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# SYSTEMIC RISK AFFECTED
# BY COUNTRY LEVEL DEVELOPMENT.
# THE CASE OF THE EUROPEAN BANKING SECTOR

The goal of this study is to identify empirically how country level development affects the risk profiles of the EU banking sector. We examine the implications of banks' activity and risk-taking that manifest themselves as spreading and growing instability. Additionally we explore the interaction between banking risk and structural, macroeconomic and financial market determinants. Through a dataset that covers 4678 European banks spanning the period 1996–2011 and the methodology of panel regression, the empirical findings document that credit, liquidity or insolvency risk are determined by market factors and could be systemic risk indicators in the banking sector. To show the heterogeneity of systemic risk determinants, the study sample was divided according to the economic development of a country into two groups: advanced and developing countries. The findings have implications for both bank risk management and regulators. This paper advances the agenda of making macroprudential policy operational.

## 1. INTRODUCTION AND MOTIVATION

The direct cause of the study is the last global financial collapse of 2007–2009. The global financial crisis has shown that reaping the benefits of international financial integration is not possible without incurring large risks. Regulatory perspectives (e.g. the application of liquidity and solvency buffers) impose the need to understand the systemic risk contributions of individual banks and find sources and measure them. The introduction of the U.S. Gramm-Leach-Bliley Act of 1999 reduced any functional obstacles between traditional and non-traditional bank activities, allowing banks to use additional funding mechanisms and offer a full range of services. This phenomenon was important not only for the US market, but also for the European sector. Regarding the above and the high degree of integration of

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the banking sector, the aim of the research is evaluating the systemic risk in the banking sector in European countries. Although some researchers suggest that banks' revenue diversification increases the similarities among banks and thereby elevates the systemic risk of the banking sector (Pozsar *et al*. 2010), there is significant disagreement in the literature due to the differences in methodology for identifying the determinants of systemic risk. While there is no widely accepted definition of systemic risk measure or its factors (De Bandt and Hartmann 2000; Perotti and Suarez 2009), the working hypothesis in this paper is that the sources of systemic risk are differentiated across countries and driven by the type of banking activity.

From a quantitative viewpoint, systemic risk refers to small-probability events in the financial system that result in high losses (Drehmann and Tarashev 2011). The theory also provides conflicting predictions about optimal systemic risk measures. It suggests that measurement tools should support the understanding of linkages between financial institutions and macroeconomics. The European Central Bank categorized three forms of systemic risk in the banking sector: first, as a slow build-up of vulnerabilities in the banking sector that may drive a financial crisis; second, as a result of an idiosyncratic risk to a particular financial institution that is transmitted to other entities; third, as a common shock that affects the whole system and is propagated to the real sectors (EBC 2009). The causes and effects of banking crisis contagion have been addressed in several studies (Acharya *et al.* 2010a; Brunnermeier 2009; Allen and Gale 2004; Gropp *et al.* 2009), but we know relatively little about the macroeconomic, structural and financial determinants of systemic risk.

Taking into account the incompleteness of systemic risk definition, this paper adopts a combined approach and presents four indicators (leverage ratio, liquidity gap, loan loss provision and profitability) which cover a wide range of risk-taking by banks.

Another problem is the location of systemic risk sources in the banking sector. This study addresses the need for a better understanding of the factors of systemic risk by taking a local and global perspective. To the best of the author's knowledge, this is the first study that seeks to identify which determinants can explain the vulnerability contributed by individual banks to systemic risks by analyzing several risk-taking indicators in two groups of countries: advanced and emerging markets in Europe.

The reversal of the financial market integration in Europe during the global financial crisis required the tools to measure and monitor banking sector fragmentation. Feedback loop between emerging and developed

economies, particularly at the height of the European sovereign debt crisis, needs to incorporate another important question of whether the factors of the banks' contribution to systemic risk are the same in a cross-country analysis and for different stages of country development. In order to examine the above we consider different sub-groups: advanced economies vs. emerging economies. It could be necessary to explain the essentials and differences in affecting systemic risk. If systemic risk is driven by different sets of determinants in European countries, the regulators could not design the same strategies to limit systemic risk for advanced and emerging markets.

Based on the empirical literature, identification of systemic risk determinants in the Central and Eastern European banking sector appears to be limited. The international regulatory framework of the banking sector, which is dedicated to advanced economies, may not have an application in the emerging markets.

Prior to the last crisis, in advanced countries, banking systems' vulnerabilities built up through complex chains of credit intermediation. On their funding side, banks were vulnerable to wholesale markets, so liquidity shortages spread quickly. Alternatively, disturbance was also caused because of higher than average developments in investment banking.

The novelty of the article is the identification and comparison of systemic risk determinants in two samples of groups: advanced economies and emerging markets, taking into account different banking risks. Different banking activities can generate systemic risks that can affect financial systems and the economy in dissimilar ways in emerging markets and developed countries.

The contribution of this study is as follows: first, based on the research undertaken by Brunnermeier and Pedersen (2009), Beck, Demirgüç-Kunt and Levine (2005) and Brewer, *et al.* (2008), we present a bank's risk indicators that can describe systemic risk: i. leverage ratio, ii. financing gap, iii. credit asset quality, iv. the profitability of the bank. Each of the above factors can contribute to the changing and growing instability of individual banks and the entire financial system. We document trends in the relative importance of risk and efficiency ratios for a large sample of international banks over 10 years to take into account the impact of the business cycle in systemic risk fluctuation. Still open is the question of the pro-cyclical nature of systemic risk (see Bank of England 2009; Borio *et al.* 2001); second, the study explores the implications of the interaction between bank risk-taking and a range of determinants associated with countries at different levels of economic development. The empirical study on the determinants of systemic

risk diversification will answer the question of which factors, omitted in previous studies, and which factors: structural, specific for the financial sector, or macroeconomic conditions implicate significant impulses for systemic risk spread.

To test the direction of systemic risk causality we employed a panel data framework using the Arellano and Bond GMM-estimator (Arrelano and Bond 1991; Blundell and Bond 1998) for data spanning the years 1996–2011 on individual banks available in the Bankscope database.

Our estimates show that in developing countries, a bank's risk is characterized by macroeconomic factors (change of economic growth). Increasing volatility in financial markets and financial liberalization can have a discernible negative impact on the banking sector stability through a number of channels, including the leverage, liquidity and solvency risk. This result is particularly evident in banks in advanced countries of Europe. These findings highlight the need for regulatory bodies to better monitor the market and banking activities. The determination of a bank's contribution to systemic risk provides us with further insights into the factors that drive systemic risk in a relatively unified and standardized area, which the European Union is. A bank's contribution to the probability of a systemic financial crisis in Europe can be explained by the country-specific characteristics of the banking sector and the regulatory system.

The remainder of the paper is organized as follows: Section 2 analyzes the relevant literature and the nature of systemic risk determinants. Section 3 outlines the study design and methodological issues. Section 4 presents the data sample. Section 5 presents the study results. Finally, concluding remarks and policy implications are provided in section 6.

## 2. THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

In this section, we briefly discuss the related theoretical and empirical literature on the determinants of a financial institution's contribution to systemic risk.

Early research on contagion effects during bank crises has primarily been concerned with the negative effects on financial systems as expressed by the reactions of the capital markets (see e.g. Akhigbe and Madura 2001). The systemic risk of banks is shown to be due to the similarity of banks' balance sheets and customer base, or the high correlation of the assets. For example, Goldsmith-Pinkham and Yorulmazer (2010) find significant contagion

effects within British banks after the subprime crisis. Further empirical studies on the performance of banks during the last financial crisis of 2007–2008, conducted by Fahlenbrach *et al.* (2012), show the drivers of banks' returns. Additionally, extensive studies of the causes and effects of bank contagion were conducted by Allen and Gale (2000); Allen and Gale (2004); Brunnermeier (2009); Acharya *et al.* (2010a). Then Mendoza and Quadrini (2010) discovered that financial integration leads to a sharp rise in net banking credit and large asset price spillovers. Goodhart and Huang (2005) show that contagion in the banking sector is the key factor affecting a central bank's decision to bail out failing banks. Ratnovski (2009) stated that a policy of bailing out troubled banks might only be possible in transparent economies. Hempell and Sorensen (2010) emphasized that banks change their bank credit standards depending on the current phase of the economic cycle. Gai *et al.* (2011) investigated a model in which the concentration and complexity of a financial market can increase systemic liquidity problems.

In the empirical literature on financial stability, several macroeconomic and idiosyncratic determinants have been conjectured to be significantly related to a bank's contribution to the systemic risk. Most prominently, bank leverage and liquidity are often cited as the main drivers of a bank's input to systemic risk. High leverage ratio and the short-term funding in the capital market could promote systemic crisis effects (e.g. Stein 2011; Shleifer and Vishny 2011). In fact, Basel III attributes the recent crisis to the build-up of excessive leverage. In the second line of research, the importance of the bank size and connections have been empirically analyzed. Larger banks, as too big to fail, are often more complex and highly interconnected with their competitors (see e.g. Acharya *et al.* 2010b; Beltratti and Stulz, 2012). The information about the network of financial firms is very useful in the prediction of disturbances, but much more difficult to collect in a dynamic financial system. Recently, Cont (2010) and Kim and Giesecke (2010) presented a network-based systemic risk measure.

The topic of systemic risk determinants has been broadly investigated in the literature, but a consensus on whether banks' regulators should use the same macroprudential approach to commercial banks with a signaling effect is still missing. The recent crisis has significant implications for the feasibility of different banking models. On the assets and funding side, the crisis exposed weaknesses in different banks. Interbank money market rates rose dramatically, reflecting perceptions of increased counter-party risk (Demirgüç-Kunt, Huizinga 2009).

In the second line of research, the severity of systemic risk and its determinants have been empirically analyzed. The empirical literature on the measures and the sources of systemic risk is vast, but the evidence found in the studies is unconfirmed both in advanced and emerging markets. This article relates to the broader literature on systemic risk. The latest studies that have proposed measures of systemic risk are Jajuga *et al.* (2017), Acharya *et al.* (2010a), Allen *et al.* (2010), Brunnermeier *et al.* (2011), Billio *et al.* (2010), Chan-Lau (2010), Huang *et al.* (2009), Browlees and Engle (2010), Karkowska (2012) and Zhou (2010). Acharya *et al.* (2010a), who measured systemic risk as the amount by which a bank is undercapitalized in a systemic event in which the entire financial system is undercapitalized. For example, Brunnermeier et al. (2011) found that banks' non-interest income explains some of the variations in their systemic risk proxies. Weiß *et al.* (2014) analyzed the factors of the contribution of banks to both global and systemic risk during financial crises and found no evidence supporting assumptions that bank leverage, size or non-interest income are determinants of systemic risk across financial crises. Laeven *et al.* (2016) used American financial institutions in the period of 2007 to the end of 2008 and found that systemic risk grows with bank size and some evidence that risk is lower in more-capitalized banks. Silva *et al.* (2017) developed an estimation of systemic risk that accounts for feedback effects between the real and financial sectors in the Brazilian market. Laeven and Levine (2009) used an international sample of 296 banks in 2001 from 48 countries to check how banks' risk-taking ratios, measured by stock return variability and *Z*-score ratio, are affected by banking regulations. A few studies employed ratings as systemic risk indicators and find various dimensions of bank regulation and supervision that affect bank risk. Pasiouras *et al.* (2006) also used this survey using bank-level data from 71 countries and 857 banks. Most studies on bank soundness use country-level data and focus on one indicator of risk (for instance, Beck *et al.* 2005; Barth *et al.* 2004). In contrast, we applied a factor analysis to four indicators of banking risk and examined individual bank-level data (see Gonzalez 2005; Demirgüç-Kunt *et al.* 2008). A multitude of the used methods was tested in the mature economies, which, however, does not allow for drawing clear conclusions for the emerging countries.

Therefore, we hypothesize that:

H: The nature and sources of the systemic risk generated in banks in emerging countries are different from those in advanced countries, as a result of:

‒ macroeconomic factors;
‒ differentiation of the specific features of the banking sector, expressed by its size, development, concentration and participation of foreign capital;
‒ financial sector vulnerability to capital market changes.

In the empirical literature on systemic risks, several macroeconomic and idiosyncratic drivers have been conjectured to be significantly associated with a bank's contribution to the variability of the financial sector. An important question to ask in this context is whether the determinants of banks' input to systemic risk are constant over the whole Europe. If systemic risk is indeed driven by the same set of factors in different countries, regulators could create strategies developed on the basis of these findings to recognize unstable institutions and limit the build-up of systemic risks. In contrast, if the systemic risk drivers are unique to each country, then the same regulations for Europe could increase problems and promote the next systemic crisis.

Banking activity and strategy are also different in the advanced and the emerging countries. Our paper fills a gap in the literature, since to our knowledge no empirical studies have considered the implications of a large group of factors for systemic risk, making a comparison analysis in advanced and emerging countries in Europe. However, several studies have examined the implications of various bank activities for banks' risk and systemic risk based mostly on the U.S. banking system.

Finally, banking crises experienced by several countries in Central and Eastern Europe (CEE) are caused by economic restructuring in the real economy and financial liberalization. According to Mannasoo and Mayes (2005), the 1990s crisis that hit the CEE countries was the result of the domination of state-owned banks, and the high proportion of non-performing loans. Emerging markets may be particularly vulnerable to systemic risk, as they tend to receive capital flows that are huge in relation to the size of financial systems and their capacity. The integration of the CEE countries into the European Union led to strong links of financial markets with institutions from Western Europe, which may increase the vulnerability of these markets to external crises (the 2008 crisis in the Western European economies has led to a devaluation in the foreign exchange markets and a significant increase in risk premiums). Any crisis shocks may be exacerbated more easily in emerging countries because of institutional and structural characteristics. These findings build on earlier work (Claessens and Horen, 2012) which showed that business cycles are much more volatile in emerging markets than in advanced economies. On the one hand, the

operations of global banks can stabilize the sector in developing countries in response to local shocks. However, Cetorelli and Goldberg (2011) claim that the transmission of crisis turbulence by a cross-section of advanced countries to emerging markets can significantly affect the latter's stability.

## 3. RESEARCH DESIGN AND METHODOLOGICAL ISSUES

To analyze a wide spectrum of the systemic risk effects of banking activity, we made use of four different measures that have been proposed in the literature. According to the studies by Brunnermeier and Pedersen (2009), Beck *et al.*(2005), Athanasoglou *et al.* (2008) and Brewer *et al.* (2008), the following measures were adopted as the basis for determining a bank's sensitivity to adverse shocks that generate systemic risk: i. leverage, ii. financing gap, iii. credit asset quality, iv. the profitability of the bank. Each of the above factors can stimulate the changing and growing instability of individual banks and the entire financial system.

### 3.1. Identification of systemic risk measures

Amongst other indicators of systemic risk, theorists take into account different measures showing the ability of banks to avoid the crunch such as liquidity risk measures. According to Kaminsky and Reinhart (1998), a high ratio of the bank reserves means the inability of banks to manage a potential crisis. Calmès and Théoret (2013) explain that market-oriented banking creates new sources of liquidity generated by off-balance-sheet activities, so time-varying indicators of liquidity gap become more informative of the risk-taking dynamics in the banking sector. In accordance with Basel III, certain banks will have to maintain better-quality and more liquid assets to better manage their liquidity risk. However, because it targets only individual banks, Basel III liquidity rules can address systemic liquidity risk only in a limited way (the systemic liquidity risk means that multiple institutions may encounter simultaneous problems in rolling over their short-term debts or in obtaining new short-term funding, because of difficulties in money and capital markets). López-Espinosa *et al.* (2013) focused on the five categories that the Basel Committee on Banking Supervision proposed as indicators of systemic importance, and suggested that unstable funding is the main factor driving systemic risk**.** Larger liquidity buffers should lower the liquidity shortfalls (Bank of England 2009; Brunnermeier and Pedersen 2009). As the liquidity risk we examine the liquidity gap LIQGAP that is captured by a crude ratio of total loans to total deposits.

To assess the solvency risk of a bank, we make use of the leverage ratio LEV – defined as the inverse of the capital value of the total assets of a bank. A high leverage ratio may also indicate riskiness. The value of the leverage ratio in European commercial banks in the period 1996–2011 showed that since the late 1990s we have been dealing with a strong upward trend of this indicator (Borio *et al.* 2001; Berger *et al.* 1995; Zhou 2008). Both leverage, as a measure of solvency risk of a bank, and the funding gap, as a measure of liquidity risk, can become excessive. As mentioned above, this is usually a result of misperceptions of risk or wrong responses to risk by banks across the business cycle. Valencia (2014) showed that banks with limited deposits lever up to finance future loans. Lower monetary policy rates always provide risk-taking incentives across banks. In a related study, Dell'Ariccia *et al.* (2014) showed that reductions in interest rates lead to higher risk and greater leverage. In a rare study on cross-bank variation of systemic risk, Berger and Bouwman (2013) found that higher capital helps small banks increase their probability of survival during bank crises. Acharya *et al.* (2010b), Beltratti and Stulz (2012) emphasized that reliance on short-term capital market funding and leverage could have an effect on the banking sector stability.

Following Albertazzi and Gambacorta (2009) we assume that profitability (PROFIT) is the next indicator of systemic risk. Bank efficiency is measured in many different ways. Some authors consider return on average assets, whereas other focus on several dimensions of efficiency, such as net interest income, non-interest income, overhead costs, provisions as well as gross profit (Foos *et al.*, 2010; Barth *et al.*, 2006). The bank's efficiency ratio is measured as profit before tax normalized by average assets. Usually high profits may signal excessive risk taking by banks. However, declining trends in profit indicators may signal problems regarding the sustainability of financial institutions (Shehzad *et al.* 2010).

The last risk indicator is asset quality. We proxied asset quality by the ratio of loan loss provision to total loans (LLP). Loan loss provisioning is a very important indicator influencing the cyclicality of bank profitability. A changing LLP ratio might suggest the fragility of the credit portfolio quality, which may be a predictor of banking insolvency. Van del Heuvel (2009) emphasized that shocks to bank capital are a result of loan losses and might impact bank lending and increase capital inadequacy. Some other authors suggested that loan loss provisions may be used as a systemic risk warning signal and a prudential risk management tool (see Laeven and Majnoni 2003; Fonseca and González 2008; Bikker and Metzemakers 2005).

### 3.2. Model for identification of determinants of systemic risk according to bank activity and country development level

The main focus of our study is to explain the sources of systemic risk across banking activities and countries. To this end, we gathered a database on bank characteristics as well as information about financial, macroeconomic and global fundamentals for 31 European countries. Following the previous study of the risk sensitivity and framework of Brunnermeier and Pedersen (2009), Beck *et al.* (2005), Athanasoglou *et al.* (2008) and Brewer *et al.* (2008), specifications of the risk factors equation capture the relationship between banks' risk levels and the set of independent variables, aggregated into four groups: STRUCTURAL, MARKET, MACRO and GLOBAL. Our basic model applied to test our hypotheses reads as follows:

$$y_{n,i,t} = \sum_{j=1}^{k} \alpha_j y_{n,i,t-j} + \sum_{j=1}^{k} \beta_j x_{n,i,t-j} + \sum_{j=1}^{k} \gamma_j z_{n,i,t-j} + \sum_{j=1}^{k} \vartheta_j s_{n,i,t-j} + \mu_{ji} + \varepsilon_{i,t}, \quad (1)$$

where: $y_{n,i,t}$ – indicates the selected dependent variables for bank $n$, in country $i$, observed in period $t$; $y$ = [*LEV, LIQGAP, LLP, PROFIT*], where *LEV* – leverage, defined as the inverse of the capital value of the total assets of the bank, *LIQGAP* – liquidity gap, which is captured by a crude ratio loans less total customer deposits less deposits from banks divided by loans, *LLP* – the quality of the loan portfolio, measured by the share of provisions for risks in the bank's total loans, *PROFIT* – is the profit before taxes to average assets ratio; $x_{n,j,t}$ is a vector of independent variables that are specific to the banking sector, namely STRUCTURAL: $x$ = [*SIZE, CREDIT, LIQ/ASSET, HHI, FOREIGN*], where: *SIZE* – is the natural logarithm of total assets, *CREDIT* – is total credit lending by the banking sector, calculated as the bank's loans / total assets ratio, *LIQ/ASSET* – is the liquid assets to total assets ratio; *HHI* – *Herfindahl-Hirschmann* index of concentration of the banking sector, measured in terms of bank assets, *FOREIGN* – share of foreign-owned banks; $z_{n,i,t}$ – is a vector of independent variables defining the financial market conditions, $z$ = [*ΔSPREAD, ΔVIX, STOCK, ΔRISK*], where: *ΔSPREAD* – annual change in bid-ask spread in O/N transactions, *ΔVIX* – annual change in Chicago Board Options Exchange Market Volatility Index, a popular measure of the implied volatility of S&P 500 index options, *STOCK* – is the natural logarithm of stock exchange capitalization; *ΔRISK* – risk premium on lending (lending rate minus treasury bills rate (in %); $s_{n,i,t}$ – is a vector of independent macroeconomic variables, $s$=[*GDP, ΔMONEY, INF, BASERATE*], where: *GDP* – annual growth rate of real GDP, *ΔMONEY* – annual change in money supply, *INF* – inflation rate, *BASERATE* – basic interest rate of central bank.

To find the globalization and liberalization effects, we adopted a group of institutional variables w=[*FINFREE, OFFSH, GLOBAL*], where *FINFREE* – is the Financial Freedom Index of the Heritage Foundation; *OFFSH* – the share of deposits institutions registered offshore; *GLOBAL* – index of globalization. This variable is drawn from the dataset on institutional development (Dreher, 2006). Finally, we introduced a group effect – $\mu_j$, and a random component – $\varepsilon_{j,t}$.

Due to the necessity for the data and model specification, we applied the two-step GMM robust estimator for data spanning the years 1996–2011 on individual banks. The two-step GMM estimator (Arellano and Bond 1991; Blundell and Bond 1998) may impose a downward or upward bias in standard errors due to its dependence on the estimated residuals, which may lead to unreliable asymptotic statistical inference (Bond, 2002). In most cases, we used the appropriate lags of the dependent variables and the bank characteristics as GMM-style instruments and we used the remaining variables as IV-style instruments. When necessary, we modified the composition of instruments appropriately. To test the validity of the instruments, we implemented the Sargan specification test, which, under the null hypothesis of valid moment conditions, is asymptotically distributed as chi-square (Arellano and Bond, 1991; Blundell and Bond, 1998). All regression parameters are provided with the levels of significance, which should facilitate interpretation of results.

## 4. DATA DESCRIPTION

Our dataset covers the full range of 4678 European banks from 31 countries of Europe divided into two groups: 19 advanced countries (Austria, Belgium, Cyprus, Greece, Finland, France, Denmark, Germany, Spain, the Netherlands, Luxembourg, Ireland, Iceland, Norway, Portugal, Sweden, Switzerland, Great Britain, Italy) and 12 developing countries (Bulgaria, the Czech Republic, Estonia, Latvia, Lithuania, Poland, Romania, Slovenia, Slovakia, Ukraine, Hungary, Turkey[1]). Due to the specific nature of systemic risk and the scale of its intensity at different times, the proposed study period is 15 years, i.e. 1996 to 2011.

This is because we believe that banking activities should be considered multi-dimensionally, using a set of financial indicators, i.e. leverage,

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[1] Turkey and Ukraine have been selected for testing due to the significantly expanded banking sector and the aspirations of these countries to join the European Union.

liquidity gap, asset quality and profitability. We compute a measure of bank's risk using the Bankscope database, which reports bank balance sheet data. We use unconsolidated statements since they are preferred to avoid relevant differences in the balance sheets of headquarters and subsidiaries compensating each other. Our international sample of banks is restricted to banks with availability of no less than 75 per cent of data. Financial market data was provided from Thomson Reuters Eikon service, while the macroeconomic and structural variables were obtained from the databases: OECD Statistics, and the World Bank. For the estimation of all of our measures of systemic risk, we additionally used globalization as well as financial freedom region-specific bank sector indexes. While the globalization index is used to measure global sources of systemic risk, the liberalization index was used to measure the extent of the crises' effects on banking systemic risk. The data we related to risk models as well as descriptions of the control variables are provided in Appendix A. To test the hypothesis concerning the nature and diversification of systemic risk sources in the banking sector, the panel regression model was used. We compared the results of systemic risk factors separately for advanced and developing countries in Europe.

## 5. RESULTS

Descriptive statistics of systemic risk indicators in the sample of banks are reported in Table 1 (the sample of advanced countries in Europe) and Table 2 (the sample of developing countries). The information given in both Table 1 and Table 2 emphasizes the differences in the control variables across the banking activity we analyzed. For example, a comparison between the values of systemic risk indicators in advanced and developing countries banking reveals that the average is higher in advanced countries, particularly leverage (mean = 17.37, std. dev. = 13.95) and liquidity gap ratio (mean = 0.991, std. dev. = 8.93]. The analysis conducted revealed the higher profitability of banks in the group of developing vs. advanced economies (mean = 0.013 vs. 0.007]. On the other hand, the analysis of the loan loss provisions to total loans ratio in advanced banking activity is characterized by lower level (mean = 0.01] and volatility (std. dev. = 0.079].

The next step of the study was the calculation of the correlation matrix of systemic risk indicators and independent variables. Detailed correlation coefficients are presented in Table 3. All the dependent variables (*LEV* – leverage ratio; *LIQGAP* – liquidity gap; *LLP* – loan loss provision over total

Table 1

Descriptive statistics in the sample of commercial banking in advanced countries in Europe

| Variables | Leverage | Liquidity gap | Profitability | LLP |
|---|---|---|---|---|
| Obs. | 44504 | 44504 | 44504 | 44504 |
| Mean | 17.37 | 0.991 | 0.007 | 0.01 |
| Std. Dev. | 13.95 | 8.93 | 0.027 | 0.079 |
| Min | 0.39 | -29.06 | -0.67 | -33.01 |
| Max | 287.32 | 0.087 | 4.18 | 37.01 |

Notes: Leverage: total assets/equity; Liquidity gap: ratio loans less total customer deposits less deposits from banks divided by loans; LLP: loan loss provisions/total loans; Profitability: profit before tax/total assets. The table presents descriptive statistics for the bank-specific balance sheet and income statement variables used in the cross-sectional regressions. The sample includes observations from 19 advanced European countries, spanning the period 1996–2011. The balance sheet and income statement data are taken from the Bankscope database. Variable definitions are provided in Appendix A. The risk ratios are given in per cent.

Source: author's calculation.

Table 2

Descriptive statistics in the sample of commercial banking  in developing countries in Europe

| Variables | Leverage | Liquidity gap | Profitability | LLP |
|---|---|---|---|---|
| Obs. | 2745 | 2745 | 2745 | 2745 |
| Mean | 10.809 | -5.205 | 0.013 | 0.025 |
| Std. Dev. | 12.103 | 34.543 | 0.045 | 0.134 |
| Min | 0.393 | -15.175 | -0.694 | 0.007 |
| Max | 269.765 | 0.239 | 0.606 | 3.025 |

Notes: Leverage: total assets/equity; Liquidity gap: ratio loans less total customer deposits less deposits from banks divided by loans; LLP: loan loss provisions/total loans; Profitability: profit before tax/total assets. The table presents descriptive statistics for the bank-specific balance sheet and income statement variables used in the cross-sectional regressions. The sample includes observations from 12 European developing countries, spanning the period 1996–2011. The balance sheet and income statement data are taken from the Bankscope database. Variable definitions are provided in Appendix A. The risk ratios are given in per cent.

Source: author's calculation.

loans; *PROFIT* – profit before taxes normalized by the bank total assets) are mostly significantly correlated with the independent variables (at 10% and 5% levels). Leverage is positively correlated with the size of the banking sector (calculated as the bank total assets), the size of the loans, which results from the natural banks' lending. A positive correlation is also

Table 3. Correlations of bank-specific and model variables

| | LEV | LIQGAP | LLP | PROFIT | SIZE | CREDIT | LIQAS | HHI | GDP | ΔMONEY | BASE | INF | ΔSPREAD | ΔVIX | STOCK | ΔRISK | OFFSH | FINFREE | GLOBAL | FOREIGN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LEV | 1.0000 | | | | | | | | | | | | | | | | | | | |
| LIQGAP | -0.0321* | 1.0000 | | | | | | | | | | | | | | | | | | |
| LLP | 0.0778 | -0.0055 | 1.0000 | | | | | | | | | | | | | | | | | |
| PROFIT | -0.0468 | 0.0059 | -0.0036* | 1.0000 | | | | | | | | | | | | | | | | |
| SIZE | 0.1539** | 0.047** | 0.0432** | 0.0091 | 1.0000 | | | | | | | | | | | | | | | |
| CREDIT | 0.1117** | 0.0452* | 0.0337* | 0.0737* | 0.2603* | 1.0000 | | | | | | | | | | | | | | |
| LIQAS | 0.0595* | 0.015** | -0.0639* | 0.0366* | -0.0094 | 0.0500 | 1.0000 | | | | | | | | | | | | | |
| HHI | -0.1847** | 0.0014* | -0.0543* | -0.018* | -0.2189* | 0.0515 | 0.2438* | 1.0000 | | | | | | | | | | | | |
| GDP | 0.1029* | 0.0279* | 0.0368* | -0.054* | 0.2991* | 0.3000* | 0.0271 | -0.0045 | 1.0000 | | | | | | | | | | | |
| ΔMONEY | -0.0149* | -0.0389* | 0.0390** | 0.0416* | -0.0482 | -0.0061 | -0.0238 | 0.0379 | 0.1268* | 1.0000 | | | | | | | | | | |
| BASE | 0.1864* | 0.0462* | -0.0451 | 0.041* | 0.1145* | 0.1193* | -0.0188 | 0.0453 | 0.2657* | 0.0281 | 1.0000 | | | | | | | | | |
| INF | 0.0833** | 0.0216** | 0.1412* | 0.017* | 0.0097 | 0.1780* | 0.0349 | 0.0229 | 0.1904* | -0.0991 | 0.2885* | 1.0000 | | | | | | | | |
| ΔSPREAD | 0.1915* | -0.0101* | -0.0441 | 0.022** | 0.0455 | 0.1290* | -0.0583 | -0.0877* | 0.0172 | -0.3295* | -0.0435 | 0.1799* | 1.0000 | | | | | | | |
| ΔVIX | 0.0697 | 0.0840* | -0.082* | -0.1031 | 0.0116 | 0.0883 | -0.0407 | -0.0282 | 0.4035* | -0.1909* | 0.2404* | 0.3214* | 0.2729* | 1.0000 | | | | | | |
| STOCK | 0.0036* | 0.061** | -0.1699* | 0.1609* | 0.1876* | -0.0046 | 0.0607 | 0.1049 | -0.1823* | 0.1823* | 0.0410 | -0.208* | -0.2262* | -0.54* | 1.0000 | | | | | |
| ΔRISK | 0.1869** | 0.0030** | 0.0853* | 0.059** | 0.1016 | -0.0432 | -0.241* | -0.2724* | 0.1257 | 0.0680 | -0.0705 | -0.0967 | 0.0674 | 0.0110 | -0.0198 | 1.0000 | | | | |
| OFFSH | -0.0707* | 0.0740* | 0.0302* | 0.0079* | 0.0719 | -0.148* | 0.0511 | -0.0495 | 0.0288* | -0.1226* | 0.0914 | 0.0461 | -0.0927* | 0.0761 | -0.0427 | -0.017 | 1.0000 | | | |
| FINFREE | 0.0455** | 0.0427* | 0.0633* | 0.010* | -0.0948 | -0.0535 | -0.107* | 0.0018 | -0.0804* | -0.1972* | -0.0475 | 0.0148* | -0.0464* | -0.018 | -0.053* | -0.15* | 0.0911 | 1.000 | | |
| GLOBAL | -0.0437** | -0.0384* | 0.0481* | 0.065* | 0.1211* | 0.0713 | -0.0055 | -0.0834 | 0.0564 | -0.1160* | 0.1085* | 0.0003 | 0.0012 | -0.085 | 0.2780* | 0.0683 | 0.0591 | -0.063 | 1.0000 | |
| FOREIGN | -0.0337* | 0.0302* | 0.0238** | 0.0171* | -0.2251* | -0.318* | -0.0183 | -0.0340 | -0.2667* | 0.0176 | -0.138* | -0.0729 | -0.0677 | -0.027 | -0.0206 | 0.1648 | 0.1056 | -0.036 | -0.0831 | 1.0000 |

Notes: *LEV* – leverage ratio; *LIQGAP* – liquidity gap; *LLP* - loan loss provisions/total loans; *PROFIT* – profitability as profit before tax/total assets; *GDP* - real GDP growth; Δ*MONEY* – change in money supply; *BASE* – central bank base rate; *INF* – inflation rate; *SIZE* – the logarithm of total assets; *LIQAS* – liquid assets/total assets; *HHI* – Herfindahl index; *CREDIT* – credit growth; Δ*SPREAD* – *BID-ASK* spread at O/N transactions; Δ*VIX* – volatility index; *STOCK* – logarithm of stock exchange capitalization; Δ*RISK* – risk premium on lending; *FINFREE* – the Financial Freedom index of the Heritage Foundation (Abiad et al. 2008); *OFFSH* – share of offshore institutions; *GLOBAL* – globalization index (Dreher 2006); *FOREIGN* – share of foreign-owned banks. *, **, *** significance level at 10%, 5% and 1%.

Source: author's calculation.

maintained with macroeconomic variables, i.e. increase in Gross Domestic Product, interest rates, and financial market variables. In other words, the development of a real economy causes an increase in risk appetite, not only in the capital market, but also in the banking system. Among a few variables correlated negatively with the size of the leverage, we can distinguish: *OFFSH* – the share of deposits institutions registered offshore, *GLOBAL* – index of globalization. Similar negative correlations can be seen between leverage and the liquidity gap. Banks hold less liquidity in periods of economic growth (*GDP* and *STOCK* – market capitalization), but have problems with liquidity in times when liquidity decreases in the money market (measured as the O/N spread). On the other hand, loan loss provisions increase significantly with the growth in the banks' liquidity and credit risk. The negative correlation with market factors confirms that the downturn in the stock market promotes the growth of risk and the need to maintain larger provisions. The last variable, the profitability of banks – *PROFIT*, positively correlated with the majority of the independent variables, except for: i. $\Delta VIX$ volatility index (this suggests that the increased risk in the capital market may limit banks' profits); ii. changes in economic growth – *GDP* (may be due to the rising cost of handling credit activities, and iii. increase in the concentration of the banking sector, and thus a possible increase in competition among banks to generate high margins.

## 5.1. A detailed analysis of the systemic risk factors across countries

We estimated the systemic risk in banking sector scores relative to a common best-practice frontier by pooling the data across countries. This approach allows for estimating risk differentials across countries. We applied the system-GMM estimator in both the first and the second stage of the procedure. The non-significant values of the Hansen test confirm the validity of the instruments in all the estimations. Empirical results are presented in four tables for each of dependent variables (Table 4 for leverage ratio, Table 5 for liquidity gap, Table 6 for profitability and Table 7 for loan loss provisions). The first column (1) in each table presents the basic regression that includes all explanatory variables for full sample – all banks and all countries. Additionally, in columns (2) and (3), we tested the sensitivity of each bank's risk indicator to different factors for emerging markets in columns (2), and for advanced countries in columns (3).

## 5.2. The relationship between bank's risk-taking
## and its determinants in the sample of emerging and advanced countries

Our results indicate that a bank's leverage ratio [Table 4] and liquidity [Table 5] are significantly determined by macroeconomic and banking specific factors. In particular, *SIZE* and *GDP* display a positive and statistically significant coefficient in all regression models.

These results confirm the importance of the size of the banking sector risk-taking. Economic trends are also conducive to risk-taking. This means that systemic risk should be a pro-cyclical phenomenon. Both leverage, as a measure of solvency risk of a bank, and liquidity gap can become excessive. As mentioned above, this is usually a result of misperceptions of risk or wrong responses to risk by banks across the business cycle (Borio et al. 2001).

In the group of developed countries (column 3), changes in indicators of risk: credit, liquidity or insolvency are determined by market factors, including the increased risk and the size of market capitalization. This seems to confirm the maturity of the capital market in developed countries. In the group of developed countries, the degree of globalization and financial liberalization is a factor of changes of risk in banks. In turn, the impact of central banks, monetary policy used (money supply and interest rates) showed no significant effect on the risk in the banking sector. The results are in line with Cetorelli and Goldberg (2011) and Campello (2002), who found that in advanced countries, global operations insulate banks from changes in the monetary policy, as opposed to banks without global operations, which are more affected by the monetary policy. The effect of interest rates on the bank risk is stronger if bank credit for businesses and non-profit entities is used to a greater degree. However, in developed economies available financing alternatives are also foreign loans and the capital market. In addition, the impact of interest rates on the economy is not the same throughout the range of variation. The results indicate that banks in developed countries are more insulated than expected based on the Kashyap and Stein (2000) findings.

Different results were found in emerging countries (column 2). Drivers of globalization and liberalization proved not to be statistically significant, also the changes in the capital market are not a source of risk in the banking sector. The biggest influence on the risk of banks is exerted by liquidity in the interbank market, measured as O/N spread. This demonstrates the importance of funding for banks in the interbank market and liquidity

Table 4

The relationship between bank's leverage ratio and specific,
market and macroeconomic determinants

| COUNTRY CATEGORY | OVERALL | | | EMERGING | | | ADVANCED | | |
|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: LEV | (1) | p value | t-stat | (2) | p value | t-stat | (3) | p value | t-stat |
| Y(-1) | -0.433 | ** | -13.3 | -0.007 | ** | -14.9 | -0.048 | * | -0.32 |
| Y(-2) | -0.454 | ** | -6.3 | -0.009 | * | -1.23 | 0.774 | | 0.89 |
| Constant | -0.512 | ** | -2.16 | 0.002 | ** | -3.98 | -0.098 | ** | -5.24 |
| **Structural (banking specific)** | | | | | | | | | |
| *SIZE* | 0.923 | *** | 9.41 | 0.534 | ** | 3.56 | 0.084 | *** | -0.88 |
| *LIQASSET* | -0.380 | | -5.66 | -0.071 | ** | 16.23 | -0.031 | * | 11.32 |
| *CREDIT* | 0.398 | *** | 9.46 | 0.153 | ** | 12.23 | 0.011 | *** | 3.88 |
| *HHI* | 0.034 | ** | -26.2 | -0.075 | * | -1.34 | 0.001 | * | 2.89 |
| *FOREIGN* | 0.017 | *** | 3.78 | 0.033 | | 1.32 | 0.008 | | 3.34 |
| **Market drives** | | | | | | | | | |
| Δ*SPREAD* | 0.019 | * | 6.33 | 0.376 | *** | -1.99 | 0.005 | * | -6.22 |
| Δ*VIX* | 0.037 | *** | -0.52 | 0.007 | * | -2.99 | 0.004 | *** | 2.98 |
| *STOCK* | 0.023 | * | -0.36 | 0.004 | | 2.63 | 0.003 | ** | 5.48 |
| Δ*RISK* | 0.089 | * | -0.19 | 0.001 | * | -2.65 | 0.003 | ** | 2.99 |
| **Macroeconomic factors** | | | | | | | | | |
| *GDP* | 0.067 | **** | 4.44 | 0.034 | *** | 33.53 | 0.93 | *** | -3.66 |
| Δ*MONEY* | 0.004 | | 0.23 | 0.221 | | 0.55 | -0.792 | * | -12.1 |
| *BASERATE* | 0.023 | * | 2.44 | 0.307 | ** | 1.28 | 0.209 | * | 0.77 |
| *INF* | 0.011 | * | 1.31 | 0.731 | ** | 3.02 | 0.239 | ** | 32.1 |
| **Global-specific variables (liberalization and globalization)** | | | | | | | | | |
| *FINFREE* | 0.797 | *** | 16.49 | 0.045 | * | 4.44 | 0.007 | * | -1.51 |
| *OFFSHORE* | 0.022 | * | 5.47 | 0.052 | * | -7.38 | 0.016 | | 4.33 |
| *GLOBAL* | 0.046 | ** | -2.31 | -0.003 | | -12.3 | 0.002 | * | -2.98 |
| **Tests** | | | | | | | | | |
| AR(1) | -2.55 | *** | | -3.76 | *** | | -1.32 | * | |
| AR(2) | -0.55 | | | 0.65 | | | -0.58 | * | |
| Hansen's test | | 0.90 | | | 0.00 | | | 0.90 | |
| **Observations** | 50,358 | | | 2745 | | | 44,504 | | |
| **Number of banks** | 4678 | | | 303 | | | 3947 | | |
| **Number of countries** | 31 | | | 12 | | | 19 | | |

Notes: *LEV* – leverage ratio; *GDP* - real GDP growth; Δ*MONEY* – money supply; *BASE* – central bank base rate; *INF* – inflation rate; *SIZE* – the natural logarithm of total assets; *LIQAS* – liquid assets/total assets; *HHI* – Herfindahl index; *CREDIT* – credit growth; Δ*SPREAD* – *BID-ASK* spread at O/N transactions; Δ*VIX* – volatility index; *STOCK* – stock exchange capitalization; Δ*RISK* – risk premium on lending; *FINFREE* – the Financial Freedom index of the Heritage Foundation (Abiad *et al.* 2008); *OFFSH* – share of offshore institutions; *GLOBAL* – globalization index (Dreher 2006); *FOREIGN* – share of foreign-owned banks. *, **, *** significance level at 10%, 5% and 1%. The samples of commercial banks in emerging and advanced countries in 1996–2011.

Source: author's calculation.

Table 5

The relationship between bank's liquidity gap and specific,
market and macroeconomic determinants

| COUNTRY CATEGORY | OVERALL | | | EMERGING | | | ADVANCED | | |
|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: LIQGAP | (1) | p value | t-stat | (2) | p value | t-stat | (3) | p value | t-stat |
| Y(-1) | -0.268 | ** | -13.3 | -0.002 | ** | -24.9 | -0.933 | * | -0.32 |
| Y(-2) | -0.491 | ** | -6.3 | -0.009 | * | -3.23 | -0.775 | | 0.89 |
| constant | -0.122 | ** | -2.16 | -0.002 | ** | -2.98 | -0.134 | ** | -5.24 |
| **Structural (banking specific)** | | | | | | | | | |
| SIZE | 0.052 | *** | 9.41 | -0.052 | ** | 2.56 | -0.505 | * | -0.88 |
| LIQASSET | 0.073 | | -5.66 | 0.053 | ** | 15.23 | 0.668 | * | 11.32 |
| CREDIT | -0.098 | *** | 9.46 | -0.365 | ** | 13.23 | -0.443 | *** | 3.88 |
| HHI | 0.044 | * | -26.2 | -0.011 | * | -2.34 | 0.213 | | 2.89 |
| FOREIGN | 0.061 | * | 3.78 | 0.922 | * | 3.32 | -0.658 | * | 3.34 |
| **Market drives** | | | | | | | | | |
| ΔSPREAD | -0.126 | * | 6.33 | -0.543 | *** | -2.99 | -0.835 | ** | -6.22 |
| ΔVIX | -0.012 | *** | -0.52 | -0.010 | * | -1.99 | -0.421 | *** | 2.98 |
| STOCK | 0.018 | * | -0.36 | 0.791 | | 1.63 | 0.345 | | 5.48 |
| ΔRISK | 0.045 | * | -0.19 | -0.423 | * | -1.65 | -0.934 | ** | 2.99 |
| **Macroeconomic factors** | | | | | | | | | |
| GDP | 0.022 | | 4.44 | 0.099 | *** | 34.53 | -0.092 | ** | -3.66 |
| ΔMONEY | -0.048 | * | 0.23 | 0.002 | | 0.67 | -0.227 | * | -12.1 |
| BASERATE | 0.0322 | * | 2.44 | -0.009 | ** | -0.28 | 0.232 | | 0.77 |
| INF | 0.033 | * | 1.31 | -0.019 | ** | 2.02 | 0.224 | | 32.1 |
| **Global-specific variables (liberalization and globalization)** | | | | | | | | | |
| FINFREE | 1.455 | * | 16.49 | 0.045 | * | 5.44 | 0.606 | | -1.51 |
| OFFSHORE | 0.095 | * | 5.47 | 0.002 | * | -6.38 | -0.607 | * | 4.33 |
| GLOBAL | -0.089 | * | -2.31 | -0.000 | | -15.3 | -0.664 | * | -2.98 |
| **Tests** | | | | | | | | | |
| AR(1) | -0.22 | *** | | -5.76 | *** | | -1.22 | * | |
| AR(2) | -0.63 | | | 0.15 | | | -1.45 | * | |
| Hansen's test | | 0.90 | | | 0.00 | | | 0.90 | |
| **Observations** | 50 358 | | | 2 745 | | | 44 504 | | |
| **Number of banks** | 4 678 | | | 303 | | | 3 947 | | |
| **Number of countries** | 31 | | | 12 | | | 19 | | |

Notes: *LIQGAP* – liquidity gap as loans less total customer deposits less deposits from banks divided by loans; *GDP* - real GDP growth; *ΔMONEY* – money supply; *BASE* – central bank base rate; *INF* – inflation rate; *SIZE* – the natural logarithm of total assets; *LIQAS* – liquid assets/total assets; *HHI* – Herfindahl index; *CREDIT* – credit growth; *ΔSPREAD* – *BID-ASK* spread at O/N transactions; *ΔVIX* – volatility index; *STOCK* – stock capitalization; *ΔRISK* – risk premium on lending; *FINFREE* – the Financial Freedom index of the Heritage Foundation (Abiad *et al.* 2008); *OFFSH* – share of offshore institutions; *GLOBAL* – globalization index (Dreher 2006); *FOREIGN* – share of foreign-owned banks. *, **, *** significance level at 10%, 5% and 1%. The samples of commercial banks in emerging and advanced countries in 1996–2011.

Source: author's calculation.

Table 6

The relationship between bank's profitability and specific,
market and macroeconomic determinants

| COUNTRY CATEGORY | OVERALL | | | EMERGING | | | ADVANCED | | |
|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: | (1) | p value | t-stat | (2) | p value | t-stat | (3) | p value | t-stat |
| Y(-1) | -0.561 | ** | -15.5 | -0.005 | ** | -54.9 | 0.095 | * | -0.55 |
| Y(-2) | -0.491 | ** | -6.5 | -0.009 | * | -5.55 | 0.077 | | 0.79 |
| constant | -0.155 | ** | -5.16 | -2.995 | ** | -5.97 | 0.015 | ** | -5.54 |
| **Structural (banking specific)** | | | | | | | | | |
| SIZE | 0.555 | *** | 9.41 | 0.005 | ** | 5.56 | 0.054 | * | -0.77 |
| LIQASSET | -0.757 | | -5.66 | 0.005 | ** | 15.55 | 0.066 | * | 11.55 |
| CREDIT | 0.975 | *** | 9.46 | -0.056 | *** | 15.55 | 0.044 | *** | 5.77 |
| HHI | 0.400 | ** | -26.2 | 0.112 | * | -2.24 | 0.021 | * | 2.79 |
| FOREIGN | 0.612 | ** | 2.77 | 0.922 | ** | 2.22 | -0.022 | *** | 2.24 |
| **Market drives** | | | | | | | | | |
| ΔSPREAD | 0.156 | * | 6.55 | -0.054 | ** | -5.99 | 0.075 | ** | -6.55 |
| ΔVIX | -0.155 | *** | -0.55 | -0.001 | * | -1.99 | -0.044 | *** | 5.97 |
| STOCK | -0.175 | * | -0.56 | 0.007 | | 1.65 | 0.054 | * | 5.47 |
| ΔRISK | 0.454 | * | -0.19 | 0.045 | * | -1.65 | 0.095 | ** | 5.99 |
| **Macroeconomic factors** | | | | | | | | | |
| GDP | 0.055 | | 4.44 | 0.099 | *** | 54.55 | 0.095 | ** | -5.66 |
| ΔMONEY | 0.047 | * | 0.55 | 0.123 | ** | 0.67 | 0.055 | ** | -15.1 |
| BASERATE | 0.555 | * | 5.44 | 0.432 | ** | -0.57 | 0.054 | *** | 0.77 |
| INF | 0.155 | * | 1.51 | 0.194 | *** | 5.05 | 0.057 | * | 55.1 |
| **Global-specific variables (liberalization and globalization)** | | | | | | | | | |
| FINFREE | 0.455 | *** | 16.49 | 0.045 | * | 5.44 | 0.066 | *** | -1.51 |
| OFFSHORE | 0.951 | * | 5.47 | 0.446 | * | -6.27 | 0.066 | ** | 4.22 |
| GLOBAL | 0.790 | ** | -2.21 | -0.551 | * | -15.2 | 0.017 | ** | -2.97 |
| **Tests** | | | | | | | | | |
| AR(1) | -2.55 | *** | | -2.76 | *** | | -4.22 | * | |
| AR(2) | -0.65 | | | 0.65 | | | -0.47 | * | |
| Hansen's test | | 0.01 | | | 0.01 | | | 0.02 | |
| **Observations** | 50,358 | | | 2745 | | | 44,504 | | |
| **Number of banks** | 4678 | | | 303 | | | 3947 | | |
| **Number of countries** | 31 | | | 12 | | | 19 | | |

Notes: *PROFIT* – profitability as profit before tax/total assets; *GDP* - real GDP growth; Δ*MONEY* – money supply; *BASE* – central bank base rate; *INF* – inflation rate; *SIZE* – the natural logarithm of total assets; *LIQAS* – liquid assets/total assets; *HHI* – Herfindahl index; *CREDIT* – credit growth; Δ*SPREAD* – *BID*-ASK spread at O/N transactions; Δ*VIX* – volatility index; *STOCK* – stock exchange capitalization; Δ*RISK* – risk premium on lending; *FINFREE* – the Financial Freedom index of the Heritage Foundation (Abiad *et al.* 2008); *OFFSH* – share of offshore institutions; *GLOBAL* – globalization index (Dreher 2006); *FOREIGN* – share of foreign-owned banks. *, **, *** significance level at 10%, 5% and 1%. The samples of commercial banks in emerging and advanced countries in 1996–2011.

Source: author's calculation.

Table 7

The relationship between bank's LLP and specific, market and macroeconomic determinants

| COUNTRY CATEGORY | OVERALL | | | EMERGING | | | ADVANCED | | |
|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: LLP | (1) | p value | t-stat | (2) | p value | t-stat | (3) | p value | t-stat |
| Y(-1) | 0.062 | ** | 24.4 | 0.002 | ** | -24.9 | 0.09 | * | -0.42 |
| Y(-2) | 0.001 | ** | 6.4 | 0.009 | * | -4.24 | 0.77 | * | 0.89 |
| constant | 0.222 | ** | -2.26 | 0.002 | ** | -2.98 | 0.24 | ** | -5.24 |
| **Structural (banking specific)** | | | | | | | | | |
| *SIZE* | 0.052 | *** | 9.42 | 0.522 | ** | 2.56 | 0.05 | * | -0.88 |
| *LIQASSET* | 0.074 | * | -5.66 | 0.054 | ** | 25.24 | 0.06 | * | 22.42 |
| *CREDIT* | 0.982 | *** | 9.46 | 0.465 | *** | 24.24 | 0.00 | *** | 4.88 |
| *HHI* | 0.469 | * | 26.2 | 0.002 | * | -2.34 | 0.22 | * | 2.89 |
| *FOREIGN* | 0.622 | ** | 3.78 | 0.009 | * | 3.32 | 0.65 | *** | 3.34 |
| **Market drives** | | | | | | | | | |
| ΔSPREAD | 0.062 | * | 6.44 | 0.004 | * | -2.99 | 0.79 | * | -6.22 |
| ΔVIX | 0.024 | * | -0.52 | 0.004 | * | 2.09 | 0.42 | * | 2.98 |
| STOCK | 0.028 | * | -0.46 | 0.009 | | 2.64 | 0.44 | | 5.48 |
| ΔRISK | 0.048 | * | -0.29 | 0.002 | | -2.65 | 0.94 | ** | 2.99 |
| **Macroeconomic factors** | | | | | | | | | |
| GDP | 0.055 | | 4.44 | 0.099 | *** | 34.53 | 0.07 | *** | -3.66 |
| ΔMONEY | 0.004 | * | 0.53 | 0.020 | * | 0.67 | 0.05 | *** | -55.5 |
| BASERATE | 0.355 | * | 5.44 | 0.955 | * | -0.58 | 0.00 | * | 0.77 |
| INF | 0.533 | * | 5.35 | 0.059 | * | 5.05 | 0.00 | * | 35.5 |
| **Global-specific variables (liberalization and globalization)** | | | | | | | | | |
| *FINFREE* | 0.455 | *** | 26. | 0.004 | * | 5.44 | 0.62 | *** | -2.52 |
| *OFFSHORE* | 0.952 | * | 5.4 | 0.044 | | -6.38 | 0.60 | ** | 4.33 |
| *GLOBAL* | 0.898 | ** | 2.3 | 0.003 | * | -25.3 | 0.34 | ** | -2.98 |
| **Tests** | | | | | | | | | |
| AR(1) | 1.55 | *** | | -4.66 | *** | | - | * | |
| AR(2) | 0.25 | | | 0.63 | | | - | * | |
| Hansen's test | | 0.60 | | | 0.90 | | | 0.90 | |
| **Observations** | 50,358 | | | 2745 | | | 44,5 | | |
| **Number of banks** | 4678 | | | 303 | | | 3947 | | |
| **Number of countries** | 31 | | | 12 | | | 19 | | |

Notes: *LLP* – loan loss provisions/total loans; *GDP* - real GDP growth; Δ*MONEY* – money supply; *BASE* –central bank base rate; *INF* – inflation rate; *SIZE* – the natural logarithm of total assets; *LIQAS* – liquid assets/total assets; *HHI* – Herfindahl index; *CREDIT* – credit growth; Δ*SPREAD* – *BID-ASK* spread at O/N transactions; Δ*VIX* – volatility index; *STOCK* – stock exchange capitalization; Δ*RISK* – risk premium on lending; *FINFREE* – the Financial Freedom index of the Heritage Foundation (Abiad *et al.* 2008); *OFFSH* – share of offshore institutions; *GLOBAL* – globalization index (Dreher 2006); *FOREIGN* – share of foreign-owned banks. *, **, *** significance level at 10%, 5% and 1%. The samples of commercial banks in emerging and advanced countries in 1996–2011.

Source: author's calculation.

dependence in developing countries. The fact that global banks activate local money markets in response to changes in domestic liquidity has implications for systemic risk propagation. Our estimates show that in developing countries, a bank's risk is characterized by macroeconomic factors (change of economic growth). A positively affecting factor was the formulation of the monetary policy of central banks, especially as regards interest rates changes. This relationship was directly proportional: the higher the interest rate, the higher the risk in banks. We discovered that the risk of a bank is not determined by stock market capitalization and volatility.

The results for banks' profitability are strongly correlated with the macroeconomic factors and specific characteristics of the banking sector, and with market drivers (like $\Delta VIX$ and $STOCK$) and financial liberalization in advanced countries (Table 6). This indirectly supports the idea that banks might rely on non-traditional activities to participate in regulatory capital arbitrage (Calmès and Théoret, 2013; Nijskens and Wagner, 2011). The risk of excessive loan loss provisions also proved to be the result of macroeconomic factors and the growing pool of loans. The results in Table 7 show that $LLP$ of commercial banks from emerging countries seems to be more procyclical than $LLP$ of banks from advanced economies. Our results emphasize that loan loss provisions may be used as a prudential risk management tool (as suggested by Laeven and Majnoni, 2003; Fonseca and González, 2008). In contrast to previous literature, we found a stronger impact of macroeconomics on $LLP$ in the subsample of commercial banks from the emerging markets. Moreover, other banks seem to employ income smoothing and capital management with the use of $LLP$ more intensively.

## CONCLUSION

The goal of this work is to analyze empirically how country level development influences systemic risk, by identifying a wide range of structural, macroeconomic and financial factors of systemic risk in the European banking sector. There is significant disagreement in the literature due to differences in methodology for identifying the determinants of systemic risk.

We focused on the sample of banks operating in 31 European countries over the period 1996–2011. To show the heterogeneity of systemic risk determinants, the study sample was divided, according to the economic development of the country, into two groups: advanced economies and developing countries.

We empirically analyzed our main research questions and found evidence that bank risk-taking ratios tend to be at different levels in advanced and emerging countries, for several characteristics of global and local variables of banking systems help to explain a significant amount of the cross-country variation in the changes in banks' contribution to systemic risk. The factors of systemic risk are often unique to each group of countries. For example, in the group of developed countries, changes in systemic risk indicators were determined by market factors, including the increased risk and the size of market capitalization. In turn, the influence of central banks and their monetary policy (money supply and interest rates) showed no significant effect on the risk in the banking sector. On the other hand, globalization and financial liberalization drivers proved to be not significant in the emerging countries. In this group of countries, the biggest influence on the bank risk-taking ratio was exerted by the liquidity in the interbank markets. This demonstrates the importance of wholesale funding for banks and liquidity dependence in developing countries. The risk-taking was not matched with adequate capital protection, and strong linkages between banks created high levels of systemic risk. Our results suggest that the variables capturing macroeconomic and specific bank factors are positively associated with improved bank risk. Increasing volatility in financial markets and financial liberalization can have a discernible negative impact on the banking sector stability through a number of channels, including the leverage, liquidity and solvency risk.

We found that banks operating in advanced countries with more concentrated and more developed systems tend to have relatively higher levels of risk. This is not especially surprising, given the relatively low level of development of the capital market and banking system in emerging countries. Checking for national characteristics can explain cross-bank differences in terms of risk-taking in the banking sector.

The emerging challenge is to consider which particular aspects of specific, market and macroeconomic determinants affect bank risk and how the regulatory implementation should be related to the institutional framework. There is no doubt that the recent global financial crisis puts the policy discussion on a new path, with the revisited problem of whether the regulations are a panacea or failure for the banking sector.

These findings have policy implications. First, our results suggest more stringent liquidity and capital requirements in banks, as they are the most effective instrument for negative effects on banking stability. Second, the imposed standards and macro-prudential supervision in the banking sector

should be geographically differentiated across emerging and advanced countries. The insulation of lending against the monetary policy achieved in global capital markets by banks in the advanced countries has expanded to the emerging countries in Europe. Our results suggest that a number of regulatory reforms that have been initiated to address the banking sector in Europe should take into account the variation in the banking activity and the macroeconomic environment of the particular country.

The discussion can be extended to regulation policy debate, because of the trade-off between micro-level risk management and systemic importance. We concluded that there is a great need for macroprudential approaches on non-traditional banking activity.

# APPENDIX A

Variable definitions and data sources

| Variable | Description | Data source |
|---|---|---|
| **Risk control variables:** | | |
| *Liquidity* | loans less total customer deposits less deposits from banks divided by loans | Bankscope, 2012 |
| *Leverage* | total assets/equity | Bankscope, 2012 |
| *Profitability* | profit before tax/total assets | Bankscope, 2012 |
| *LLP* | loan loss provisions/total loans | Bankscope, 2012 |
| **Banking specific factors:** | | |
| *SIZE* | the logarithm of total banking assets | Bankscope, 2012 |
| *LIQASSET* | liquid assets/total assets | Bankscope, 2012 |
| *CREDIT* | total credit lending by the banking sector, calculated as the bank's loans/total assets ratio | Bankscope, 2012 |
| *HHI* | Herfindahl–Hirschman Index computed as the sum of the squared market shares of a country's domestic and foreign banks | WDI database |
| *FOREIGN* | share of foreign-owned banks in country's banking sector | WDI database |
| **Market drives:** | | |
| *ΔSPREAD* | annual change in (ask price – bid price) in O/N transaction in interbank market (in basis points) | Thomson Reuters Datastream |
| *ΔVIX* | annual change in Chicago Board Options Exchange Market Volatility Index, a measure of the implied volatility of S&P 500 index options. | Thomson Reuters Datastream |
| *STOCK* | logarithm of stock market capitalization | S&P Global Stock Markets Factbook data |
| *ΔRISK* | annual change in risk premium on lending (lending rate minus treasury bills rate, in %) | WDI database |
| **Macroeconomic variables:** | | |
| *GDP* | annual growth of real GDP (in %) | WDI database |
| *INFLATION* | inflation rate (in %) | WDI database |
| *MONEY* | annual change in money supply | WDI database |
| *BASE* | central bank base rate (in %) | Thomson Reuters Datastream |
| **Global-specific variables (liberalization and globalization)** | | |
| *FINFREE* | the Financial Freedom index of the Heritage Foundation (in%) | Abiad *et al.* (2008) |
| *OFFSHORE* | the share of offshore institutions (in%) | WDI database |
| *GLOBAL* | the index of financial globalization (in%) | Dreher (2006) |

Notes: The appendix presents definitions as well as data sources for all dependent and independent variables that are used in the empirical study. The bank risk characteristics are from Bankscope database. The banking specific factors, market and financial markets data are taken from Thomson Reuters Financial Datastream and Thomson Worldscope, and the World Bank's World Development Indicator (WDI) database. The Financial Freedom index (Abiad *et al.* 2008), the index of financial globalization (Dreher 2006).

Source: author's own.

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