2 for a description of the independent variables. Except for HHIIC, GPD, Inflation, UR and Interest, all variables are considered endogenous in our model. We report heteroskedasticity-consistent asymptotic standard errors in parentheses, and significance levels are indicated as follows: ***= significant at the 1% level; **= significant at the 5% level; and *= significant at the 10% level. z1 is a Wald test of the joint significance of the reported coefficients, asymptotically distributed as F under the null hypothesis of no significance, with degrees of freedom in parentheses. mi is a serial correlation test of order i using residuals in first differences, asymptotically distributed as N(0,1) under the null hypothesis of no serial correlation. Hansen is a test of the over-identifying restrictions, asymptotically distributed as $\chi 2$ under the null hypothesis of no correlation between the instruments and the error term, with degrees of freedom in parentheses.*

5 Summary and conclusions

Financial institutions in Europe continue to be confronted with significant challenges, primarily related to a weak economic environment that has dampened profitability and increased credit risk. This essay empirically analyzes the factors influencing bank risk in the Eurozone from 2001 to 2012 using an unbalanced panel data set of 1,423 observations. This time span allows us to consider the impact of the recent financial and economic crisis on the Eurozone banking system. We apply the system-GMM estimator developed for dynamic panel models by Arellano and Bover (1995) and Blundell and Bond (1998), which has only recently been used in a few studies on the determinants of bank risk (e.g., Delis and Staikouras, 2011; Haq and Heaney, 2012; Louzis *et al.*, 2012). We examine both the bank-specific and macroeconomic determinants of bank risk, analyzing 12 variables that have been proven to influence bank risk: asset structure, capitalization, non-deposit funding, profitability, efficiency, revenue diversification, size, industry concentration, economic growth, inflation, unemployment and interest rates. We proxy bank risk using two complementary metrics that are intuitive and easily measured: NPLr, which focuses on credit risk, and the Z-score, which is an overall measure of bank risk that also includes liquidity and market risk.

Our results indicate that capitalization, profitability, efficiency and liquidity are inversely and significantly related to bank risk. However, the recourse to wholesale funding by banks seems to increase their risk. We also find that less concentrated markets, lower interest rates, higher inflation rates and a context of economic crisis (with a falling GDP) increase bank risk. We apply different robustness checks, first by using simpler statistical methodologies, such as OLS, and re-estimating our panel data model using fixed effects and then by considering four alternative measures of bank risk: the stock of NPLs, the reserve of losses to total loans (LLR/GL), the loan loss provision to net interest revenue and the Sharpe ratio. We also re-estimate the baseline equation using alternative regressors. The results of these tests yield signs and significance levels that are similar to those in the original model for most of the independent variables, thus proving their robustness. Nevertheless, we find that the effect of size exhibits contradictory behavior, which makes this variable a noteworthy topic for further research. As a final robustness check, we divide the sample into two

periods to examine possible differences in our regression because of the impact of both the 2008 financial crisis and the sovereign debt crisis starting in 2010 in the European banking sector. Although the results obtained using this approach resemble those of our baseline models, our results suggest that a reduced capitalization and the recourse to wholesale funding seem to be associated with significantly higher risk in the banking industry only in the crisis period. Similarly, a higher unemployment rate is related to increased bank risk in the 2008-2012 period (but only when the non-performing loan ratio is used as the bank risk proxy).

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Essay 2: Effects of Revenue Diversification on Non-Performing Loans in Europe

Abstract

This essay analyzes the effect of revenue diversification on non-performing loans of banks in 14 European countries from 1999 to 2012. Our main finding is that revenue diversification significantly reduces non-performing loans of Eurozone banks. In addition, our results show that higher proportions of commission and fee income and other operating income in total income contribute to increase asset quality. We also conclude that the relationship between revenue diversification and non-performing loans is enhanced during the financial crisis period and that regulations restricting banking activity may increase non-performing loans.

1. Introduction

During the last several decades, deregulation of the banking industry has fostered the emergence of numerous alternative sources of income for banks, including underwriting and trading securities, brokerage and investment banking, and other activities that generate non-interest income (Meslier *et al.*, 2014). Many studies, ranging from the Markowitz portfolio theory (1952) to more recent works (e.g., Köhler, 2014, 2015; Lee *et al.*, 2014), show that diversification reduces the likelihood of bank default. However, an important strand of the literature supports the argument that financial institutions should concentrate on lending activities because alternative sources of income, particularly trading, are associated with higher risks (Jensen and Meckling, 1976; Mercieca *et al.*, 2007). Moreover, the transition to a less traditional banking industry is said to have played an important role in the development of the most recent global financial crisis (Demirgüç-Kunt and Huizinga, 2010).

Given the lack of consensus regarding the effect of revenue diversification on bank risk, we examine how revenue diversification affects non-performing loan ratios (*NPLR*) of European banks. We use a Herfindahl-Hirschman index (*HHIRD*) to assess revenue diversification and separately analyze which types of operating income (commissions and fees, interest, trading and other operating income) significantly contribute to the reduction of impaired loans. Then, we test whether the diversification

effects differ among banks according to their classification (commercial banks versus saving and cooperative banks) and to their degree of specialization (bank- versus market-oriented banks).

Our sample includes a maximum of 2,265 banks in the Eurozone from 1998 to 2012. We use the general method of moments (GMM) estimator (also referred to as the system GMM estimator) developed for dynamic panel data models by Arellano and Bover (1995) and Blundell and Bond (1998). This estimator allows us to control for unobserved heterogeneity and endogeneity by means of suitable instruments.

We conduct a series of additional checks to provide robustness to our results. First, we control for the financial crisis period by including a dummy variable that equals one if the year is between 2008 and 2012 and equals zero otherwise. We also include an alternative dependent variable, the Z-score, which has been widely used in the literature to assess both risk-adjusted performance and the risk of financial distress or default (Lepetit *et al.*, 2008; Demirgüç-Kunt and Huizinga, 2010; Sanya and Wolfe, 2010; Köhler, 2014, 2015; Lee *et al.*, 2014; and Meslier *et al.*, 2014). Moreover, we test our results using different revenue diversification proxies, and finally, we provide robust results after using alternative panel data methodologies (fixed and random effects).

This essay contributes to the existing body of banking literature on revenue diversification in the following respects. First, studies about the relationship between the quality of loan portfolios and revenue diversification are relatively scarce, and those that do exist are inconclusive (e.g., Louzis *et al.*, 2012; Chaibi and Ftiti, 2015)[1]. Second, similar to Elsas *et al.* (2010), Baselga-Pascual *et al.* (2014), and Trujillo-Ponce (2013), we use an adjusted Herfindahl-Hirschman index (*HHIRD*) that considers different types of revenue to proxy for revenue diversification rather than using less specific revenue diversification measures that reflect only interest and non-interest income (e.g., Lepetit *et al.*, 2008; Demirgüç-Kunt and Huizinga, 2010; Sawada, 2013). Third, we consider the different effects of revenue diversification on *NPLR* between commercial banks and

[1] A notable exception is Lee *et al.* (2014)

savings and cooperative banks and between bank- and market-oriented institutions. Fourth, we control for possible differences in bank regulatory schemes by including four indicators (*capital stringency, official supervisory power, private monitory index and activity restrictions index*) obtained from the World Bank database on Bank Regulation and Supervision developed by Barth *et al.* (2001).

The essay is structured as follows: section 2 provides a review of the literature on the effects of revenue diversification on bank risk and performance; section 3 describes the data and variables used in this analysis; section 4 presents the empirical analysis; and finally, section 5 highlights the main conclusions of this study.

2. Literature review

In this section, we summarize the main findings in the literature regarding the effects of revenue diversification on bank performance. First, advocates of the focused view, including DeYoung and Rice (2004), Laeven and Levine (2007), Mercieca *et al.* (2007), Lepetit *et al.* (2008), and De Jonghe (2010), state that revenue diversification reduces bank performance by increasing bank risk and reducing returns because the agency problems associated with different sources of income imply costs that exceed the benefits obtained from economies of scope; therefore, the benefits of revenue diversification do not compensate for the increased risk generated by non-traditional banking activities. Using a European sample, Mercieca *et al.* (2007) find an inverse association between non-interest income and performance for small banks. Similarly, Lepetit *et al.* (2008) show that expansion into non-interest income activities, particularly into activities with increased commissions and fees, presents a higher insolvency risk for small European banks, and De Jonghe (2010) states that non-interest income generating activities increase the systemic risk of Eurozone banks. Likewise, DeYoung and Rice (2004) show that increased non-interest income is associated with poorer risk-return tradeoffs in US banks. Finally, Laeven and Levine (2007) examine an international sample of financial conglomerates and find that their respective market values reflect a diversification discount.

Second, some authors argue that revenue diversification increases both bank returns and bank risk (e.g., Stiroh and Rumble, 2006; Baele *et al.*, 2007; and Demirgüç-

Kunt and Huizinga, 2010). Stiroh and Rumble (2006) focus on financial holding companies in the US and find that the benefits of income diversification, in terms of higher returns, are offset by the increased volatility of non-interest activities. Similarly, Baele *et al.* (2007) investigate whether functionally diversified banks in Europe have a comparative advantage in terms of long-term performance/risk profile relative to their specialized counterparts; their results show that a higher percentage of non-interest income in total income positively affects banks' franchise values but also increases systematic risk. Demirgüç-Kunt and Huizinga (2010) analyze an international sample of banks and conclude that non-interest income generating activities, such as trading, increase the rate of return on assets but also reduce the distance to default.

Third, there are studies that find no significant relationship between revenue diversification and bank risk-taking (e.g., Louzis *et al.*, 2012; Sawada, 2013; and Chaibi and Ftiti, 2015). Louzis *et al.* (2012) focus on the Greek banking sector and study the determinants of NPL separately for each loan category (i.e., consumer, business and mortgage). Their "diversification hypothesis" posits a negative sign between the share of non-interest income in total income (NIIr) and NPLR, but they do not find any statistically significant relationship between them. Similarly, Chaibi and Ftiti (2015) compare the determinants of non-performing loans held by commercial banks in a market-based economy (France) and in a bank-based economy (Germany) and find no statistically significant relationship between non-interest income (as a proxy for revenue diversification) and NPLR in either economy. Sawada (2013) tests whether revenue diversification increases Japanese banks' profitability and, consequently, their market valuations but finds no evidence that revenue diversification reduces systematic, idiosyncratic or total bank risk.

Finally, authors including Chiorazzo *et al.* (2008), Elsas *et al.* (2010), Sanya and Wolfe (2010), Köler (2014, 2015), Lee *et al.* (2014) and Meslier *et al.* (2014), among others, support a positive correlation between revenue diversification and performance and argue that the benefits of diversification exceed both the costs of increased complexity and the associated agency costs of diversification. Chiorazzo *et al.* (2008) find that non-interest income increases risk-adjusted returns and that this relation is enhanced for large Italian banks; however, they also find limits on the benefits of diversification as banks grow larger. Similarly, Köhler (2015) shows that an increase in

non-interest income improves European banks' risk-adjusted returns; the benefits are greatest for savings and cooperative banks, whereas investment banks experience increased risk. Köhler (2014) finds similar results using a German sample. Elsas *et al.* (2010) consider a sample of large banks from Australia, Canada, Europe and the US and show that diversification increases bank profitability and, consequently, bank market valuation. Sanya and Wolfe (2010) and Meslier *et al.* (2014) focus on banks in emerging economies and provide empirical evidence that an observed shift toward non-interest income generating activities has a positive effect on bank performance and decreases the risk of insolvency. Lee *et al.* (2014) study the effect of revenue diversification on bank risk and performance in Asia-Pacific countries, as well as the interaction between revenue diversification and regulation policies; their results also confirm the portfolio diversification effect.

Appendix 1 provides a summary of the main findings on revenue diversification in the banking literature.

Although the subject of revenue diversification has been widely studied in the banking literature, whether revenue diversification should be encouraged or banned by regulators remains unclear. The lack of consensus and the potential impact of these policies on the real economy make it necessary to examine the effects of bank diversification more deeply.

3. Data

3.1. Sample

Our essay studies the effect of revenue diversification on non-performing loan ratios using unbalanced panel data covering a maximum of 2,132 individual banks from 14 Eurozone countries (for a maximum of 32,028 observations) over the period 1999 to 2012. We focus on countries that belong to the EU and have adopted the euro as their common currency (i.e., the Eurozone) during the sample period. Cyprus, Estonia and Malta are excluded from our sample because these countries were only recently incorporated into the euro area and the methodology used, the system GMM estimator (which is explained further in section 4.3), requires data for at least five consecutive years to test for the absence of second-order serial correlation. As is common in the

literature, we include credit cooperatives, commercial banks, and savings banks in our sample.

Indicators are calculated on a non-consolidated basis, meaning that banking subsidiaries and foreign branches are considered separate credit institutions. This reduces the possibility of introducing aggregation bias into the results (Delis and Staikouras, 2011). Merged banks are considered separate entities prior to the merger and a single entity subsequent to the merger. All ratios that capture bank-specific characteristics are calculated based on the standardized global accounting format. Entities that present abnormal ratios or extreme values were eliminated from the sample as outliers. In contrast to other studies that examine only listed banks (e.g., Baele *et al.*, 2007; Laeven and Levine, 2007; Elsas *et al.*, 2010), only 5% of the banks in our sample are publically listed. This sample composition yields a more representative picture of the EU banking sector because unlisted banks account for the majority of European banks (Köhler, 2015).

Table 1 shows observations per country and bank type.

Table 1: *Observations per country and bank type*

Country	Commercial	Cooperatives	Savings	*Total*	*Percent*
Austria	1,162	1,845	1,542	4,549	14.20
Belgium	534	75	60	669	2.09
Germany	1,871	7,147	0	9,018	28.16
Spain	944	957	277	2,178	6.80
Finland	130	29	25	184	0.57
France	2,056	1,231	399	3,686	11.51
Greece	174	15	0	189	0.59
Ireland	203	0	0	203	0.63
Italy	1,602	6,344	555	8,501	26.54
Luxemburg	1,230	32	28	1,290	4.03
Netherlands	537	14	16	567	1.77
Portugal	381	31	60	472	1.47
Slovenia	240	28	31	299	0.93
Slovakia	191	0	32	223	0.70
Total	11,255	17,748	3,025	32,028	100.00
Percent	35.14	55.41	9.44	100	

3.2. Variables definition

5.1.1 Non performing Loan ratio

We use the non-performing loan ratio expressed in natural logarithm (*NPLR*) as our main dependent variable. *NPLR* is defined as the proportion of non-performing loans to gross loans; higher (lower) values of *NPLR* represent lower (higher) quality loan portfolios.

NPLR is commonly used in the literature as a proxy of bank asset quality, soundness and credit risk (e.g., Louzis *et al.*, 2012; Baselga-Pascual *et al.*, 2014; Chaibi and Ftiti, 2015). Moreover, Poghosyan and Čihak (2011) consider asset quality in addition to bank capitalization when designing pan-European benchmarks for sound banking conduct because they believe that bank earnings and asset quality have a greater impact on bank distress than capitalization does.

5.1.2 Revenue diversification

We proxy revenue diversification with a Herfindahl–Hirschman index (*HHIRD*) that reflects the balance of different types of income, including net interest, net commissions, trading, and other operating income. We follow Elsas *et al.* (2010), Baselga-Pascual *et al.* (2014), and Lee *et al.* (2014) and calculate *HHIRD* as follows:

$$HHIRD = 1 - \left[\left(\frac{INT}{TOR}\right)^2 + \left(\frac{COM}{TOR}\right)^2 + \left(\frac{TRAD}{TOR}\right)^2 + \left(\frac{OTH}{TOR}\right)^2\right] \qquad [1]$$

where *INT* denotes gross interest income; *COM* denotes gross commission and fee revenue; *TRAD* denotes trading revenue; *OTH* denotes all other gross operating income; and *TOR* denotes total operating revenue and is equal to the sum of the absolute values of *INT, COM, TRAD* and *OTH*. HHIRD can take values between 0 (no revenue diversification) and 0.75 (indicating a bank that generates a fully balanced revenue mix from all four business areas).

To identify whether each source of income has a significant effect on the *NPLR* of European banks and to increase the robustness of the results, we use the share of each revenue source in total revenue as an alternative proxy for diversification:

$$COMr = \left(\frac{COM}{TOR}\right) \quad [2]$$

$$TRADr = \left(\frac{TRAD}{TOR}\right) \quad [3]$$

$$OTHr = \left(\frac{OTH}{TOR}\right) \quad [4]$$

$$INTr = \left(\frac{INT}{TOR}\right) \quad [5]$$

These four diversification proxies are commonly used in the literature. Higher revenue diversification is represented by a higher share of non-interest income generated by a wide range of non-traditional businesses (e.g., underwriting, securitizing, distributing insurance policies, etc.) that have low correlations with conventional sources of interest income (Baele *et al.*, 2007; Laeven and Levine, 2007; Lepetit *et al.*, 2008; Sanya and Wolfe, 2010; and Köhler, 2014). Therefore, we expect higher (lower) diversification for higher (lower) values of *COMr*, *TRADr* and *OTHr*. The opposite relationship is expected for *INTr*.

5.1.3 Control variables

We control for several bank-specific variables that influence *NPLR,* as is common in the literature (e.g., Louzis *et al.*, 2012; Baselga-Pascual *et al.*, 2014; Köhler, 2015; Chaibi and Ftiti, 2015). Asset structure is measured as the proportion of loans in total assets (*LoanTA*); bank size is measured as the natural logarithm of total assets (*Size*) and alternatively as a dummy variable that equals 1 if the bank is in the first tertile of total assets (*Large)*; growth is measured as the annual growth of total assets; capitalization is proxied by the ratio of equity to total assets (*EqTA*); profitability is proxied by return on assets (*ROA*); and inefficiency is proxied by the cost-to-income ratio (*CIR*) that captures the overhead or running costs (the largest proportion of which is usually salaries) as a percentage of income generated before provisions. Finally, like previous studies (Baselga-Pascual *et al.*, 2014; Lee *et al.*, 2014; Köhler *et al.*, 2014), we control for (i) the public status of the bank (*Listed*); (ii) bank type, using a dummy variable that equals 1 for commercial banks and equals 0 for savings banks and credit cooperatives (*Commercial*); and (iii) degree of specialization, using a dummy variable that equals 1 for institutions that are among the median share in terms of non-interest income over total income (*Market*).

Following previous studies of *NPLR* determinants (e.g., Festic *et al.*, 2011; Louzis *et al.*, 2012; Baselga-Pascual *et al.*, 2014), we also control for industry concentration and for various macroeconomic variables. Industry concentration is measured by a Herfindahl–Hirschman index (*HHIIC*) that is calculated as the sum of the squares of the market shares (based on total assets) of all credit institutions within a country (in percentage form). The HHIIC is more accurate than an index calculated using the asset share of three or the five largest banks is because the HHIIC reflects the entry of new and smaller banks into the market as well as the impact of a single bank with a very large market share. A value higher than 1,800 indicates that the market is highly concentrated, whereas a value less than 1,000 indicates an unconcentrated market. The *HHIIC* data for the euro area countries are obtained from the Banking Structural Financial Indicators database of the European Central Bank (ECB). We use the annual growth rate of the real gross domestic product of the country in which the bank is located (*GDPG)* to explore the association between economic growth and non-performing loans. We measure the effect of inflation (*Inflation*) using the annual average rate of change in the consumer price index (*CPI*). Unemployment (*UR*) is proxied by the annual average unemployment rate obtained from Eurostat, which represents the percentage of unemployed persons (aged 15 to 74) in the country's labor force. We also use the interest rate of the main refinancing operations (MRO) of the ECB, which provides the bulk of the liquidity of the European banking system, as a proxy for interest rates (*Interest*).

Finally, because differences may continue to exist between the regulatory and supervisory environments in each Eurozone country, we use four indices from the World Bank database on Bank Regulation and Supervision developed by Barth *et al.* (2001) to control for regulation in our equation specification (Baselga-Pascual *et al.*, 2014). Capital stringency (*Capregind*) measures the extent of regulatory oversight of bank capital, which assesses and verifies the degree of capital risk in a bank; official supervisory power (*Suppowind*) reflects the degree to which the country's bank supervisory agency has the authority to take specific actions (e.g., to force a bank to change its internal organizational structure); the private monitory index (*Privmonind*) shows the degree to which banks are forced to publicly disclose accurate information and whether there are incentives to increase market discipline; and activity restrictions

(*Actrestind*) measures the degree to which regulations restrict banks' activities in securities markets, insurance, and real estate and/or restrict banks' ownership shares in nonfinancial firms, with higher values indicating greater restrictions (Demirgüç-Kunt and Huizinga, 2010). We use the first lag of these indices because regulatory initiatives are unlikely to immediately affect *NPLR* (Agoraki *et al.*, 2011; Delis and Staikouras, 2011).

Table 2 contains detailed information about the variables used.

Table 2: Description of variables

Classification	Variable	Description	Source
Dependent variable	NPLr	Ratio of non-performing loans to total loans in natural logarithm.	Bankscope
	Z-score	(ROA+EqTA)/standard deviation of ROA. (ROA = pretax ROA)	
Revenue diversification	HHIRD	$1-(INTr^2+COMr^2+TRADr^2+OTHr^2)$	Bankscope
	COMr	Net commissions and fees/ total operating income	
	TRADr	Net trading/ total operating income	
	OTHr	All other net revenue/ total operating income	
	INTr	Net interests/ total operating income. Also known as the inverse of non-interest income over total income (NIIr)	
	HHIREV	$(NON/TOR)^2+(INT/TOR)^2$. Where NON = non-interest income; TOR = Total operating income; INT = net interest income.	
	RDLL	1-ABS ((INT-NON)/TOR)	
	HHINON	$(COM/NON)^2+(TRAD/NON)^2+(OTH/NON)^2$	
	Diversified	Dummy equal to 1 if HHIRD > median	
Bank specific controls	LoanTA	Loans/ Total assets	Bankscope
	Size	Natural logarithm of total assets	
	GTA	Growth rate of total assets	
	EqTA	Equity/ Total assets	
	ROA	Return on assets	
	CIR	Cost /Income	
	Listed	Dummy variable equal to 1 if the bank is publically traded.	
	Market	Dummy variable equal to 1 if the bank is market oriented (Lee *et al.*, 2014)	
	Large	Dummy variable equal to 1 if the bank is among the 33% largest banks (in terms of total assets)	
	Commercial	Dummy variable equal to 1 if the bank is classified as Commercial bank.	
Macroeconomic controls	HHIIC	Herfindahl-Hirschman Index of industry concentration.	ECB
	Interest	Interest rate on the MRO of the ECB	Eurostat
	GDPG	Annual real GDP Growth Rate	
	Inflation	Annual Average Rate Change in CPI	
	UR	Unemployment rate	
Crisis period	Crisis	Dummy variable equal to 1 if year >2007	
Regulation controls	Capregind	Capital stringency index	Barth *et al.* (2001) and
	Suppowind	Official supervisory power index	

Classification	Variable	Description	Source
	Privmonind	Private monitory index	updates.
	Actrestind	Activity restrictions index	

4. Empirical analysis

4.1. Descriptive statistics

Table 3 shows the descriptive statistics (means and standard deviations) for the main variables in our study. Most macroeconomic and bank-specific variables are affected by the financial crisis. This is the case for *NPLR* and *ROA*, each of which shows a drastic decreasing trend since 2008. *GTA* and *GDPG* reach their lowest levels in 2009, whereas *UR* starts to increase in 2008 and maintains that trend until the end of the sample period. Similarly, *Interest* decreases significantly after 2008 as a result of European Central Bank policies aimed at stimulating the Eurozone economy. However, other variables, such as *HHIIC* and *HHIRD*, are less vulnerable to the financial crisis and exhibit changes that are most likely related to the deregulation trend in the financial sector during the last several decades. Revenue diversification increases slightly more than 10% during the sample period, with *COMr* exhibiting the largest growth (30%); the share of interest income in total income decreases by 20%, and *OTHr* increases by the same percentage. The only account that suffers a crisis effect is *TRADr*, which experienced negative values in 2008.

Table 3: *Descriptive statistics*

			Bank specific controls			
Year	**NPLR**	**Size**	**GTA**	**EqTA**	**ROA**	**CIR**
1999	9.95	13.12	11.24	7.39	0.47	68.92
	(12.76)	(1.19)	(28.08)	(9.22)	(1.12)	(23.17)
2000	5.26	13.15	9.70	7.71	0.45	71.99
	(2.54)	(1.24)	(29.37)	(9.61)	(0.93)	(33.76)
2001	6.03	13.20	10.75	8.01	0.35	73.41
	(4.08)	(1.31)	(28.80)	(10.08)	(1.36)	(30.61)
2002	6.71	13.24	7.78	8.43	0.31	73.37
	(4.90)	(1.31)	(35.55)	(10.79)	(2.92)	(45.02)
2003	8.72	13.25	6.10	8.56	0.43	71.37
	(6.81)	(1.31)	(28.07)	(10.21)	(1.91)	(29.85)
2004	7.84	13.49	6.54	8.56	0.44	69.47
	(5.00)	(1.59)	(21.49)	(9.45)	(2.15)	(26.23)
2005	3.97	13.40	10.75	10.00	0.73	68.49

			Bank specific controls			
Year	**NPLR**	**Size**	**GTA**	**EqTA**	**ROA**	**CIR**
	(3.36)	(1.77)	(29.65)	(9.58)	(1.30)	(19.02)
2006	3.67	13.48	10.03	10.56	0.79	64.76
	(3.01)	(1.84)	(19.22)	(11.35)	(1.60)	(21.20)
2007	5.61	13.59	12.05	10.42	0.83	65.78
	(4.43)	(1.88)	(34.70)	(10.86)	(2.38)	(24.69)
2008	5.27	13.63	10.80	10.30	0.50	68.00
	(4.21)	(1.86)	(25.12)	(11.44)	(1.46)	(23.23)
2009	5.81	13.72	6.14	10.27	0.35	68.89
	(4.42)	(1.88)	(25.39)	(10.84)	(1.93)	(29.68)
2010	6.87	13.78	5.29	10.30	0.29	69.79
	(4.95)	(1.92)	(23.99)	(10.70)	(3.00)	(31.28)
2011	7.59	13.82	6.39	10.47	0.24	69.79
	(5.56)	(1.89)	(38.06)	(11.60)	(1.54)	(33.68)
2012	8.48	14.11	7.06	9.36	0.22	67.18
	(7.57)	(1.88)	(25.33)	(7.87)	(1.34)	(22.75)
Total	8.67	13.55	8.51	9.58	0.47	68.87
	(6.98)	(1.74)	(28.41)	(10.47)	(1.90)	(27.88)

Table 3: *(Continued)*

	Industry concentration and macroeconomic controls				
Year	**HHIIC**	**GDPG**	**Inflation**	**UR**	**Interest**
1999	377.58	2.81	1.21	8.89	3.00
	(343.03)	(1.75)	(1.12)	(3.10)	(0.00)
2000	401.50	3.85	2.36	8.06	4.75
	(362.40)	(1.27)	(1.24)	(2.82)	(0.00)
2001	435.45	1.83	2.62	7.55	3.25
	(378.21)	(0.79)	(0.97)	(2.56)	(0.00)
2002	446.07	1.00	2.13	7.83	2.75
	(394.84)	(1.21)	(0.81)	(2.37)	(0.00)
2003	447.25	0.54	2.01	8.23	2.00
	(416.90)	(1.22)	(1.00)	(2.31)	(0.00)
2004	446.58	2.13	2.11	8.48	2.00
	(424.87)	(0.96)	(0.62)	(2.23)	(0.00)
2005	462.06	1.69	2.03	8.53	2.25
	(439.97)	(1.34)	(0.52)	(2.30)	(0.00)
2006	448.46	3.26	1.95	7.84	3.50
	(427.53)	(1.06)	(0.63)	(2.09)	(0.00)
2007	475.14	3.04	2.13	6.95	4.00
	(418.25)	(1.33)	(0.52)	(1.71)	(0.00)
2008	465.76	0.31	3.19	6.83	2.50
	(437.83)	(1.21)	(0.69)	(1.82)	(0.00)
2009	450.47	-4.73	0.38	8.13	1.00

	Industry concentration and macroeconomic controls				
Year	**HHIIC**	**GDPG**	**Inflation**	**UR**	**Interest**
	(409.83)	(1.16)	(0.52)	(3.01)	(0.00)
2010	506.39	2.29	1.51	8.29	1.00
	(396.58)	(1.38)	(0.46)	(3.64)	(0.00)
2011	514.16	1.85	2.64	8.04	1.00
	(385.62)	(1.54)	(0.55)	(4.18)	(0.00)
2012	496.97	-0.60	2.46	8.93	0.75
	(350.59)	(1.54)	(0.46)	(5.16)	(0.00)
Total	451.46	1.47	2.01	8.24	2.26
	(396.96)	(2.40)	(1.02)	(3.30)	(1.26)

Table 3: *(Continued)*

	Revenue diversification proxies				
Year	**HHIRD**	**INTR**	**TRADR**	**COMR**	**OTHR**
1999	52.51	57.73	0.99	17.86	23.98
	(10.74)	(25.20)	(3.67)	(12.55)	(15.54)
2000	53.86	57.23	0.82	18.51	23.95
	(9.59)	(23.03)	(4.31)	(11.60)	(14.43)
2001	51.40	54.70	0.62	18.82	26.55
	(10.65)	(95.15)	(5.17)	(28.55)	(87.84)
2002	50.57	61.44	0.41	16.34	22.28
	(10.36)	(66.20)	(3.69)	(27.66)	(62.43)
2003	52.59	58.35	1.44	17.42	23.72
	(11.02)	(58.76)	(6.00)	(30.68)	(29.58)
2004	54.20	55.14	1.20	19.28	25.06
	(10.62)	(51.45)	(4.62)	(26.39)	(26.10)
2005	54.37	55.87	0.96	18.05	25.55
	(10.18)	(34.41)	(3.80)	(17.56)	(18.27)
2006	55.55	52.61	1.14	18.80	28.06
	(9.63)	(83.86)	(4.24)	(42.68)	(42.19)
2007	53.40	57.42	1.20	17.72	24.40
	(11.23)	(45.08)	(9.50)	(21.82)	(24.15)
2008	50.30	62.88	-0.02	17.02	20.61
	(13.19)	(91.32)	(4.85)	(43.67)	(54.39)
2009	55.08	52.89	1.63	19.69	26.33
	(9.29)	(84.02)	(4.99)	(45.63)	(46.99)
2010	54.25	55.13	0.18	19.83	25.12
	(10.44)	(29.85)	(4.35)	(14.68)	(17.25)
2011	54.00	54.92	0.35	20.52	24.65
	(10.33)	(47.22)	(4.74)	(21.40)	(28.58)
2012	56.27	52.96	1.35	19.96	26.03

	Revenue diversification proxies				
Year	**HHIRD**	**INTR**	**TRADR**	**COMR**	**OTHR**
	(9.25)	(60.22)	(4.99)	(26.96)	(36.91)
Total	53.63	56.33	0.86	18.58	24.74
	(10.68)	(62.07)	(5.23)	(29.79)	(38.95)

Notes: This table reports the means and standard deviations (in parentheses) for the entire sample for each year. The sample comprises a maximum of 2000 banks (32,028 observations). NPLR and Size are in Logarithm form. See table 2 for a description of the variables.

In the following sections, we implement several statistical techniques to deeply analyze and provide robust results for the effect of revenue diversification on the quality of loan portfolios held by European banks.

4.2. Univariate tests

First, we implement univariate tests to examine whether market-oriented banks, defined as institutions with higher shares of non-interest generating income (Lee *et al.*, 2014), are also better diversified and exhibit lower *NPLRs*. To that end, we divide our sample into two subsamples based on the ratio of non-interest income to total operating income; the "Market" subsample comprises banks that generate more non-interest income than the median level, whereas the "Bank" subsample includes banks that generate less non-interest income than the median level[2]. We then perform two-tailed *t*-tests under the null hypothesis that there are no differences in the means and medians between market- and bank-based financial institutions. Table 4 shows that market-oriented banks are more revenue diversified in terms of the balance between the four main sources of income (interest, commissions and fees, trading, and other operating income) as proxied by *HHIRD*. Not surprisingly, market-based banks show significant positive differences in the means of the proportions of commissions, trading, and other operating income in total income and a negative difference in the mean of the proportion of net interest income in total operating income; these results indicate that market-oriented banks are more diversified than bank-oriented banks. Finally, market-oriented institutions also show significant positive differences in the means of *NPLR*, which indicates that market-oriented banks have better quality assets.

[2] We also divide the sample into tertiles and compare the first and last tertiles, which yields similar results in terms of both signs and significance.

Table 4: *Univariate tests. Market vs. bank oriented banks*

	Observations	Market	Bank	Dif. in means (market - bank)
HHIRD	13,594	61.03	47.03	13.99***
COMR	20,420	24.89	24.89	0.00***
TRADR	13,621	1.85	-0.04	1.89***
OTHR	20,594	34.37	15.05	19.32***
INTR	20,642	39.65	73.04	-33.39***
NPLR	5,638	1.41	1.79	-0.38***

*Notes: This table reports the results of two-tailed t-tests under the null hypothesis that there is no difference in the means between market based and bank based financial institutions. Market and bank subsamples consist of financial institutions with below and above median non-interest income over total operating income, respectively. See table 2 for a description of the variables. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.*

We also conduct univariate tests to examine possible significant differences between large and small banks. In this exercise, we split our sample into two subsamples based on the amount of total assets; the "Large" subsample comprises banks with total assets greater than the median, whereas the "Small" subsample includes banks with total assets below the median. We again perform two-tailed *t*-tests under the null hypothesis that there are no differences in the means and medians between large and small banks. According to our results, large banks are better diversified and have lower *NPLRs*.

Table 5: *Univariate tests. Large vs. small banks*

	Observations	Large	Small	Dif. in means (large-small)
HHIRD	13,594	55.32	51.80	3.52***
COMR	20,420	19.56	17.63	1.92***
TRADR	13,621	1.04	0.64	0.41***
OTHR	20,594	25.69	23.77	1.92***
INTR	20,642	54.18	58.51	-4.33***
NPLR	5,642	1.38	1.92	-0.55***

*Notes: This table reports the results of two-tailed t-tests under the null hypothesis that there is no difference in the means between the largest and the smallest banks. Large and small subsamples consist of financial institutions with below and above median total assets, respectively. See table 2 for a description of the variables. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.*

Tables 4 and 5 show highly significant differences between the means of market- and bank-oriented banks and between the means of large and small banks, indicating that large and market-oriented banks are more diversified and have a better-quality asset portfolios.

4.3. Multivariate analysis

In this section, we conduct a series of multivariate analyses employing the GMM estimator (also referred to as the system GMM estimator) developed for dynamic panel data models by Arellano and Bover (1995) and Blundell and Bond (1998). The GMM estimator allows us to control for unobserved heterogeneity and endogeneity by means of suitable instruments. As proposed by Windmeijer (2005), we employ the two-step estimation procedure with finite sample corrected standard errors, which produces less biased coefficient estimates and more accurate standard errors. We require at least five consecutive years during the sample period for each analyzed variable to test for the absence of second-order serial correlation.

Our baseline equation is as follows:

$$Y_{itj} = \alpha =+ =_1 Y_{itj-1} + \beta_2 (Diversification\ index)_{j,t} + \beta_3 (Bank\text{-}specific\ controls)_{i,j,t} + \beta_4 (Macroeconomic\ controls)_{j,t} + ,_5 (Regulation\ controls)_{j,t-1} + \varepsilon_{i,j,t} \quad [6]$$

where Y denotes the natural logarithm of the non-performing loans (*NPLR*) of bank i in country j at year t; $Y_{i,j,t-1}$ represents its lagged value; β_1 measures the speed of mean reversion (a value of β_1 that is not significantly different from 0 implies that *NPLR* is characterized by a high speed of adjustment, whereas a value that is not significantly different from 1 means that adjustment is very slow); *Diversification index* represents 5 different proxies of diversification; *Bank-specific controls* denotes the bank-specific variables considered in our study, and *Macroeconomic controls* denotes the industry-specific and macroeconomic variables used; *Regulation controls* refers to several bank regulation and supervision control variables; and β denotes vectors of coefficient estimates. Finally, $\varepsilon_{i,j,t}$ is the disturbance term that contains the unobserved bank-specific effect and the idiosyncratic error.

Bank-specific controls and diversification variables are considered endogenous in our equation specification to prevent possible unobserved heterogeneity and reverse causality (Demirgüç.-Kunt and Huizinga, 2010, Baselga-Pascual *et al.*, 2013; Köhler, 2015). To that end, we employ lagged first differences of the bank-specific explanatory variables as instruments for the equation in levels and use the lagged values of the

explanatory variables in levels as instruments for the equation in differences (in line with Arellano and Bover, 1995, and Blundell and Bond, 1998). Regulatory controls are also treated as endogenous variables in our regression because we assume that banks and regulators choose their respective strategies when they observe economic conditions at the beginning of the period (Delis and Staikouras, 2011; Baselga-Pascual *et al.*, 2014). Finally, industry concentration and macroeconomic variables are treated as strictly exogenous. We verify that the instruments are statistically valid using the Hansen J-test of overidentifying restrictions.

5.1.4 The effect of revenue diversification on NPLR in Europeans banks

The first panel (table 6) shows the effect of revenue diversification on bank *NPLR* after controlling for bank-specific characteristics, macroeconomic conditions and regulatory restrictions. Models 1 to 5 show the effects of alternative revenue diversification proxies and of bank-specific characteristics, macroeconomic conditions and regulatory controls on *NPLR* in European banks. In model 6, the variable *Size* is substituted for *Large*, which is a dummy variable that equals one for banks in the first tertile of total assets. Model 7 includes the dummy variable *Market,* which equals 1 for market-based institutions (i.e., institutions with shares of non-interest income in net income that are above the median level) (Lee *et al.*, 2014).

Table 6: *The effect of revenue diversification on NPLR in European banks*

	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**
Revenue diversification					
HHIRD	-0.00***				
	(0.00)				
COMr		-0.01**			
		(0.00)			
TRADr			-0.00		
			(0.00)		
OTHr				-0.00***	
				(0.00)	
INTr					0.00***
					(0.00)
Control variables					
NPLR_1	0.79***	0.79***	0.78***	0.79***	0.79***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)

	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)	
loanTA	0.00	***	0.00	**	0.00	**	0.00	**	0.00	**
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Size	-0.01		-0.01		-0.00		-0.00		-0.00	
	(0.02)		(0.02)		(0.02)		(0.01)		(0.02)	
Large										
GTA	-0.00		-0.00		-0.00		-0.00		-0.00	
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
EqTA	-0.00		-0.00		-0.00		-0.00		-0.01	
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	
ROA	-0.12	***	-0.12	***	-0.11	***	-0.12	***	-0.11	***
	(0.02)		(0.02)		(0.02)		(0.02)		(0.02)	
CIR	-0.00	**	-0.00		-0.00	**	-0.00	**	-0.00	**
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Listed	0.04		0.05		0.07				0.00	
	(0.08)		(0.09)		(0.08)		(0.08)		(0.09)	
Actrestind	0.03	***	0.03	***	0.04	***	0.03	***	0.03	***
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	
Capregind	-0.04	***	-0.03	***	-0.05	***	-0.04	***	-0.03	***
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	
Suppowind	0.03	***	0.03	***	0.04	***	0.04	***	0.03	***
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	
Privmonind	-0.00		-0.01		0.04	**	-0.00		-0.01	
	(0.01)		(0.01)		(0.02)		(0.01)		(0.01)	
HHIIC	-0.00	***	-0.00	***	-0.00	***	-0.00	**	-0.00	
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
GDPG	-0.01	***	-0.01	***	-0.01	***	-0.01	***	-0.01	***
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Inflation	-0.01		-0.00		-0.00		-0.01		-0.01	
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	
UR	0.01	***	0.01	***	0.02	***	0.01	***	0.01	***
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Interest	-0.04	***	-0.04	***	-0.05	***	-0.04	***	-0.04	***
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	
Market										
Constant	0.57	*	0.34		-0.15		0.28		0.02	
	(0.35)		(0.39)		(0.36)		(0.33)		(0.33)	
Observations	4,268		4,259		3,854		4,268		4,268	
AR2	-1.80		-1.73		-1.59		-1.72		-1.73	
Hansen	520.16 (461)		525.75 (461)		482.35 (378)		507.43 (461)		509.76 (461)	

Table 6: *(Continued)*

	Model (6)		Model (7)	
Revenue diversification				
HHIRD	-0.00	**	-0.00	***
	(0.00)		(0.00)	
COMr				
TRADr				
OTHr				
INTr				
Control variables				
NPLR_1	0.78	***	0.79	***
	(0.02)		(0.02)	
loanTA	0.00	***	0.00	***
	(0.00)		(0.00)	
Size			-0.01	
			(0.01)	
Large	-0.01			
	(0.04)			
GTA	0.00		-0.00	
	(0.00)		(0.00)	
EqTA	-0.00		-0.01	
	(0.00)		(0.01)	
ROA	-0.12	***	-0.12	***
CIR	(0.02)		(0.02)	
	-0.00	**	-0.00	**
Listed	(0.00)		(0.00)	
	0.04		0.06	
Actrestind	(0.07)		(0.08)	
	0.03	***	0.03	***
Capregind	(0.01)		(0.01)	
	-0.04	***	-0.04	***
Suppowind	(0.01)		(0.01)	
	0.03	***	0.03	***
Privmonind	(0.00)		(0.01)	
	-0.01		-0.00	
HHIIC	(0.01)		(0.01)	
	-0.00	***	-0.00	***
GDPG	(0.00)		(0.00)	
	-0.01	***	-0.01	***
Inflation	(0.00)		(0.00)	
	-0.01	*	-0.01	

	Model (6)		Model (7)	
UR	(0.01)		(0.01)	
	0.01	***	0.01	***
Interest	(0.00)		(0.00)	
	-0.05	***	-0.04	***
Market	(0.01)		(0.01)	
			-0.02	
Constant			(0.02)	
	0.37	*	0.58	*
	(0.21)		(0.33)	
Observations	4,268		4,259	
AR2	-1.81		-1.78	
Hansen	514.04 (460)		526.1 (496)	

*Notes: This table presents the effects of revenue diversification on NPLr in the Eurozone during the period 1999–2012 using the system-GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). See Table 2 for a description of the independent variables. NPLR_1 indicates the lagged period of the dependent variable. Except for HHIIC, GPD, Inflation, UR and Interest, all variables are considered endogenous in our model. We report heteroskedasticity-consistent asymptotic standard errors in parentheses, and significance levels are indicated as follows: ***= significant at the 1% level; **= significant at the 5% level; and *= significant at the 10% level. AR2 denotes the Arellano and Bond test for the second order autocorrelation in first differences. Hansen is a test of the over-identifying restrictions, asymptotically distributed as* $\chi 2$ *under the null hypothesis of no correlation between the instruments and the error term, with degrees of freedom in parentheses.*

The panel presents a highly statistically significant negative relationship between *HHIRD* and *NPLR*. It also shows that increasing the shares of commission and fee income and other operating income in total income would enhance the quality of assets held by European banks.

Regarding bank-specific controls, we find that a larger share of loans in assets significantly increases *NPLR,* whereas greater profitability significantly reduces *NPLR*. Unexpectedly, less efficient banks seem to have lower *NPLRs*. Regarding macroeconomic controls, it is not surprising to observe that greater sector concentration, higher GDP growth and higher interest rates significantly reduce bank *NPLR,* whereas higher unemployment ratios significantly increase bank *NPLR*. Interestingly, only *capital stringency* significantly reduces bank *NPLR*, whereas the *activity restriction* and *official supervisory power* indices show a significant positive effect in most models and the *private monitoring* index does not significantly affect *NPLR*. These results have important implications for regulators and policy makers because restrictions on banking activities limit the diversification effect on non-performing loan ratios of European banks and therefore increase bank risk exposure.

However, although our univariate tests show significant differences between large and small banks, neither the *Size* nor the *Large* variable exerts statistical effects on

NPLR. Similarly, after controlling for *Market* institutions, the results remain unchanged, indicating that this dummy variable is statistically insignificant. Moreover, following Lee *et al.* (2014), we classify countries in which more than half of banks are market-based institutions (Austria, Belgium, Finland, France, Luxemburg, Netherlands, Portugal, Slovenia and Slovakia) as *Market based systems;* the effect of this classification on our model's results is insignificant[3].

Finally, we control for commercial banks by including the dummy variable *Commercial,* which equals 1 for commercial banks and equals 0 for savings banks and credit cooperatives, to test whether there are significant differences in the effects of diversification on *NPLR* between different bank types. We consider this issue because savings banks and credit cooperatives are significantly different than commercial banks. In particular, savings banks and credit cooperatives are more retail oriented and focus more on traditional banking activities (Köhler, 2014, 2015); they are also more geographically focused. However, the variable *Commercial* becomes statistically insignificant in our model, whereas revenue diversification maintains its sign and significance. Whether there are statistically significant differences between bank types that mediate the effect of revenue diversification on *NPLR* must be studied more extensively. However, the (unreported) results confirm thus far that diversification contributes to reductions in *NPLR* for both bank types.

4.4. Robustness tests

Table 7 shows the effects of diversification on *NPLR* after controlling for the financial crisis period. To that end, we include a dummy variable *(Crisis)* that equals 1 for the years 2008-2012. Model 1 shows that *HHIRD* keeps its sign and significance after controlling for the financial crisis effect. Similarly, models 2 through 5 demonstrate that *COMr* and *OTHr* continue to contribute significantly to reductions in *NPLR* whereas *INTr* significantly increases *NPLR*. These results indicate that even when adverse macroeconomic scenarios significantly affect *NPLR,* diversification still contributes to reductions in *NPLR* after controlling for the *Crisis* variable. We introduce the interaction between *HHIRD* and *Crisis* (CrisisXrd) in model 6. As expected, the positive and

[3] Results are available upon request.

significant sign of *CrisisXrd* shows that crisis scenarios moderate the relationship between *HHIRD* and *NPLR* by enhancing the positive impact of revenue diversification on bank risk-taking. Therefore, after this first robustness check, we can conclude that revenue diversification can significantly reduce *NPLR*, especially under adverse macroeconomic conditions, such as the conditions that characterized the last financial crisis.

Table 7: *The effect of revenue diversification on NPLR in European banks after controlling for the financial crisis effect.*

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
Revenue diversification												
HHIRD	-0.00	***									-0.00	**
	(0.00)										(0.00)	
COMr			-0.01	**								
			(0.00)									
TRADr					-0.00							
					(0.00)							
OTHr							-0.00	**				
							(0.00)					
INTr									0.00	***		
									(0.00)			
Control variables												
NPLR_1	0.80	***	0.80	***	0.79	***	0.80	***	0.80	***	0.80	***
	(0.03)		(0.03)		(0.03)		(0.03)		(0.03)		(0.03)	
loanTA	0.00	**	0.00	**	0.00	**	0.00	**	0.00	**	0.00	**
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Size	-0.02		-0.02		-0.01		-0.01		-0.01		-0.02	
	(0.02)		(0.02)		(0.01)		(0.01)		(0.01)		(0.02)	
GTA	-0.00		-0.00		-0.00		-0.00		-0.00		-0.00	
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
EqTA	-0.01		-0.00		-0.00		-0.01		-0.01		-0.01	
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	
ROA	-0.12	***	-0.12	***	-0.11	***	-0.11	***	-0.11	***	-0.12	***
	(0.02)		(0.02)		(0.02)		(0.02)		(0.02)		(0.02)	
CIR	-0.00	**	-0.00		-0.00	***	-0.00	**	-0.00	**	-0.00	**
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Listed	0.06		0.09		0.13		0.04		0.03		0.09	
	(0.09)		(0.09)		(0.09)		(0.09)		(0.10)		(0.09)	
Actrestind	0.02	***	0.02	**	0.03	***	0.02	**	0.02	**	0.02	***
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	
Capregind	-0.04	***	-0.04	***	-0.05	***	-0.04	***	-0.04	***	-0.04	***
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
Suppowind	0.04	***	0.04	***	0.04	***	0.04	***	0.04	***	0.04	***
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)		(0.00)	
Privmonind	-0.01		-0.01		0.03	*	-0.01		-0.01		-0.01	
	(0.01)		(0.01)		(0.02)		(0.01)		(0.01)		(0.01)	
HHIIC	-0.00	***	-0.00	***	-0.00	***	-0.00	***	-0.00	***	-0.00	***
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
GDPG	-0.01	***	-0.01	**	-0.01		-0.01	***	-0.01	***	-0.01	***
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Inflation	-0.03	***	-0.03	***	-0.04	***	-0.03	***	-0.03	***	-0.03	***
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	
UR	0.01	***	0.01	***	0.02	***	0.02	***	0.01	***	0.01	***
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Interest	0.01		0.02		0.03	*	0.02		0.01		0.02	
	(0.02)		(0.02)		(0.02)		(0.02)		(0.02)		(0.02)	
Crisis	0.18	***	0.21	***	0.26	***	0.18	***	0.18	***	0.02	
	(0.05)		(0.05)		(0.05)		(0.06)		(0.06)		(0.10)	
CrisisXrd											0.00	*
											(0.00)	
Constant	0.56		0.40		-0.19		0.36		0.07		0.64	*
	(0.36)		(0.36)		(0.34)		(0.32)		(0.32)		(0.35)	
Observations	4,268		4,259		3,854		4,268		4,268		3,434	
AR2	-1.80*		-1.77*		-1.54		-1.76*		-1.76*		-1.05	
Hansen	520.84**		542.49***		494.03***		524.46**		531.35***		416.51***	
	(463)		(462)		(379)		(462)		(462)		(462)	

*Notes: This table presents the effects of revenue diversification on NPLr in the Eurozone during the period 1999–2012 using the system-GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). See Table 2 for a description of the independent variables. NPLR_1 indicates the lagged period of the dependent variable. Except for HHIIC, GPD, Inflation, UR and Interest, all variables are considered endogenous in our model. We report heteroskedasticity-consistent asymptotic standard errors in parentheses, and significance levels are indicated as follows: ***= significant at the 1% level; **= significant at the 5% level; and *= significant at the 10% level. AR2 denotes the Arellano and Bond test for the second order autocorrelation in first differences. Hansen is a test of the over-identifying restrictions, asymptotically distributed as $\chi 2$ under the null hypothesis of no correlation between the instruments and the error term, with degrees of freedom in parentheses.*

We also test our model by using alternative diversification proxies. In most cases, the alternative diversification proxies produce similar outcomes; hence, the robustness of our results is reinforced. *HHIREV* and *RDLL* measure shifts into non-interest income generating activities, which allows the breakdown of net operating income into its two broad components. An increase in *HHIREV* signifies increased revenue concentration and less diversification (De Jonghe, 2010; Sanya and Wolfe, 2010). *RDLL* takes values from 0 to 1, with higher values indicating greater diversification (Laeven and Levine, 2007). Both proxies are highly statistically significant in our model, indicating that higher diversification is associated with a lower *NPLR*.

HHINON measures diversification within non-interest activities, with higher values indicating greater concentration. This is the only diversification variable that yields non-statistically significant results, probably due to losses in banks' trading operations during the crisis period.

Finally *Diversified* is a dummy variable that equals 1 if *HHIRD* is above the median and equals zero otherwise. Introduction of this variable indicates a highly statistically significant negative correlation between revenue diversification and *NPLR*.

Table 8a: *The effect of revenue diversification on NPLR in European banks: Alternative revenue diversification proxies*

	Model 1		Model 2		Model 3		Model 4	
Revenue diversification								
HHIREV	0.00	***						
	(0.00)							
HHINON			-0.00					
			(0.00)					
Diversified					-0.07	***		
					(0.02)			
RDLL							-0.00	***
							(0.00)	
Control variables								
NPLR_1	0.78	***	0.77	***	0.79	***	0.79	***
	(0.02)		(0.03)		(0.03)		(0.03)	
loanTA	0.00	***	0.00	***	0.00	***	0.00	***
	(0.00)		(0.00)		(0.00)		(0.00)	
Size	-0.01		-0.00		-0.00		-0.01	
	(0.02)		(0.02)		(0.02)		(0.02)	
GTA	-0.00		-0.00		-0.00		-0.00	
	(0.00)		(0.00)		(0.00)		(0.00)	
EqTA	-0.01		-0.00		-0.00		-0.01	
	(0.01)		(0.01)		(0.01)		(0.01)	
ROA	-0.13	***	-0.10	***	-0.12	***	-0.13	***
	(0.02)		(0.02)		(0.02)		(0.02)	
CIR	-0.00	***	-0.00	**	-0.00	*	-0.00	***
	(0.00)		(0.00)		(0.00)		(0.00)	
Listed	0.03		0.04		0.01		0.06	
	(0.08)		(0.09)		(0.09)		(0.08)	
Actrestind	0.03	***	0.04	***	0.03	***	0.03	***
	(0.01)		(0.01)		(0.01)		(0.01)	
Capregind	-0.04	***	-0.05	***	-0.04	***	-0.04	***
	(0.01)		(0.01)		(0.01)		(0.01)	

	Model 1		Model 2		Model 3		Model 4	
Suppowind	0.03	***	0.03	***	0.03	***	0.04	***
	(0.00)		(0.01)		(0.00)		(0.01)	
Privmonind	0.00		0.04	**	-0.00		-0.00	
	(0.01)		(0.02)		(0.01)		(0.01)	
HHIIC	-0.00	***	-0.00	***	-0.00	***	-0.00	***
	(0.00)		(0.00)		(0.00)		(0.00)	
GDPG	-0.02	***	-0.01	***	-0.01	***	-0.01	***
	(0.00)		(0.00)		(0.00)		(0.00)	
Inflation	-0.01		-0.00		-0.01		-0.01	
	(0.01)		(0.01)		(0.01)		(0.01)	
UR	0.01	***	0.02	***	0.01	***	0.01	***
	(0.00)		(0.00)		(0.00)		(0.00)	
Interest	-0.04	***	-0.05	***	-0.04	***	-0.04	***
	(0.01)		(0.01)		(0.01)		(0.01)	
Constant	0.27		-0.16		0.23		0.52	
	(0.33)		(0.38)		(0.35)		(0.35)	
Observations	4268		3849		4268		4268	
AR2	-1.76		-1.55		-1.83		-1.83	
Hansen	513.61 (461)		474.20 (378)		508.39 (461)		527.12 (461)	

*Notes: This table presents the effects of revenue diversification on NPLr in the Eurozone during the period 1999–2012 using the system-GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). See Table 2 for a description of the independent variables. NPLR_1 indicates the lagged period of the dependent variable. Except for HHIIC, GPD, Inflation, UR and Interest, all variables are considered endogenous in our model. We report heteroskedasticity-consistent asymptotic standard errors in parentheses, and significance levels are indicated as follows: ***= significant at the 1% level; **= significant at the 5% level; and *= significant at the 10% level. AR2 denotes the Arellano and Bond test for the second order autocorrelation in first differences. Hansen is a test of the over-identifying restrictions, asymptotically distributed as $\chi 2$ under the null hypothesis of no correlation between the instruments and the error term, with degrees of freedom in parentheses.*

Detailed descriptions of the variables are provided in Table 2. Table 8a shows the effect of the alternative diversification proxies on *NPLR*, and Table 8b presents the correlation matrix between the different measures of diversification.

Table 8b: *Correlation matrix between diversification proxies*

	HHIRD	HHIREV	RDLL	HHINON	COMR	TRADR	INTR	OTHR	Diversified
HHIRD	1.00								
HHIREV	-0.58	1.00							
RDLL	0.65	-0.94	1.00						
HHINON	-0.14	0.11	-0.09	1.00					
COMR	0.58	0.02	0.08	-0.05	1.00				
TRADR	0.27	0.16	-0.10	-0.04	-0.12	1.00			
INTR	-0.72	-0.10	-0.04	0.07	-0.75	-0.36	1.00		
OTHR	0.63	0.08	0.05	-0.06	0.55	0.28	-0.93	1.00	
Diversified	0.69	-0.32	0.50	-0.03	0.48	0.19	-0.57	0.50	1.00

Notes: This table presents the correlation between the revenue diversification variables. See Table 2 for a description of the variables

Table 9 presents our final robustness checks, wherein we use the *Z-score*, which is defined as the number of standard deviations by which a bank's return on assets must fall below the mean to become insolvent, as an alternative dependent variable (models 1, 2 and 4). We expect a higher (lower) Z-score to reflect a lower (higher) likelihood that a bank will become insolvent. The Z-score is widely used in the literature as a measure of financial stability and of risk-adjusted performance (Laeven and Levine, 2010; Lee *et al.*, 2014; Köhler, 2015). Additionally, we apply alternative data panel methodologies (fixed effects in models 2 and 3 and random effects in models 4 and 5). In both cases, the results generally resemble those from the baseline model and show similar diversification effects on both *NPLR* and *Z-score.* Specifically, an increase in diversification produces higher Z-scores and lower *NPLRs*. These results remain highly statistically significant for all methodologies and dependent variables used, with the exception of the random effects methodology and *NPLR* (model 5), although the negative coefficient is maintained in this model. In conclusion, these results provide robustness to our model by reinforcing the hypothesis that higher diversification leads to lower risk-taking and greater financial stability for European banks.

Table 9. *The effect of revenue diversification on NPLR and Z Score in European banks: Alternative model specifications and dependent variable.*

	Model 1 (ZSCORE)		**Model 2 (ZSCORE)**		**Model 3 (NPLR)**		**Model 4 (ZSCORE)**		**Model 5 (NPLR)**	
Revenue diversification:										
HHIRD	0.00	***	0.00	***	-0.00	*	0.00	***	-0.00	
	0.00		0.00		0.00		0.00		0.00	
Control variables:										
Z Score_1	0.86	***								
	(0.02)									
loanTA	0.00	*	0.00	*	-0.01	***	0.00	***	-0.01	***
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Size	0.02	**	-0.07	***	-0.17	***	-0.06	***	-0.14	***
	(0.01)		(0.01)		(0.05)		(0.01)		(0.01)	
GTA	-0.00	***	-0.00		-0.00	***	-0.00		-0.00	***
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
EqTA	0.02	***	0.07	***	-0.01	**	0.07	***	-0.01	*
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	

	Model 1 (ZSCORE)		Model 2 (ZSCORE)		Model 3 (NPLR)		Model 4 (ZSCORE)		Model 5 (NPLR)	
ROA	0.03		0.04	***	-0.13	***	0.04	***	-0.14	***
	(0.02)		(0.00)		(0.01)		(0.00)		(0.01)	
CIR	-0.00	***	-0.00	***	-0.00	***	-0.00	***	-0.00	***
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Listed	-0.59	***	-0.00		0.00		-0.00	***	-0.00	***
	(0.12)		(0.00)		(0.00)		(0.00)		(0.00)	
Actrestind	-0.03	***	0.00	***	0.00		0.00	***	0.01	**
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Capregind	-0.01		-0.00		0.01		-0.00		0.01	*
	(0.01)		(0.00)		(0.01)		(0.00)		(0.01)	
Suppowind	-0.00		-0.01	***	0.11	***	-0.01	***	0.10	***
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Privmonind	-0.00		-0.01	***	-0.08	***	-0.01	***	-0.08	***
	(0.01)		(0.00)		(0.01)		(0.00)		(0.01)	
HHIIC	-0.00	***	0.02	***	0.03	***	0.01	***	0.06	***
	(0.00)		(0.00)		(0.01)		(0.00)		(0.01)	
GDPG	0.00	***	0.00		-0.02	**	0.01	***	-0.06	***
	(0.00)		(0.00)		(0.01)		(0.00)		(0.01)	
Inflation	-0.02	***	-0.00		0.02	***	-0.00	**	0.04	***
	(0.00)		(0.00)		(0.01)		(0.00)		(0.01)	
UR	-0.01	***	0.01	***	-0.01		0.01	***	-0.02	
	(0.00)		(0.00)		(0.01)		(0.00)		(0.01)	
Interest	-0.01	***	-0.00		-0.18		-0.07	*	0.03	
	(0.00)		(0.04)		(0.11)		(0.04)		(0.08)	
Constant	0.58	***	3.63	***	4.18	***	3.35	***	3.13	***
	(0.20)		(0.12)		(0.64)		(0.10)		(0.24)	
Methodology	System-GMM		Fixed effects		Fixed effects		Random Effects		Random Effects	
Observations	10,769		10,809		5,346		10,809		5,346	
AR2	0.99		0.63		0.46		0.63		0.45	
Hansen	986.98 (619)		209.78***		15.34***		14,959.66***		3,347.72***	

*Notes: This table presents the effects of revenue diversification on NPLr and Zscore pretax in the Eurozone during the period 1999–2012 using alternative dependent variables and/or model specifications for our baseline equations. In Models 1, 2 and 4 ZScore is used as the dependent variable. Model 1 applies system-GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). ZScore_1 indicates the lagged period of the dependent variable (ZScore). Except for HHIIC, GPD, Inflation, UR and Interest, all variables are considered endogenous in this model. Models 2 and 3 use fixed-effects (within) regressions, while Models 4 and 5 use random effects. See Table 2 for a description of the independent variables. We report heteroskedasticity-consistent asymptotic standard errors in parentheses, and significance levels are indicated as follows: ***= significant at the 1% level; **= significant at the 5% level; and *= significant at the 10% level. AR2 denotes the Arellano and Bond test for the second order autocorrelation in first differences. Hansen is a test of the over-identifying restrictions, asymptotically distributed as $\chi 2$ under the null hypothesis of no correlation between the instruments and the error term, with degrees of freedom in parentheses. R2 is the proportion of variation in the dependent variable explained by the model.*

5. Conclusions

This essay examines the effect of revenue diversification on *NPLR* using a sample of more than 2,000 Eurozone banks. We apply the system-GMM estimator, which was developed for dynamic panel data models by Arellano and Bover (1995) and Blundell and Bond (1998). We control for bank-specific characteristics as well as for variables related to macroeconomic conditions and bank regulations.

Our results show that revenue diversification reduces *NPLR*. Moreover, a closer look at the different types of income shows that higher percentages of commission and fee income and other operating income in total operating revenue increase asset quality, whereas the proportion of trading revenues in a bank's total income does not significantly affect *NPLR*.

We further provide robustness to our results by using alternative revenue diversification variables, alternative risk proxies and alternative methodologies. In most cases, the use of these alternatives produces similar results.

This study has important implications for regulators and policy makers because regulatory controls that restrict banking activities limit the diversification effect on non-performing loan ratios and on the Z-scores of European banks and therefore such regulations increase bank risk exposure. Furthermore, we show that the financial crisis increases the effect of revenue diversification on *NPLR,* implying that diversified banks are better prepared than their non-diversified counterparts and that the crisis has less impact on the quality of diversified banks' loan portfolios.

6. Limitations and further research

We acknowledge several limitations of our study. First, we focus on accounting measures of bank risk, which are susceptible to managerial manipulation and backward looking (Altunbas *et al.*, 2007). We could therefore extend our analysis by using alternative market risk measures, such as systematic and idiosyncratic risk (Baele *et al.*, 2007; Sawada, 2013) or standard deviations of returns (Lepetit, 2008), among others. However, because only 5% of the banks in our study are publically traded, the use of market measures would not be representative of the full sample. Second, the use of

NPLR as the main dependent variable drastically reduces the number of available observations. We try to overcome this limitation by using the Z-score as an alternative proxy for bank risk-taking, and similar results are obtained. Finally, whether large and/or market-oriented banks or different types of banks have a moderating effect on the relationship between revenue diversification and *NPLR* is a question that must be studied more carefully. Interaction between these variables and revenue diversification could provide a deeper analysis and more accurate results.

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Appendix 1: *Summary of the findings on the impact of revenue diversification on banks' risk and return*

Author (s)	Country	Period	Empirical findings
DeYoung andRice (2004)	US	1989 -2001	Well-managed banks expand more slowly into noninterest activities, and marginal increases in noninterest income are associated with poorer risk-return trade-offs on average.
Stiroh and Rumble (2006)	US	1997 - 2002	Diversification benefits exist between Financial Holding Companies (FHCs), but these gains are offset by the increased exposure to non-interest activities, which are much more volatile but not necessarily more profitable than interest-generating activities.
Baele *et al.* (2007)	EU15+ Norway and Switzerland	1989–2004	A higher share of non-interest income in total income affects banks' franchise values positively. Diversification of revenue streams from distinct financial activities increases the systematic risk of banks while the effect on the idiosyncratic risk component is non-linear and predominantly downward sloping.
Laeven and Levine, (2010)	International (43 countries)	1998–2002	The market values of financial conglomerates that engage in multiple activities, e.g., lending and non-lending financial services, are lower than if those financial conglomerates were broken into financial intermediaries that specialize in the individual activities.
Mercieca *et al.* (2007)	Europe (small banks)	1997-2003	A shift from interest income activities into non-interest income activities results in lower average profitability. This implies that small banks in Europe do not gain by diversifying outside their traditional lines of business, suggesting that it may be difficult for those institutions to get a strong foothold in non-interest activities
Chiorazzo *et al.*, (2008)	Italy	1993-2003	Income diversification increases risk-adjusted returns being this relation stronger at larger banks. Small banks can make gains from increasing non-interest income, but only when they have very little non-interest income share to start with.
Lepetit *et al.* (2008)	Europe	1996-2002	Banks expanding into non-interest income activities present higher risk and higher insolvency risk than banks, which mainly supply loans. However, the positive link with risk is mostly accurate for small banks and essentially driven by commission and fee activities.
De Jonghe (2010)	EU-15	1992–2007	Non-interest generating activities increase banks' tail beta.
Demirgüç-Kunt and Huizinga (2010)	101 countries.	1995-2007	Expansion into non-interest income-generating activities such as trading increases the rate of return on assets, and it could offer some risk diversification benefits at very low levels. Overall, banking strategies that rely prominently on generating non-interest income or attracting non-deposit funding are very risky, consistent with the demise of the US investment banking sector.
Elsas et al (2010) (JBandF)	US, Canada, Australia, Europe,	1996-2008	Diversification increases bank profitability and, as a consequence also market valuations. This evidence against a conglomerate discount in banking remains robust also during the sub-prime crisis.
Sanya and Wolfe (2010)	226 listed banks across 11 emerging economies		Diversification across and within both interest and non-interest income generating activities decrease insolvency risk and enhance profitability.
Sawada (2013)	Japan, 1999-2011		Revenue diversification positively affects bank market value but there is no evidence that it reduce bank risks. By contrast, when non-interest income is divided into its constituent parts— fee income, trading income, and other non-interest income— a shift towards fee income-generating business decreases all types of risks (systematic risk, idiosyncratic risk, and total risk). Furthermore, revenue diversification affects bank value and risk differently depending on particular bank characteristics, such as organizational form and traditional banking business performance.

Author (s)	Country	Period	Empirical findings
Köhler (2015)	15 EU countries	2002 - 2011	Banks will be significantly more stable and profitable if they increase their share of non-interest income. Such benefits are particularly large for savings and cooperative banks. Investment banks, in contrast, become significantly more risky.
Köhler (2014)	Germany	2002 - 2012	The impact of non-interest income on bank risk differs between retail and investment-oriented banks: while retail-oriented banks such as savings, cooperative and other banks that focus on lending and deposit-taking services become significantly more stable (in the sense of having a higher Z-score) if they increase their share of non-interest income; investment-oriented banks become significantly more risky.
Lee *et al.* (2014)	Asia-Pacific countries	1995-2009	For bank-based groups, bank performance can be improved through diversification, supporting the ''bank-based view'' hypothesis. Under different financial systems, the relationships among revenue diversity, financial reforms, and bank performances are multidimensional.
Meslier *et al.* (2014)	Philippines	1999 - 2005	A shift toward non-interest activities increases bank profits and risk-adjusted profits particularly when banks are more involved in trading in government securities.

Essay 3: Board Characteristics and Ethical Reputation of Financial Institutions☆

Abstract

This essay examines the association between board characteristics and the ethical reputation of financial institutions. Given the pivotal governance role of the board of directors and the value-relevance of ethical corporate behavior, we postulate a positive relationship between ethical reputation and board features that foster more effective monitoring and oversight. Using a sample of large financial institutions from 13 different countries, we run several alternative panel regressions of ethical reputation on board characteristics and firm-specific controls. Our results demonstrate that the ethical reputation of financial institutions is positively associated with board size, experience, gender diversity, and CEO duality, while being negatively related to the busyness of the board members and a composite index reflecting poor monitoring. Nevertheless, inconsistent with our hypothesis, we also document that financial institutions with less frequent board meetings have better ethical reputation. Overall, our empirical findings suggest that stronger board oversight may promote ethical behavior in the financial industry.

1. Introduction

This essay focuses on the association between board characteristics and the ethical reputation of financial institutions. In the aftermath of the global financial crisis, politicians, banking supervisors, and central bankers have alleged and acknowledged that flaws in the corporate governance mechanisms and ethical culture of financial institutions had a central role in the in the development of the crisis (see e.g., Basel Committee on Banking Supervision, 2010; Board of Governors of the Federal Reserve System, 2009, 2010; Haldane, 2012). More generally, the financial crisis demonstrated that poor governance structures and absence of ethics in the financial industry may have severe adverse consequences on global financial stability and societal well-being. The significant impact that major financial institutions can have not only on global economic conditions but on the overall health and functioning of the society has

☆ Part of this essay was written while L. Baselga-Pascual was visiting the University of Vaasa (Finland).

amplified expectations towards stronger governance and more ethical behavior in the financial industry. Therefore, it is of general interest to empirically examine whether and how the ethical reputation of financial institutions is affected by the board of directors. If ethical reputation is a value-relevant intangible asset for financial institutions, we should observe a positive relationship between ethical reputation and board attributes that reflect more stringent monitoring and oversight.

The board of directors is the most important internal governance mechanism within a firm. The board is responsible, among other things, for monitoring and controlling the major long-term strategic decisions of the firm and ensuring that the firm acts in the best interests of its shareholders (for a review, see e.g. Fields and Keys, 2003). Board members also have a fiduciary duty towards shareholders as well as other stakeholders to monitor that the firm is following the basic ethical customs and rules of society. Hence, it can be argued that the board of directors is directly responsible for monitoring the ethical culture within the firm.

Previously, a vast body of literature has examined how observable board characteristics such as size, independence, experience, and gender diversity affect corporate decisions and outcomes (see Hermalin and Weisbach, 2003 and Adams *et al.*, 2010 for comprehensive literature reviews). The role of the board of directors in financial institutions has been examined, for instance, by Mishra and Nielsen (2000), Macey and O'Hara (2003), Sierra *et al.* (2006), de Andrés and Vallelado (2008), Jiraporn and Chintrakarn (2009), Laeven and Levine (2009), Pathan (2009), Fortin *et al.* (2010), Aebi *et al.* (2012), Adams and Mehran (2012), Beltratti and Stulz (2012), and Erkens *et al.* (2012). In brief, these studies demonstrate that boards have a pivotal monitoring role in financial institutions, and moreover, that structural differences across boards are reflected in the financial performance, market valuation, and the level of risk-taking of financial institutions. Our essay builds upon the prior literature by addressing the relationship between board characteristics and the ethical reputation of financial institutions around the global financial crisis. To the best of our knowledge, this essay is the first attempt to examine the association between ethical reputation and the board of directors in the financial industry.

The empirical findings reported in this essay demonstrate that board characteristics may matter for the ethical reputation of financial institutions. Our analysis is based on a sample of 43 large publicly traded financial institutions from 13 different countries, and we utilize the Covalence EthicalQuote index to measure the ethical reputation of these institutions. Consistent with our research hypothesis, the results indicate that more effective monitoring and oversight by the board of directors may have positive effects on ethical reputation in the financial industry.

The remainder of this essay proceeds in the following manner. The second section reviews the related literature on ethical behaviour, social responsibility, and factors that influence the responsibility and reputation of non-financial firms. The third section describes the data and introduces the variables used in the analysis. The fourth section presents the methods and reports the empirical findings on the association between board characteristics and the ethical reputation of financial institutions. Finally, the fifth section summarizes the results and provides concluding remarks.

2. Related literature

Although the association between board characteristics and ethical reputation of financial institutions has not been previously examined in the literature, our empirical analysis is closely related to at least three strands of literature. First, studies by Gunthorpe (1997), Fischer and Khoury (2007), Choi and Jung (2008) and Blazovich and Smith (2011) examine the association between ethical behavior and firm performance. In brief, these studies show that ethical conduct benefits the firm and may matter for shareholder value. Gunthorpe (1997) conducts an event study on the impact of unethical corporate behavior on stock prices, and documents a strong negative market reaction to public disclosures of unethical behavior. The results of Fischer and Khoury (2007), Choi and Jung (2008) and Blazovich and Smith (2011) provide evidence to suggest that ethical business practices may have positive effects on firm profitability and market valuation. Given these findings, Blazovich and Smith (2011) argue that ethical corporate behavior creates an intangible asset, which may enhance firm value by reducing conflicts and strengthening trust between the core stakeholders of the firm.

Our study also complements a small body of literature on social responsibility in the financial industry. Simpson and Kohers (2002), Chih *et al.* (2010), and Wu and Shen (2013) investigate the association between social responsibility and bank performance. While Simpson and Kohers (2002) and Wu and Shen (2013) document that socially responsible behavior is positively related to profitability of financial institutions, the results of Chih *et al.* (2010) suggest that the link between social responsibility and financial performance is weak and insignificant. Scholtens (2009) develops a framework for assessing social responsibility in the banking industry, and documents the extent of social responsibility activities to vary considerably across individual banks. His findings also indicate that larger banks with higher capital ratios have higher social responsibility scores. Closely related to the current study, Jizi *et al.* (2014) examine the association between board characteristics and social responsibility disclosure of large U.S. commercial banks. They find that board size and independence are positively related to the level of social responsibility disclosure in banks' annual reports.

Finally, our essay is related to the management literature about factors that influence firm reputation. In their seminal study, Fombrun and Shanley (1990) report that firm reputation is positively associated with profitability, market valuation, firm size, and advertising intensity, while being negatively affected by the variability of profits. Most closely related to the current study, Musteen *et al.* (2010) and Brammer *et al.* (2009) examine the effects of board characteristics on firm reputation. Musteen *et al.* (2010) document that board size, independence, experience, and CEO duality are positively related to firm reputation. Moreover, they find that reputation is positively influenced by profitability, growth and firm size. Brammer *et al.* (2009) use a reputational score based on the 'Britain's most admired companies' survey to examine how board gender diversity affects firm reputation. Their findings indicate that the effect of board gender diversity on reputational assessments varies across industries; female board representation is positively associated with reputation in the consumer services and consumer manufacturing industries, while being negatively related to reputation in the producer services sector. Consistent with Musteen *et al.* (2010), the findings of Brammer *et al.* (2009) suggest that firms with larger boards are associated with better reputational assessments.

In this essay, we aim to extend the existing literature by empirically examining whether board characteristics affect the ethical reputation of financial institutions. Assuming that ethical reputation is a value-relevant intangible asset for financial institutions, we expect to find a positive relationship between ethical reputation and board characteristics that reflect more stringent monitoring and oversight. To the best of our knowledge, the current study is the first attempt to address the relationship between board characteristics and ethical reputation in the financial industry.

3. Data and variables

The empirical analysis presented in this essay is based on a sample of 43 large, publicly traded financial institutions from 13 different countries (Australia, Bermuda, Brazil, Canada, Germany, France, Italy, Japan, Spain, Switzerland, Taiwan, the United Kingdom, and the United States). The sample firms are listed in Appendix 1. We limit our sample to financial institutions for which the Covalence EthicalQuote reputation index is available. The sample comprises commercial banks, investment banks, diversified financial services firms, and other lending institutions. The firms included in our sample are among the largest financial institutions in the world and about 60 percent of the sample firms are classified as globally systematically important financial institutions (g-SIFIs) by the Financial Stability Board. Hence, despite the very small number of individual financial institutions, our sample covers a substantial proportion of the total amount of banking assets in the world. The sample period spans from 2005 to 2010, and thereby covers the fiscal years surrounding the global financial crisis.

3.1. Ethical reputation

The dependent variable in our analysis is ethical reputation. Following e.g. Amazeen (2011), Erwing (2011), and Maon *et al.* (2009), we use the EthicalQuote reputation index developed by Covalence to measure the ethical reputation of financial institutions. In brief, this index tracks the ethical reputation of large, international companies based on news, reporting and stakeholders' claims related to ethical and responsible conduct. The data on the EthicalQuote index are obtained from Covalence. The EthicalQuote reputation index integrates information about various ethical criteria related to environmental, social and governance aspects that are divided to the

following seven groups: (i) governance, commitments and engagement, (ii) economic performance, (iii) environmental performance, (iv) labor practices and decent work conditions, (v) human rights, (vi) societal responsibility, and (vii) product responsibility.

The ethical reputation of firms is assessed by analyzing ethical behaviors materialized in the quantities of positive and negative news. Covalence considers positive news as ethical offers which express "information on what the company does for society", while unethical conducts reported in negative news represent ethical demands, meaning "information on what the company should do for society". Therefore, the ethical reputation index constructed by Covalence reflects the actual, observed ethical behavior of the firm. Nevertheless, it is important to acknowledge that ethical behavior is a human concern which is difficult to quantify.

The subjectivity and credibility problems are addressed by integrating multiple opinion and information sources like search engines, individual websites, and different correspondents. Each news item is assessed and graded from the cumulative addition of positive and negative points produced by ethical offers and demands. A specific news item can receive as many points as there are criteria involved (i.e. a news item coded with two ethical offers related to governance and economic performance and one ethical demand concerning customer privacy would be graded as 2 – 1 = +1 point).

An absolute ethical score (S) is calculated for each company by subtracting items that received negative scores (B) from positive scored items (A), i.e. $S = A - B$. To control for the potential size and media exposure biases related to the fact that larger firms typically obtain much more media attention than smaller firms, a rate-adjusted score (Ras) is created as $Ras = S \times |R|$. The absolute ethical score (S) is changed to a relative measure (R) by dividing each score by the overall volume of news affecting the company. This rate-adjusted score enables comparisons between companies with different size. With respect to our empirical analysis, it is important to note that the size and media exposure biases should be mitigated by our sample which consists of a relatively homogeneous set of very large financial institutions.

Finally, to control for potential time effects, a two percent erosion factor (E) per month is applied in order to reduce the relevance of the older news items. Hence, the ethical reputation score ERS of firm *j* at time *t* is measured as follows:

$$ERS_{j,t} = S \times |R| + ERS_{j,t-1} \times (1 - E) \quad (1)$$

In our empirical analysis, we use two alternative measures of ethical reputation: (i) Ethical score$_{j,t}$ and (ii) Ethical rank$_{j,t}$. Ethical score is the Covalence EthicalQuote index given by Equation (1), while Ethical rank is the EthicalQuote index rank order of the financial institutions included in the sample. Specifically, Ethical rank is constructed by assigning the financial institution with the best ethical reputation at time *t* to value 1 and the institution with the worst ethical reputation to value 43.

3.2. Board characteristics

The test variables of interest in our empirical analysis are the following board characteristics: (i) Board size, (ii) Small board, (iii) Board independence, (iv) Board meetings, (v) Board experience, (vi) Board gender diversity, (vii) Two or more females, (viii) Board affiliations, (ix) Busy board, and (x) CEO duality. These variables have been extensively used in the prior literature to measure the functioning and monitoring effectiveness of the board of directors. The data on board characteristics are obtained from Thomson Reuters Worldscope.

We use two alternative proxies for board size; Board size is the logarithm of the number of board members and Small board is a dummy variable which equals one for firms with below median board size. These two variables are used as substitutes for each other and are not used in the regressions simultaneously. Previous studies indicate that larger boards may be more effective monitors of financial institutions and other complex firms (see e.g. Boone *et al.*, 2007; Coles *et al.*, 2008; de Andrés and Vallelado, 2008; Linck *et al.*, 2008; Pathan, 2009; Adams and Mehran, 2012). Hence, we predict a positive (negative) relationship between Board size (Small board) and ethical reputation. Board independence is measured as the percentage of independent board

members. A large body of literature indicates that independent directors are more effective monitors of the firm (see e.g., Brickley *et al.* 1994; Mehran, 1995; Harvey and Shrieves, 2001; Webb, 2004; Yeh *et al.*, 2011), and therefore, we expect a positive relation between Board independence and ethical reputation. Board meetings is measured as the logarithm of the number of board meetings during a fiscal year. A larger number of board meetings are assumed to reflect more stringent monitoring by the board (e.g., Brick and Chidambaran, 2010). Thus, a positive relationship between Board meetings and ethical reputation is predicted.

We measure Board experience as the average number of years each board member has been on the board (i.e., membership tenure). Given that more experienced boards may have better firm-specific knowledge and expertise (e.g., Bacon *et al.*, 1997), and moreover, may exert more stringent monitoring (e.g., Kosnik, 1990; Mallette and Fowler, 1992), we expect to find a positive association between Board experience and ethical reputation. Board affiliations is defined as the average number of other board memberships of the board members and Busy board is a dummy variable which equals one for firms in which board members on average have at least three other board memberships. These two board busyness measures are used as alternatives to each other in the regressions. Busy directors may not devote sufficient effort to effectively monitor the firm (e.g., Fich and Shivdasani, 2006; Adams and Ferreira, 2008). Furthermore, the findings of Beasley (1996) and Crutchley *et al.* (2007) suggest that board busyness increases the likelihood of accounting fraud. Therefore, we expect that Board affiliations and Busy board are negatively related to ethical reputation.

We use two alternative proxies to measure gender diversity of the boards. Board gender diversity is the percentage of female board members, while Two or more females is a dummy variable which equals one for firms with at least two female board members. Recent studies have argued that one woman on the board is a "token" and more women are needed to achieve the potential benefits of diversity (e.g. Torchia *et al.*, 2011; Joecks *et al.*, 2013). Similarly to the two board size and busyness measures, the two gender diversity variables are used as substitutes for each other in the regressions. Previous studies suggest that female representation on the boards of directors may have positive effects on board effectiveness and oversight (see e.g, Almazan and Suarez, 2003; Adams and Ferreira, 2009; Srinidhi *et al.*, 2011). Moreover, it has been argued in the

prior literature that women have higher ethical and moral standards (e.g., Betz *et al.* 1989; Albaum and Peterson, 2006; Lund, 2008). Hence, we predict that female board representation is positively associated with ethical reputation.

Finally, CEO duality is a dummy variable which equals one for firms in which the CEO is the board chair or a member of the board. In contrast to the other board characteristics, the relationship between CEO duality and the functioning of the boards is more ambiguous in nature. Hermalin and Weisbach (2003) argue that the independence of the board from the firm's CEO is the most important factor determining the effectiveness of the board. Moreover, empirical evidence suggests that CEO duality increases the CEO's influence in decision making and may hinder the monitoring function of the board (see e.g., Adams *et al.*, 2005; Goyal and Park, 2002). However, it has also been argued in the literature that CEO duality may have positive implications for the leadership of the firm (e.g., Finkelstein and D'Aveni, 1994; Boyd, 1995). In a recent study, Yang and Zhao (2014) document that CEO duality provides value-relevant benefits for the firm by improving information acquisition and transmission and by facilitating faster decision making. Furthermore, the prior studies about the reputation of non-financial firms have documented a positive relationship between CEO duality and firm reputation (Bear *et al.*, 2010; Musteen *et al.*, 2010). Thus, despite the somewhat ambiguous theoretical relationship, we are inclined to predict a positive association between CEO duality and the ethical reputation of financial institutions.

In addition to the individual board characteristics, we also build a composite index variable to reflect poor monitoring by the board of directors. Specifically, we define Poor monitoring as a (0,5) index measure constructed as the sum of the following five binary criteria: (i) the number of board members is below the sample median (0,1), (ii) the percentage of independent board members less than 50 % (0,1), (iii) the number of board meetings is below the sample median (0,1), (iv) there are no female board members (0,1), and (v) the average number of other board affiliations of the board members is at least three (0,1). Naturally, we hypothesize a negative association between ethical reputation and the poor monitoring index.

3.3. Control variables

We include several firm-specific control variables in our multivariate analysis. Previous studies have documented that firm size, profitability, and risk characteristics may affect firm reputation (Fombrun and Shanley, 1990; Bear *et al.*, 2010; Musteen *et al.*, 2010, Brammer *et al.*, 2009). Following the prior firm reputation literature and the bank corporate governance literature, we control for firm size, capital structure, financial performance, growth, riskiness, and asset structure in our analysis. Given that firm size is likely to affect the media exposure of companies, the largest companies could be over or under scored by the EthicalQuote reputation index. Although the EthicalQuote index is adjusted for firm size, it is important to control for size effects because different-sized financial institutions may have very different business strategies, product compositions, and governance structures. Previous studies have documented, for instance, that larger financial institutions hold lower levels of equity capital and are engaged in more risky operations. Moreover, size may also surrogate for numerous omitted variables in the empirical analysis. Following the prior banking literature (see e.g., de Andrés and Vallelado, 2008; Pathan, 2009; Aebi *et al.*, 2012), we measure *Size* by the natural logarithm of the total assets.

The second important variable that needs to be controlled for when comparing financial institutions is the amount of equity capital. We measure *Capital ratio* as the ratio of equity capital to total assets. Furthermore, we control for the financial performance and growth of the financial institutions. Profitability and growth can be seen as signals of management quality and both measures have been linked with firm reputation (Bear *et al.*, 2010; Musteen *et al.*, 2010). We measure financial performance with *Return on equity*, which is calculated as the ratio of net income to equity capital, while *Growth* is measured as the percentage change in total assets from year t–1 to year t. Because the level of risk-taking may affect firm reputation (Fombrun and Shanley, 1990; Brammer *et al.*, 2009; Musteen *et al.*, 2010), especially amidst periods of financial turmoil, we control for the volatility of stock returns. Following Pathan (2009), *Volatility* is measured by the logarithm of the annualized standard deviation of daily stock returns during the fiscal year. Similar to Beltratti and Stulz (2012), we control for the asset

structure of financial institutions with *Loans to assets*, which is defined as the ratio of net loans to total assets.

Finally, given that our sample comprises of commercial banks as well as other types of financial services institutions and includes institutions from 13 different countries, we include the dummy variables *Financial services* and *Non-US institution* in our analysis. *Financial services* is defined as a binary variable which equals one for other types of financial institutions than commercial banks and *Non-US institution* is assigned to one for institutions that are not headquartered in the U.S. The balance sheet and income statement data for the control variables are collected from Bankscope, while the stock price data for calculating volatility are obtained from Thomson Reuters Datastream.

4. Empirical analysis

4.1. Descriptive statistics

Table 1 reports the descriptive statistics for the variables used in the empirical analysis. In general, it can be noted from Table 1 that our sample is relatively heterogeneous in terms of board characteristics and firm-specific control variables with the variables exhibiting considerable variation from minimum to maximum values. However, given that the standard deviations are relatively low, the mean and the median values can be considered to be representative of a typical institution in our sample.

Table 1 shows that the boards of financial institutions, on average, are relatively large and typically consist of 14 directors. Furthermore, it can be noted that the boards consist mostly of independent directors and hold, on average, 11.85 board meetings during a year. Interestingly, there is considerable variation in the number of board meetings from the minimum of four to the maximum of 47 meetings. A closer look at our data indicates that for some institutions the number of board meetings increased considerably during the financial crisis. For instance, the maximum of 47 meetings were held by the board of UBS in 2008, which met only seven times annually during the pre-crisis years 2005-2007. The average tenure of board members in our sample is about

seven years and, on average, the directors are simultaneously holding less than two other board seats. In most of the sample institutions, the CEO is also the board chair or a member of the board. The descriptive statistics also demonstrate that females are severely underrepresented in the boards of large financial institutions, as only about 13 percent of board seats are held by women. Nevertheless, in almost 60 percent of our sample firms there are at least two female directors on the board.

Table 1. *Descriptive statistics*

Variable	Mean	Median	Min	Max	Std. dev.	No. of obs.
Ethical reputation:						
Ethical score	31.95	12.45	-157.74	362.31	58.15	220
Ethical rank	20.47	20.00	1.00	43.00	12.20	220
Board characteristics:						
Board size	13.89	14.00	6.00	22.00	3.25	220
Small board	0.14	0.00	0.00	1.00	0.34	220
Board independence	69.96	77.53	0.00	100.00	23.44	200
Board meetings	11.85	10.50	4.00	47.00	5.59	208
Board experience	7.10	6.67	0.48	16.08	3.13	211
Board gender diversity	13.54	14.29	0.00	40.00	8.51	220
Two or more females	0.59	1.00	0.00	1.00	0.49	220
Board affiliations	1.91	1.75	0.05	8.27	1.01	202
Busy board	0.10	0.00	0.00	1.00	0.29	220
CEO duality	0.87	1.00	0.00	1.00	0.34	220
Poor monitoring	1.34	1.00	0.00	5.00	1.03	205
Control variables:						
Size	20.04	20.41	14.65	22.06	1.47	220
SIFI	0.57	1.00	0.00	1.00	0.50	220
Capital ratio	9.62	5.76	0.38	90.51	15.51	220
Return on equity	10.37	11.87	-106.94	55.08	14.14	220
Loans to assets	39.44	41.74	0.00	89.77	23.72	220
Growth	11.36	8.39	-36.98	135.59	22.73	220
Volatility	45.13	35.33	9.01	151.83	30.36	220
Financial services	0.35	0.00	0.00	1.00	0.48	220
Non-US institution	0.53	1.00	0.00	1.00	0.50	220

The table reports the descriptive statistics for the sample. Ethical reputation is measured with the following two variables: (i) Ethical score is the EthicalQuote Index issued by Covalence and (ii) Ethical rank is the Ethical Quote Index rank order of the financial institutions included in the sample. The board characteristics are defined as follows: Board size is the number of board members, Small board is a dummy variable which equals one for firms with below median board size, Board independence is percentage of independent board members, Board meetings is the number of board meetings during a fiscal year, Board experience is the average number of years each board member has been on the board, Board gender diversity is the percentage of female board members, Two or more females is a dummy variable which equals one for firms with at least two female board members, Board affiliations is the average number of other board memberships of the board members, Busy board is a dummy variable which equals one for firms in which board members on average have at least three other board memberships, CEO duality is a dummy variable which equals one for firms in which the CEO is the board chair or a member of the board, and Poor monitoring is a (0,5) composite measure for poor monitoring by the board of

directors. The control variables are defined as follows: Size is measured as the logarithm of total assets, SIFI is a dummy variable for systematically important financial institutions as defined by the Financial Stability Board, Capital ratio is the ratio of equity to total assets, Return on equity is the ratio of net income to equity, Loans to assets is the ratio of net loans to totals assets, Growth is the percentage change in total assets from year t–1 to year t, Volatility is the annualized standard deviation of daily stock returns during the fiscal year, Financial services is a dummy variable which equals one for other financial institutions than commercial banks, and Non-US institution is a dummy variable for non-US financial institutions. The 43 financial institutions included in the sample are listed in Appendix 1.

Regarding the control variables, the descriptive statistics in Table 1 indicate that financial institutions included in our sample are very heterogeneous in terms of size, capital ratios, profitability, growth, and asset structure. The sample institutions are very large in terms of total assets and approximately 60 percent of them are classified as a globally systematically important financial institution (*SIFI*) by the Financial Stability Board. The considerable variations in *Capital ratio* and *Loans to assets* reflect the inclusion of commercial banks as well as other types of financial institutions in the sample, while the negative minimum values for *Return on equity* and *Growth* are largely driven by the global financial crisis. Finally, it can be noted from Table 1 that a vast majority of the sample firms are commercial banks and that U.S. institutions comprise almost 50 percent of our sample.

4.2. Correlations

Pairwise correlations (not tabulated) indicate that our dependent variables *Ethical score* and *Ethical rank* are statistically significantly correlated with *Board size, Small board, Gender diversity* and *Two or more females*.[4] In particular, we find positive correlation coefficients between the ethics measures and *Board Size* and *Gender diversity*, indicating that financial institutions with larger and more gender diverse boards may have better ethical reputation. Furthermore, ethical reputation is strongly positively correlated with *Size* and *SIFI*, and negatively correlated with *Financial services*. Not surprisingly, our two ethical reputation measures are strongly negatively correlated with each other (-0.71).

Regarding the board characteristics, it is observed that *Board size* is significantly negatively correlated with *Small board*, *Board independence*, and *CEO duality* and

[4] We do not tabulate the correlation coefficients for brevity. The correlation matrix is available from the authors upon request.

negatively correlated with *Busy board*. The two gender diversity variables are positively correlated with *Board size, Board independence* and *Board affiliations*, and thereby indicate that female directors are more common in larger, more independent and more busy boards. Finally, it should be noted that several of our control variables are strongly correlated with each other. Most notably, *Size* is strongly positively correlated with *SIFI*, *Capital ratio, Financial services* and *Non-US institution*. Given these strong correlations, we perform several robustness checks to ensure that our empirical findings are not affected by multicollinearity.

4.3. Univariate analysis

We first conduct univariate tests to examine the relationship between board characteristics and ethical reputation of financial institutions. For this purpose, we divide our sample into two subsamples based on the level of ethical reputation; the "stronger ethical reputation" subsample consists of financial institutions with above median *Ethical rank*, while the "weaker ethical reputation" subsample consists of institutions with below median *Ethical rank*.[5] We then perform two-tailed *t*-tests and Wilcoxon rank-sum tests under the null hypothesis that there are no differences in the means and medians between the most and the least ethical financial institutions.

[5] We conduct the univariate tests also by comparing differences between the first and last quartiles and tertiles. The results of these additional tests are similar in terms of both signs and statistical significance.

Table 2. *Univariate tests*

	Most ethical		Least ethical		Diff. in means		Diff. in medians	
	Mean	Median	Mean	Median				
Board size	2.684	2.708	2.514	2.485	0.170	***	0.223	***
Small board	0.035	0.000	0.248	0.000	-0.213	***	0.000	***
Board independence	68.868	80.000	70.917	76.920	-2.049		3.080	
Board meetings	2.347	2.303	2.434	2.398	-0.087		-0.095	*
Board experience	7.286	6.715	6.885	6.630	0.401		0.085	
Board gender diversity	15.312	15.380	11.598	11.110	3.714	***	4.270	***
Two or more females	0.704	1.000	0.467	0.000	0.238	***	1.000	***
Board affiliations	1.973	1.865	1.835	1.650	0.138		0.215	*
Busy board	0.104	0.000	0.086	0.000	0.019		0.000	
CEO duality	0.870	1.000	0.867	1.000	0.003		0.000	
Poor monitoring	1.145	1.000	1.568	1.000	-0.423	***	0.000	***

*The table reports the results of two-tailed t-tests and Wilcoxon rank-sum tests for the null hypothesis that there is no difference in the means and medians between the most and the least ethical financial institutions. The most ethical and the least ethical subsamples consist of financial institutions with below and above median Ethical rank, respectively. The board characteristics are defined as follows: Board size is the logarithm of the number of board members, Small board is a dummy variable which equals one for firms with below median board size, Board independence is percentage of independent board members, Board meetings is the logarithm of the the number of board meetings during a fiscal year, Board experience is the average number of years each board member has been on the board, Board gender diversity is the percentage of female board members, Two or more females is a dummy variable which equals one for firms with at least two female board members, Board affiliations is the average number of other board memberships of the board members, Busy board is a dummy variable which equals one for firms in which board members on average have at least three other board memberships, CEO duality is a dummy variable which equals one for firms in which the CEO is the board chair or a member of the board, and and Poor monitoring is a (0,5) composite measure for poor monitoring by the board of directors. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.*

Table 2 reports the mean and median values for the board characteristic of both subsamples and the results of the univariate tests. As can be noted from the table, there are statistically highly significant differences in the means and medians between the two subsamples in terms of *Board size*, *Small board*, *Gender diversity* and *Two or more females*. Specifically, the univariate tests indicate that financial institutions with stronger ethical reputation have larger and more gender diverse boards. This observation is consistent with the pairwise correlations discussed above, and thereby provides evidence to suggest that board size and gender diversity are strongly associated with the ethical reputation of financial institutions. Furthermore, the univariate tests for differences in *Poor monitoring* indicate that institutions with stronger ethical reputation are statistically significantly less likely to have boards that fulfill the characteristics for poor monitoring. In contrast to our expectations, the difference in the median number of board meetings between the two subgroups is

negative and significant at the 10 percent level, suggesting that the institutions with weaker ethical reputation are associated with more frequent board meetings.[6]

4.4. Regression results

We continue our empirical analysis by examining the association between board characteristics and ethical reputation in a multivariate setting. For this purpose, we estimate several alternative versions of the following panel regression specification:

$$\begin{aligned} Reputation_{j,t} = \alpha + \beta_{1-8}(Board\ characteristics)_{j,t} + \beta_{9-16}(Firm\text{-}specific\ controls)_{j,t} \\ + \beta_{17-21}(Year\ dummies)_{j,t} + \varepsilon_{j,t} \end{aligned} \quad (2)$$

where the dependent variable is one of the two alternative ethical reputation measures for bank *j* at time *t*, i.e. *Ethical score* or *Ethical rank*. In each of the alternative regressions, we include seven different board characteristics. The board characteristics included in the baseline specification are *Board size*, *Board independence*, *Board Meetings*, *Board experience*, *Board gender diversity*, *Board affiliations*, and *CEO duality*. We also estimate models in which the continuous measures of board size, gender diversity, and busyness are replaced with *Small board*, *Two or more females*, and *Busy board* dummy variables. As discussed above, the set of firm-specific control variables includes proxies for firm size, capital structure, financial performance, growth, riskiness, and asset structure. The regressions also include dummy variables to control for differences between commercial banks and other types of financial institutions as well as between U.S. and non-U.S. institutions. Finally, we control for potential time fixed effects with fiscal year dummy variables and we also estimate two-way fixed effects regressions that allow for a firm-specific constant. Throughout the regressions, we use robust standard errors which are adjusted for heteroskedasticity and within-firm clustering.

Table 3 reports the estimates of the panel regressions with *Ethical score* as the dependent variable. Models 1 and 2 are parsimonious models, which include *Size* and

[6] In further analysis, we observe that financial institutions which were experiencing severe problems during the global financial crisis increased the frequency of board meetings in 2008 and 2009.

Capital ratio as the only control variables, while Models 3 and 4 include the full set of control variables. Finally, Model 5 includes both year fixed effects as well as firm fixed effects. As can be noted from Table 3, the adjusted R^2s of Models 1-4 are around 40 percent, whereas the inclusion of firm fixed effects in Model 5 increases the adjusted R^2 to almost 80 percent. The *F*-statistics are statistically significant at the 1% level for all five regression specifications.

Table 3. *Board characteristics and ethical score*

	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)	
Constant	-667.325	***	-539.485	***	-739.304	***	-581.865	***	-1370.101	***
	(-10.251)		(-11.241)		(-8.08)		(-7.49)		(-6.194)	
Board characteristics:										
Board size	82.089	***			85.798	***			49.082	***
	(3.47)				(3.41)				(2.97)	
Small board			-2.056				-4.985			
			(-0.28)				(-0.88)			
Board independence	-0.042		-0.321	**	0.135		-0.169	*	-0.212	
	(-0.23)		(-2.24)		(0.81)		(-1.72)		(-0.64)	
Board meetings	-58.144	***	-60.618	***	-58.189	***	-60.543	***	-26.641	**
	(-8.93)		(-8.91)		(-7.66)		(-7.98)		(-2.04)	
Board experience	-0.669		0.773		0.580		1.512	*	4.091	
	(-0.84)		(1.59)		(0.65)		(1.83)		(1.48)	
Board gender diversity	1.040	***			1.279	***			-0.215	
	(3.37)				(3.41)				(-0.26)	
Two or more females			26.193	***			28.689	***		
			(5.10)				(4.22)			
Board affiliations	-4.846	***			-7.435	***			-7.936	***
	(-2.62)				(-5.96)				(-4.21)	
Busy board			-18.263				-22.708			
			(-1.18)				(-1.53)			
CEO duality	53.966	***	41.325	***	59.571	***	45.738	***	29.165	*
	(3.21)		(4.17)		(3.77)		(5.41)		(1.96)	
Control variables:										
Size	28.370	***	33.523	***	29.603	***	33.913	***	63.017	***
	(14.97)		(15.93)		(9.67)		(8.99)		(5.38)	
Capital ratio	1.473	***	1.569	***	1.524	***	1.683	***	1.550	
	(12.19)		(16.75)		(7.83)		(8.16)		(1.41)	
Return on equity					-0.163		-0.147	**	-0.135	
					(-1.32)		(-2.57)		(-0.73)	
Loans to assets					-0.127		-0.021		-0.304	
					(-0.81)		(-0.15)		(-0.45)	
Growth					-0.029		-0.004		-0.173	

	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)	
					(-0.21)		(-0.04)		(-1.57)	
Volatility					0.083		0.066		15.763	***
					(0.91)		(0.88)		(2.82)	
Financial services					8.349		4.149			
					(0.68)		(0.33)			
Non-US institution					22.077	**	18.172	**		
					(2.52)		(2.28)			
Firm fixed effects	No		No		No		No		Yes	
Year fixed effects	Yes		Yes		Yes		Yes		Yes	
Adjusted R2	41.44%		37.29%		40.83%		36.15%		79.63%	
F-stat.	10.30	***	9.07	***	7.35	***	6.38	***	13.40	***

*The table reports the estimates of five alternative versions of Equation (2). The dependent variable in the regressions is Ethical score which is the EthicalQuote Index issued by Covalence. The board characteristics are defined as follows: Board size is the logarithm of the number of board members, Small board is a dummy variable which equals one for firms with below median board size, Board independence is percentage of independent board members, Board meetings is the logarithm of the number of board meetings during a fiscal year, Board experience is the average number of years each board member has been on the board, Board gender diversity is the percentage of female board members, Two or more females is a dummy variable which equals one for firms with at least two female board members, Board affiliations is the average number of other board memberships of the board members, Busy board is a dummy variable which equals one for firms in which board members on average have at least three other board memberships, and CEO duality is a dummy variable which equals one for firms in which the CEO is the board chair or a member of the board. The control variables used in the regressions are defined as follows: Size is measured as the logarithm of total assets, Capital ratio is the ratio of equity to total assets, Return on equity is the ratio of net income to equity, Loans to assets is the ratio of net loans to totals assets, Growth is the percentage change in total assets from year t–1 to year t, Volatility is the logarithm of the annualized standard deviation of daily stock returns during the fiscal year, Financial services is a dummy variable which equals one for other financial institutions than commercial banks, and Non-US institution is a dummy variable for non-US financial institutions. The t-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and within-firm clustering. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.*

As can be seen from Table 3, the coefficient estimates for *Board size* are positive and statistically highly significant in all three models, while the coefficients for *Board gender diversity* and *Two or more females* are positive and statistically significant throughout Models 1-4. Hence, consistent with our research hypothesis and the univariate tests reported in Table 2, the regressions indicate that financial institutions with larger and more gender diverse boards are associated with better ethical reputation. However, it can also be noted from Table 3 that the coefficient estimate for *Board gender diversity* becomes insignificant after firm fixed effects are included in Model 5. This suggests that there are omitted (or unobserved) variables that mediate the relationship between gender diversity and ethical reputation. The documented positive effects of board size and gender diversity on ethical reputation are broadly consistent with the findings of Brammer *et al.* (2009), Musteen *et al.* (2010), and Bear *et al.* (2010), who report that board size and gender diversity are positively related to the reputation of non-financial firms.

Table 3 further shows that ethical reputation is significantly negatively associated with *Board affiliations* and positively associated with *CEO duality* throughout the alternative model specifications. With respect to the CEOs' presence on the board, our results are consistent with the findings of Bear *et al.* (2010) and Musteen *et al.* (2010) regarding the reputation of non-financial firms, and hence, provide further evidence that CEO duality may be beneficial for firm reputation. Overall, the regression estimates in Table 3 suggest that board characteristics that reflect stronger board monitoring and oversight may have positive effects of the ethical reputation of financial institutions.

However, inconsistent with our hypothesis, the coefficient estimates for *Board meetings* are negative and statistically highly significant throughout the alternative regression specifications. This provides strong evidence that financial institutions with less frequent board meetings have better ethical reputation. The unexpected negative relation between ethical reputation and the number of board meetings may be at least partially related to the drastic increase in the number of board meetings during the global financial crisis, especially in troubled institutions. Regarding the control variables, the estimates in Table 3 indicate that ethical reputation is strongly positively associated with *Size* and *Capital ratio*, suggesting that larger financial institutions with higher levels of equity capital have better ethical reputation. The estimates also indicate that non-US financial institutions are associated with better reputation.

Table 4. *Board characteristics and ethical rank*

	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)	
Constant	208.158	***	182.526	***	162.491	***	137.003	***	399.183	***
	(12.373)		(10.303)		(9.44)		(14.49)		(4.999)	
Board characteristics:										
Board size	-13.749	***			-11.838	***			-13.749	***
	(-5.02)				(-2.91)				(-3.08)	
Small board			2.986				2.317			
			(1.45)				(1.17)			
Board independence	-0.032		0.002		-0.025		0.015		-0.038	
	(-1.08)		(0.07)		(-1.30)		(0.59)		(-0.60)	
Board meetings	8.246	***	9.472	***	7.287	***	8.013	***	4.342	*
	(3.01)		(3.78)		(2.98)		(3.79)		(1.89)	
Board experience	-0.473	***	-0.667	***	-0.262	*	-0.356	*	-1.520	***
	(-3.05)		(-4.29)		(-1.82)		(-1.85)		(-5.88)	
Board gender diversity	-0.238	**			-0.239	*			-0.169	
	(-2.41)				(-1.96)				(-0.79)	
Two or more females			-4.225	**			-3.990	*		
			(-2.33)				(-1.92)			
Board affiliations	1.291	***			1.898	***			2.286	***
	(4.21)				(6.64)				(3.93)	
Busy board			3.189	*			4.101	**		
			(1.81)				(2.55)			
CEO duality	-5.201	**	-3.698	***	-8.130	***	-6.437	***	-1.272	
	(-2.48)		(-4.68)		(-5.49)		(-5.30)		(-0.19)	
Control variables:										
Size	-7.833	***	-8.541	***	-5.583	***	-6.053	***	-16.525	***
	(-8.08)		(-11.77)		(-14.01)		(-19.98)		(-4.31)	
Capital ratio	-0.414	***	-0.441	***	-0.306	***	-0.338	***	-0.434	
	(-9.79)		(-12.75)		(-9.38)		(-14.29)		(-1.53)	
Return on equity					0.007		-0.002		0.004	
					(0.26)		(-0.09)		(0.24)	
Loans to assets					0.064	*	0.041		-0.108	
					(1.75)		(1.19)		(-1.25)	
Growth					-0.008		-0.014		0.047	
					(-0.32)		(-0.68)		(1.60)	
Volatility					-2.458	***	-2.078	***	-0.538	
					(-3.34)		(-4.58)		(-0.55)	
Financial services					8.739	***	9.218	***		
					(2.82)		(3.14)			
Non-US institution					-0.229		0.682			
					(-0.11)		(0.44)			
Firm fixed effects	No		No		No		No		Yes	

	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)	
Year fixed effects	Yes		Yes		Yes		Yes		Yes	
Adjusted R2	50.33%		47.21%		52.36%		49.72%		77.27%	
F-stat.	14.32	***	13.14	***	11.11	***	10.40	***	11.78	***

The table reports the estimates of five alternative versions of Equation (2). The dependent variable in the regressions is Ethical rank *which is the EthicalQuote Index rank order of the financial institutions included in the sample.* Ethical rank *is constructed by assigning the financial institution with the best ethical reputation to value 1 and the institution with the worst ethical reputation to value 43. The board characteristics are defined as follows:* Board size *is the logarithm of the number of board members,* Small board *is a dummy variable which equals one for firms with below median board size,* Board independence *is percentage of independent board members,* Board meetings *is the logarithm of the number of board meetings during a fiscal year,* Board experience *is the average number of years each board member has been on the board,* Board gender diversity *is the percentage of female board members,* Two or more females *is a dummy variable which equals one for firms with at least two female board members,* Board affiliations *is the average number of other board memberships of the board members,* Busy board *is a dummy variable which equals one for firms in which board members on average have at least three other board memberships, and* CEO duality *is a dummy variable which equals one for firms in which the CEO is the board chair or a member of the board. The control variables used in the regressions are defined as follows:* Size *is measured as the logarithm of total assets,* Capital ratio *is the ratio of equity to total assets,* Return on equity *is the ratio of net income to equity,* Loans *to assets is the ratio of net loans to totals assets,* Growth *is the percentage change in total assets from year* t*–1 to year* t, Volatility *is the logarithm of the annualized standard deviation of daily stock returns during the fiscal year,* Financial services *is a dummy variable which equals one for other financial institutions than commercial banks, and* Non-US institution *is a dummy variable for non-US financial institutions. The* t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and within-firm clustering. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.*

The regression results with *Ethical rank* as the dependent variable are reported in Table 4. Overall, the estimates of the regressions with *Ethical rank* as the dependent variable are very similar to the results presented in Table 3. Specifically, the estimated coefficients for *Board size*, *Board gender diversity*, *Two or more females*, and *Board affiliations* suggest that financial institutions with larger, more gender diverse, and less busy boards are associated with better ethical reputation. Moreover, consistent with Table 3, the coefficient estimates for *Board meetings* and *CEO duality* suggest that ethical reputation is negatively related to the number of board meetings and positively related to CEO's board membership.

The main difference between Tables 3 and 4 is the statistical significance of the coefficient estimates of *Board experience*. The negative coefficient estimates suggest that institutions with more experienced boards are associated with better ethical reputation. Analogously to Table 3, the negative coefficients for *Size* and *Capital ratio* indicate that larger financial institutions with higher levels of equity capital have better ethical reputation. In general, the regressions with *Ethical rank* as the dependent variable are very similar to the estimates reported in Table 3, and thereby provide further evidence to suggest that board characteristics that are considered to reflect stronger board monitoring and oversight may have positive effects on the ethical reputation of financial institutions.

As the next step of the analysis, we utilize the composite index measure *Poor monitoring* to further examine the association between board monitoring and ethical reputation. Specifically, we estimate alternative versions of Equation (2) with *Poor monitoring* as the only test variable of interest. The estimates of the alternative panel regressions are presented in Table 5. In Models 1-3, we use *Ethical score* as the dependent variable, whereas in Models 4-6 the dependent variable is *Ethical rank*. Models 1 and 4 include only two control variables, while Models 2 and 5 include the full set of firm-specific controls. Finally, Models 3 and 6 include year fixed effects as well as firm fixed effects. The adjusted R^2s for the models with *Poor monitoring* as the only board related variable are considerably lower than the R^2s reported in Tables 3 and 4. Nevertheless, the adjusted R^2s indicate relatively good fit and the *F*-statistics are all statistically significant at the 1 percent level.

Table 5. *Poor monitoring and ethical reputation*

	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
	Ethical score		Ethical score		Ethical score		Ethical rank		Ethical rank		Ethical rank	
Constant	-509.941	***	-423.155	***	-1400.648	***	143.354	***	100.927	***	341.126	***
	(-17.226)		(-7.803)		(-5.50)		(8.80)		(7.615)		(4.883)	
Board variable:												
Poor monitoring	-9.891	***	-7.844	***	2.356		2.936	***	1.738	**	-0.264	
	(-7.29)		(-5.75)		(0.96)		(4.48)		(2.38)		(-0.54)	
Control variables:												
Size	27.181	***	26.096	***	70.445	***	-6.190	***	-4.272	***	-16.031	***
	(18.09)		(13.11)		(6.27)		(-7.81)		(-5.45)		(-5.27)	
Capital ratio	1.523	***	1.483	***	0.529		-0.333	***	-0.252	***	-0.117	
	(23.53)		(15.46)		(0.83)		(-11.08)		(-10.40)		(-0.61)	
Return on equity			0.303	**	-0.060				-0.071	**	-0.039	
			(2.03)		(-0.29)				(-2.06)		(-0.73)	
Loans to assets			0.021		0.531	***			0.024		-0.140	
			(0.15)		(3.46)				(0.61)		(-1.60)	
Growth			0.194	*	-0.193	**			-0.053	**	0.021	
			(1.97)		(-2.10)				(-2.09)		(0.77)	
Volatility			-18.675	**	-0.869				0.005		2.064	
			(-2.15)		(-0.08)				(0.00)		(0.66)	
Financial services			-7.436	*					10.109	***		
			(-1.78)						(6.97)			
Non-US institution			-1.018						2.769	**		
			(-0.17)						(1.98)			
Firm fixed effects	No		No		Yes		No		No		Yes	
Year fixed effects	Yes		Yes		Yes		Yes		Yes		Yes	

	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
	Ethical score		Ethical score		Ethical score		Ethical rank		Ethical rank		Ethical rank	
Adjusted R^2	18.04%		17.57%		79.86%		33.15%		40.16%		70.97%	
F-stat.	6.09	***	3.66	***	13.60	***	12.48	***	9.36	***	8.76	***

The table reports the estimates of six alternative versions of Equation (2). In Models 1-3, the dependent variable in the regressions is Ethical score *which is the EthicalQuote Index issued by Covalence. In Models 4-6, the dependent variable in the regressions is* Ethical rank *which is the EthicalQuote Index rank order of the financial institutions included in the sample. The test variable of interest is* Poor monitoring *which is a (0,5) measure constructed as the sum of the following five binary criteria: (i) the number of board members is below the sample median, (ii) the percentage of independent board members less than 50 %, (iii) the number of board meetings is below the sample median, (iv) there are no female board members, and (v) the average number of other board affiliations of the board members is at least three. The control variables used in the regressions are defined as follows:* Size *is measured as the logarithm of total assets,* Capital ratio *is the ratio of equity to total assets,* Return on equity *is the ratio of net income to equity,* Loans *to assets is the ratio of net loans to totals assets,* Growth *is the percentage change in total assets from year* t–*1 to year* t, Volatility *is the logarithm of the annualized standard deviation of daily stock returns during the fiscal year,* Financial services *is a dummy variable which equals one for other financial institutions than commercial banks, and* Non-US institution *is a dummy variable for non-US financial institutions. The* t-*statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and within-firm clustering. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.*

As can be noted from Table 5, the coefficient estimates for *Poor monitoring* are negative and statistically highly significant in Models 1 and 2 with *Ethical score* as the dependent variable and positive and significant in Models 4 and 5 with *Ethical rank* as the dependent variable. Hence, consistent with our research hypothesis, the regressions suggest that poor monitoring by the board of directors may have a negative effect on ethical reputation. However, after firm fixed effects are included in the regressions (Models 3 and 6), the coefficients for *Poor monitoring* appear statistically insignificant, suggesting that omitted or unobserved firm characteristics may mediate the negative relationship between ethical reputation and poor monitoring. With respect to the control variables, it can be again noted from Table 5 that *Size* and *Capital ratio* are strongly positively associated with the ethical reputation of financial institutions.

4.5. Endogeneity

It is important to acknowledge that our empirical analysis may suffer from endogeneity and reverse causality. Unfortunately, we are unable to use the standard econometric tools for alleviating endogeneity problems. We cannot use instrumental variable regressions because we have seven potentially endogenous board characteristics in each regression and this would require seven valid instruments. Moreover, given the small sample limited to financial institutions for which the Covalence EthicalQuote is available, we are unable to use propensity score matching. Finally, we cannot perform difference-in-difference tests because most board

characteristics change very slowly over time and do not display much within-firm variation during the sample period. In order to alleviate endogeneity concerns, we exploit the financial crisis as an "exogenous" shock to the ethical reputation of financial institutions. Specifically, we estimate cross-sectional regressions with the changes in *Ethical score* and *Ethical rank* amidst the financial crisis from year 2008 to year 2009 as the dependent variables and the pre-crisis board characteristics and institution-specific controls as the independent variables.

Table 6 reports the estimates of six alternative regressions with the change in ethical reputation as the dependent variable. In Models 1-3, the dependent variable is the change in *Ethical score* from 2008 to 2009, while in Models 4-6 we use the change in *Ethical rank* as the dependent variable. Hence, the coefficients of these regressions indicate how board characteristics are related to the direction and the magnitude of the change in ethical reputation amidst the financial crisis. Interestingly, the regressions indicate that a large proportion of the changes in ethical reputation during the financial crisis can be explained with the pre-crisis board characteristics. Consistent with our main analysis in Tables 3 and 4, the coefficient estimates for *Board size*, *Board meetings*, and *CEO duality* are statistically highly significant, and indicate that the change in the ethical reputation of financial institutions during the crisis is positively related to board size and the CEO's board membership and negatively related to the number of board meetings. Furthermore, the coefficient for *Poor monitoring* is positive and statistically significant in Model 6, suggesting that the adverse influence of the financial crisis on ethical reputation may have been moderated by boards that exert stronger monitoring.

Table 6. *Board characteristics and changes in ethical reputation during the financial crisis*

	Model (1) Δ Ethical		Model (2) Δ Ethical		Model (3) Δ Ethical	Model (4) Δ Ethical		Model (5) Δ Ethical		Model (6) Δ Ethical	
Board											
Board size	58.099	***				-15.886	**				
	(3.03)					(-2.38)					
Small board			-4.406					0.289			
			(-0.49)					(0.08)			
Board independence	0.232		-0.093			-0.044		0.013			
	(0.95)		(-0.33)			(-0.78)		(0.19)			
Board meetings	-36.661	**	-45.072	***		4.659		7.285	**		
	(-2.49)		(2.87)			(1.38)		(2.22)			
Board experience	-1.317		-0.041			0.228		0.038			
	(-1.17)		(-0.03)			(0.69)		(0.08)			
Board gender	-0.844					0.111					
	(-1.10)					(0.70)					
Two or more females			-8.148					0.565			
			(-0.81)					(0.21)			
Board affiliations	8.216	*				-1.433					
	(1.73)					(-1.37)					
Busy board			13.409					-2.182			
			(1.52)					(-1.22)			
CEO duality	51.552	***	51.110	**		-12.117	***	-9.588	*		
	(3.13)		(2.44)			(-3.00)		(-1.90)			
Poor monitoring					-3.746					1.940	*
					(-0.94)					(2.01)	
Control variables	Yes		Yes		Yes	Yes		Yes		Yes	
Adjusted R^2	55.46%		49.31%		2.33%	47.29%		47.29%		17.99%	
F-stat.	5.70	***	4.57	***	1.28	4.39	***	4.39	***	3.56	**

The table reports the estimates of six alternative cross-sectional regressions. The dependent variable is the change in Ethical score *from year 2008 to year 2009 in Models 1-3 and the change in* Ethical rank *from year 2008 to year 2009 in Models 4-6. The board characteristics are defined as follows:* Board size *is the logarithm of the number of board members,* Small board *is a dummy variable which equals one for firms with below median board size,* Board independence *is percentage of independent board members,* Board meetings *is the logarithm of the number of board meetings during a fiscal year,* Board experience *is the average number of years each board member has been on the board,* Board gender diversity *is the percentage of female board members,* Two or more females *is a dummy variable which equals one for firms with at least two female board members,* Board affiliations *is the average number of other board memberships of the board members,* Busy board *is a dummy variable which equals one for firms in which board members on average have at least three other board memberships,* CEO duality *is a dummy variable which equals one for firms in which the CEO is the board chair or a member of the board, and* Poor monitoring *is an index for poor monitoring by the board of directors.* Poor monitoring *is an (0,5) measure constructed as the sum of the following five binary criteria: (i) the number of board members is below the sample median, (ii) the percentage of independent board members less than 50 %, (iii) the number of board meetings is below the sample median, (iv) there are no female board members, and (v) the average number of other board affiliations of the board members is at least three. The* t-*statistics (in parentheses) are based on White's heteroskedasticity consistent standard errors. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.*

Nevertheless, it should be noted from Table 6 that the change regressions are somewhat inconsistent with our main analysis with respect to board busyness and gender diversity. While the panel regressions in Tables 3 and 4 provide strong evidence that *Board affiliations* and *Busy board* are negatively associated with ethical reputation, the coefficient estimates for both variables now appear insignificant in most models, indicating that the change in ethical reputation amidst the crisis is not affected by board busyness. Furthermore, as shown in Table 6, the coefficient estimates for *Board gender diversity* and *Two or more females* are statistically insignificant throughout the alternative regression specifications, suggesting that the change in ethical reputation during the financial crisis is unaffected by board gender diversity. Given the insignificance of *Board gender diversity* in the two-way fixed effects regressions in Tables 3 and 4 and also in the change regressions in Table 6, we conclude that the strong positive association between ethical reputation and board gender diversity documented in the univariate tests and in the one-way fixed effects regression specifications is not a robust result and may be largely driven by endogeneity.

In our main analysis, we use contemporaneous data on the dependent and independent variables. To further address concerns related to endogeneity and reverse causality, we re-estimate the regressions by using one-year lagged board characteristics and firm-specific control variables as the independent variables.[7] The estimation results of the regressions with lagged independent variables (not tabulated) are very similar to the results reported in Tables 3 and 4. Most importantly, the coefficient estimates for *Board size*, *Board meetings*, and *CEO duality* are statistically highly significant in the regressions with the lagged independent variables, and consistent with our main analysis indicate that ethical reputation is positively associated with board size and CEO duality and negatively associated with the number of board meetings. Furthermore, when *Ethical score* is used as the dependent variable, the estimated coefficients for

[7] It is worth noting that board characteristics change slowly over time, and therefore, the one-year lagged values of the board characteristics are highly correlated with the contemporaneous values. The only board characteristic that displays significant within-firm variation during our sample period is *Board meetings*; troubled financial institutions increased the frequency of board meetings amidst the financial crisis.

Board gender diversity, *Two or more females*, *Board affiliations*, and *Busy board* are consistent with the estimates reported in Table 3. However, in the regressions with *Ethical rank* as the dependent variable, the coefficients for our two female board representation variables as well as the two board busyness variables appear statistically insignificant.

4.6. Additional tests

We conduct several additional tests to ascertain the robustness of our empirical findings.[8] First, we re-estimate the alternative versions of Equation (2) by replacing *Size* and also by replacing both *Size* and *Capital ratio* with a dummy variable for systematically important financial institutions (*SIFI*). The estimates of these additional regressions are consistent with our main analysis. Interestingly, the coefficient estimates for *SIFI* are positive (negative) and highly significant in the *Ethical score* (*Ethical rank*) regressions, suggesting that systemically important institutions are associated with better ethical reputation.

Furthermore, to ensure that our findings are not affected by size effects, we re-estimate the regressions in two subsamples from which the largest 20 percent and the smallest 20 percent of the institutions are excluded. The results of these regressions are qualitatively similar to the results reported in Tables 3-5, and hence, provide further evidence that the ethical reputation of financial institutions is positively related to the board characteristics that reflect more effective monitoring.

We also conduct additional tests to examine the potential effect of the financial crisis on our results. Specifically, we first re-estimate the regression using data on the pre-crisis years 2005-2007. The estimates of the regressions in this subsample are very similar to our main findings. We also re-estimate the regressions using data on the crisis and the post-crisis years 2008-2010. Once again, the regression results are consistent with the results reported in Tables 3-5, and thereby suggest that our empirical findings

[8] For brevity, we do not tabulate our robustness checks. The results of these additional tests are naturally available from the authors upon request.

are not affected by the sample period. Finally, we define "troubled" institutions based on high stock return volatility and negative return on equity and exclude these institutions from the sample. The estimates based on the restricted sample without "troubled" institutions are consistent with our main findings. Hence, we conclude that our empirical findings are not affected by the financial crisis and are not particularly sensitive to different samples and different sample periods.

4.7. Limitations

We acknowledge that there are several limitations that should be considered when interpreting our empirical findings. First, the sample used in the analysis is extremely small and limited to only 43 large financial institutions for which the Covalence EthicalQuote index is available. The small number of financial institutions obviously limits the statistical power of our tests and the generalizability of the results. Second, our sample period is limited to the fiscal years surrounding the global financial crisis. Given that the financial crisis had a strong adverse effect on the performance as well as the ethical reputation of financial institutions, it is possible that the relation between board characteristics and ethical reputation would be different in more normal business conditions.

Furthermore, it is important to recognize that our empirical analysis relies on the assumption that the Covalence EthicalQuote index is an effective measure of the ethical reputation of financial institutions. Given the obvious difficulty with quantifying ethical conduct and ethical reputation, it is conceivable that the Covalence EthicalQuote index is a very imperfect proxy for ethical reputation. More generally, it is necessary to remember that ethics is a human concern that cannot be reduced to numbers. Unethical behavior is often observed only in hindsight and cases like Enron demonstrate that external assessment of ethical conduct can be difficult.

Finally, as most empirical research on corporate boards and corporate governance, our analysis is subject to endogeneity concerns. We are unfortunately unable to use the standard econometric tools for alleviating endogeneity problems, and consequently, any causal interpretations of our findings should be made with caution.

Given these severe limitations, the empirical analysis presented in this essay should be viewed as exploratory in nature.

5. Conclusions

In this essay, we examine the association between board characteristics and the ethical reputation of financial institutions. The motivation for this analysis stems from the public outcry and policy debate regarding the role of financial industry's unethical business practices and flawed governance mechanism for the outbreak of the global financial crisis. Given the amplified expectations towards more ethical behavior in the financial industry, it is of interest to empirically examine whether the ethical reputation of financial institutions is affected by the board of directors. The board of directors is the most important internal governance mechanism within a firm and is responsible, among other things, for establishing and monitoring the ethical culture of the firm. If ethical reputation is a value-relevant intangible asset for financial institutions, we should observe a positive relationship between ethical reputation and board attributes that reflect more stringent board monitoring and oversight.

The empirical analysis presented in this essay is based on a sample of large publicly traded financial institutions from 13 different countries. We measure the ethical reputation of financial institutions with the Covalence EthicalQuote index and our sample period covers the years surrounding the global financial crisis. Consistent with our research hypothesis, the results demonstrate that financial institutions with board characteristics that reflect more effective monitoring and oversight have better ethical reputation. Specifically, we document that ethical reputation is positively associated with board size, experience, gender diversity, and CEO duality, while being negatively related to board busyness and a composite index reflecting poor monitoring by the board of directors. Nevertheless, inconsistent with our hypothesis, we also find that financial institutions with less frequent board meetings are associated with better ethical reputation. We conduct a number of additional tests to ensure the robustness of our findings. These tests indicate, for instance, that the adverse influence of the global financial crisis on ethical reputation of financial institutions was less pronounced for institutions with larger boards, less frequent board meetings, CEO duality, and boards that exert stronger monitoring.

Overall, the empirical findings reported in this essay provide considerable evidence that more stringent monitoring and oversight by the board of directors may improve the ethical reputation of financial institutions. Assuming that the perceived ethical reputation reflects actual ethical behavior, our results indicate that structural factors such as board size and CEO duality as well as certain observable characteristics of individual directors such as busyness, experience, and gender may be important factors associated with firm-level ethical conduct. While recent regulatory initiatives and policy reforms have emphasized board independence and discouraged CEO duality as means to improve the functioning of boards, our findings suggest that inside directors may actually have an essential role in establishing and advocating an ethical corporate culture. Given the alleged role of governance failures and negligent ethical culture of financial institutions in the development of the global financial crisis, we believe that our results may have important implications for bank supervisors, regulators, depositors, and other stakeholders of financial institutions. Most importantly, our results highlight the benefits of effective board monitoring and oversight in advocating and sustaining ethical business practices in the financial industry.

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Appendix 1. List of financial institutions.

1. Australia and New Zealand Banking Group
2. Banco Bilbao Vizcaya Argentaria
3. Banco Santander
4. Bank of America
5. Bank of New York Mellon
6. Bank of Nova Scotia
7. Barclays Bank
8. BNP Paribas
9. Capital One Financial Corporation
10. Charles Schwab
11. Citigroup
12. Commonwealth Bank of Australia
13. Credit Agricole
14. Credit Suisse
15. Daiwa Securities Group
16. Deutsche Bank
17. Fannie Mae
18. Fifth Third Bancorp
19. Freddie Mac
20. Fubon Financial Holding
21. Goldman Sachs
22. HSBC
23. Intesa Sanpaolo
24. Invesco
25. Itausa- Investimentos Itau
26. JPMorgan Chase
27. Lloyds Banking Group
28. Macquarie Group
29. Mitsubishi UFJ Financial Group
30. Morgan Stanley
31. National Australia Bank Limited
32. Orix Corporation
33. Royal Bank of Canada
34. Royal Bank of Scotland
35. Sallie Mae
36. Société Générale
37. State Street Corporation
38. Sumitomo Mitsui Financial Group
39. T. Rowe Price
40. Toronto Dominion Bank
41. UBS
42. US Bancorp
43. Wells Fargo and Company

General conclusions

The overall conclusion of this dissertation is that bank-specific variables that are closely related to skilled and qualified management significantly contribute to reductions in bank risk-taking. In addition, effective information systems such as well-monitored boards of directors, lead to better ethical reputations for financial institutions. Moreover, these indicators exert a similar or greater effect under crisis macroeconomic conditions.

Other, more specific findings of these three essays are the following: i) an increase in bank-specific factors, such as capitalization, profitability, efficiency and liquidity, can significantly contribute to reductions in bank risk, whereas wholesale funding by banks increases their risk; ii) different sources of revenue diversification significantly contribute to reductions in non-performing loans of commercial banks in the euro area; iii) bank risk is significantly affected by external factors that do not directly depend on bankers' managerial quality and skills, such as concentrated markets, lower interest rates, higher inflation rates and economic crises (with e.g., falling GDP), each of which increases bank risk; and iv) financial institutions with board characteristics that reflect more effective monitoring and oversight have better ethical reputations.