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Banks' size, scope and systemic risk: What role for conflicts of interest?*

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Abstract

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We show that the effect of non-interest income on systemic risk exposures varies with bank size and a country's institutional setting. Non-interest income reduces large banks' systemic risk exposures, whereas it increases that of small banks. However, exploiting heterogeneity in countries' institutional setting, we show that the bright side of innovation by large banks (lower systemic risk exposure for diversified banks) disappears in countries with more private and asymmetric information, more corruption and in concentrated banking markets. These empirical findings provide support for Saunders and Cornett (2014) who hypothesize which institutional features make the materialization of conflicts of interest more likely.

Keywords: systemic risk, diversification, innovation, conflicts of interest, global sample

JEL Classifications: G21, G28, L51

1 Introduction

Deregulation, technological progress and financial innovation in the two decades prior to the global financial crisis spurred banks to become larger and more diversified. This increase in bank size and scope was believed to be profit- and value-enhancing through economies of scale and scope, and (idiosyncratic bank) risk-reducing due to portfolio diversification benefits (see e.g., DeLong (2001), Laeven and Levine (2007), Demsetz and Strahan (1997), Stiroh and Rumble (2006) or Baele, De Jonghe, and Vander Vennet (2007)). However, the onset and unwinding of the global financial crisis of 2007-09 also illustrated a darker side of bank size and bank diversification[1]. Banks' size and scope made them systemically more important leading to too-big-to-fail or too-complex-to-unwind paradigms. This has caused policymakers and researchers to re-assess the optimal size and scope of banks. The general conclusion from recent studies is that larger banks have higher (conditional) tail risk and that diversification leads to higher systemic risk.[2] Surprisingly, the concepts of size and scope and their effects on systemic risk (exposures) are usually analyzed in isolation. In most studies, the focus is either on one of the two or, when they are jointly analyzed, on additive effects.[3] Yet, the use of acronyms such as SIFI or LCBG,

[1]We follow the convention in this literature and use the word 'diversification' to refer to the extent of universal banking. That is, the extent to which banks have expanded their scope and combine traditional bank activities, which mainly generate interest income, with non-traditional, non-interest income generating activities.

[2]Barth and Schnabel (2013) present an overview of the direct and indirect channels through which large banks affect or are affected by systemic risk. Empirical evidence on the size-systemic risk relationship can be found in Demirguc-Kunt and Huizinga (2013), Fahlenbrach, Prilmeier, and Stulz (2012), Brunnermeier, Dong, and Palia (2012) and Adrian and Brunnermeier (2009). The impact of bank scope (or diversification) on systemic risk is investigated by e.g. Wagner (2010), Ibragimov, Jaffee, and Walden (2011), Boot and Ratnovski (2013), De Jonghe (2010), Brunnermeier, Dong, and Palia (2012).

[3]Fahlenbrach, Prilmeier, and Stulz (2012), Brunnermeier, Dong, and Palia (2012) and De Jonghe (2010) are examples of empirical papers that focus on the impact of bank size on systemic risk, while controlling for bank scope (or vice versa), without interacting them.

which stand for Systemically Important Financial Institutions and Large and Complex Banking Groups, by regulators and supervisors do indicate that they perceive the mix of size and scope (complexity) to have multiplicative (or interaction) effects as well. Similarly, the public perception is also tilted towards the belief that the mix of bank size and scope results in hazardous effects. This paper fills this gap in the literature by exploring two issues. First, we examine the joint and interactive impact of both bank size and scope on banks' exposure to systemic risk. Second, by exploiting a cross-country sample, we assess whether these relationships are affected by a country's institutional setting, in particular by factors affecting the realization of conflicts of interests.

We make two important contributions to the academic literature. Unconditionally, the net impact of diversification on risk depends on the relative strength of a bright and dark side. The bright side of diversification stems from the scope for risk reduction within the financial institution (Dewatripont and Mitchell (2005)) and risk sharing with the financial system (van Oordt (2013)). The dark side of diversification originates in the complexity that comes along with combining various financial services. We are the first to show that the strength of the bright side vis-à-vis the dark side depends on bank size.[4] We find that the dark side of diversification dominates for small banks, whereas the bright side effects of diversification and innovation dominate for medium and large banks. More specifically, using a sample of listed banks across the globe over the period 1997-2011, we find that the initial positive impact of non-interest income (NII) on systemic risk exposure (measured by the Marginal Expected Shortfall (MES))[5] becomes

[4]Goddard, McKillop, and Wilson (2008) show for a sample of US credit unions that the impact of diversification on financial performance (measured as risk-adjusted accounting profits) is size-dependent.

[5]The Marginal Expected Shortfall corresponds with a bank's expected equity loss per dollar in a year conditional on the banking sector experiencing one of its 5% lowest returns in that given year. As in Acharya, Pedersen, Philippon, and Richardson (2012), we use the opposite of the returns, such that a higher MES implies more systemic

smaller with size and turns negative when total assets equal 964 million US$. For almost half of the banks in the sample, there is a significant negative impact of NII on MES. Hence, we are the first to document that combining size with scope leads to multiplicative effects on systemic risk. The explanation for this finding is multifaceted. Smaller banks are more opaque and less transparent (Flannery, Kwan, and Nimalendran (2004)), and are therefore more inclined to engage in riskier and value-destroying activities, which encourages the impact of the dark side of diversification. Furthermore, larger banks have on average more sophisticated risk management techniques (Hughes and Mester (1998)), have more experienced management and employees and may therefore take more advantage of the bright side of diversification (Cerasi and Daltung (2000)). Put differently, small banks are more likely going to lack the specific knowledge and tools to handle new business ventures or manage complex financial products (Milbourn, Boot, and Thakor (1999)). Concerning the dark side, larger banks are typically subject to a larger scrutiny by various disciplining stakeholders (Freixas, Loranth, and Morrison (2007)), which may refrain large banks from taking excessive risk. Importantly, however, stakeholders will only be able to properly discipline banks when the institutional setting and information environment allow them to do this. This brings us to our second contribution.

Our second contribution consists in showing that the bright side of diversification for large banks crucially depends on country characteristics that facilitate the creation of conflicts of interests. The potential for conflicts of interest is the main rationale why innovation by banks and expansion into non-traditional banking activities is seen as detrimental for banking system stability. For an excellent overview of the theoretical predictions and empirical results, we refer the reader to Mehran and Stulz (2007), Drucker and Puri (2007) and Saunders and Cornett (2014). We directly test the assertions of Saunders and Cornett (2014) that the likelihood with which potential conflicts of interest in universal banks turn into realized conflicts of interest depends on (i)

risk.

imperfect information on banks, (ii) the level of concentration in the banking sector, and (iii) the value of reputation. These three features of the institutional setting facilitate the materialization of conflicts of interest (Mehran and Stulz (2007) and Saunders and Cornett (2014)). Hence, they will lead to negative effects of scope expansion for both small and large banks. However, an environment with more information sharing, more private monitoring, reputation concerns or more competition, works as a disciplining device for large banks and induces them to differentiate and innovate for the better cause.

These two contributions have important policy implications. First of all, the negative interaction effect implies that implementing one regulatory reform proposal, i.e. downsizing banks, may weaken another policy, ring-fencing or limiting activities. Second, ring-fencing small banks or forcing small banks to get back to the basics is always desirable to reduce systemic risk. Third, our results indicate that there might be a bright side to allowing large banks to expand into non-interest income conditional on the institutional setting. This creates a trade-off. It may be desirable to restrict activities of large banks if there is low information sharing, low private monitoring, high corruption and more concentration. On the other hand, improving transparency and the flow of information might be a desirable alternative to ring-fencing. Fourth, our results also indicate that downsizing is unconditionally desirable from a systemic risk point of view for two reasons. Not only is the effect of size on the systemic risk exposure always positive (for all levels of the non-interest income share), downsizing will also reduce concentration (and hence limits the scope for conflicts of interests).

The rest of the paper is structured as follows. In Section 2, we describe the sample construction as well as the main variables of interest. Subsequently, in Section 3, we provide empirical evidence in favour of an interaction effect between size and diversification. Our second contribution, i.e. analyzing which factors mitigate or reinforce this interaction effect is shown in Section 4. We subject this new and intriguing finding in the relationship between diversification, size and systemic risk to a battery of robustness checks, which are discussed in Section 5.

2 Descriptive Statistics

To gauge the relationship between bank size, non-interest income and systemic risk, we combine data from several sources. We obtain information on banks' balance sheets and income statements from Bankscope, which is a database compiled by Fitch/Bureau Van Dijk that contains information on banks around the globe, based on publicly available data-sources. Bankscope contains information for listed, delisted as well as privately held banks. While Bankscope does not contain stock market information on a daily basis (which is what we need to compute a systemic risk indicator), it does contain information on the ticker as well as the ISIN number of (de)listed banks' equity, which enables matching Bankscope with Datastream. From Datastream, we retrieve information on a bank's stock price as well as its market capitalization. This merged Bankscope-Datastream sample yields a panel of 16507 bank-year observations, distributed over 15 years and 76 countries[6]. We include commercial banks (44.5% of our sample), bank holding companies (51%), saving banks and cooperatives (4.5%). Our data span the period of 1997-2011.

The dependent variable is a bank's systemic risk exposure. A bank's exposure to systemic risk is measured by the Marginal Expected Shortfall (MES), as proposed by Acharya, Pedersen,

[6]In terms of geographical spread, US banks constitute the largest part of our sample (1137 banks out of 2199). However, this US dominance does not impact our main findings, as our results also hold when using various subsamples (including a non-US sample) or when weighting observations such that each country-year combination gets equal weight. A list of countries and number of banks is available on request.

Philippon, and Richardson (2012). Mathematically, the MES of bank i at time t is given by the following formula:

$$MES_{i,t}(Q) = E[R_{i,t}|R_{m,t} < VaR_{m,t}^{Q}] \tag{1}$$

In Equation (1), $R_{i,t}$ denotes the daily stock return of bank i at time t, $R_{m,t}$ the return on a banking sector index at time t. $VaR_{m,t}^{Q}$ stands for Value-at-Risk, which is a threshold value such that the probability of a loss exceeding this value equals the probability Q. Q is an extreme percentile, such that we look at systemic events. Following common practice in the literature, we compute MES using the opposite of the returns such that a higher MES means a larger systemic risk exposure. Conceptually, MES measures the increase in the risk of the system induced by a marginal increase in the weight of bank i in the system[7]. The higher a bank's MES (in absolute value), the higher is the contribution of bank i to the risk of the banking system.

In this paper, we measure MES for each bank-year combination and follow common practice by setting Q at 5%. Doing so, $MES_{i,t}$ corresponds with bank i's expected equity loss per dollar in year t conditional on the market experiencing one of its 5% lowest returns in that given year. While Datastream provides return indices for the banking sector indices, it does not do so for all countries in our sample. For consistency across countries, we therefore construct the (value-weighted) indices ourselves. Moreover, the bank for which we compute the MES is excluded from the banking sector index for a given country. The independent variables of interest are bank size and non-interest income. The former is computed as the natural logarithm of total assets expressed in 2007 US dollars. We measure a bank's share of non-interest income to

[7]The Expected Shortfall of the market portfolio is given by: $E[R_{m,t}|R_{m,t} < VaR_{m,t}^{Q}] = \sum_{i=1}^{N} w_{i,t} E[R_{i,t}|R_{m,t} < VaR_{m,t}^{Q}]$, and is hence equal to the weighted sum of the MES of all banks in the system. The first derivative of the Expected Shortfall of the market portfolio with respect to $w_{i,t}$ equals the MES of bank i at time t.

total operating income, by dividing other operating income (which comprises trading income, commissions and fees as well as all other non-interest income) by the sum of interest income and other operating income.[8] Summary statistics of all variables are reported in Table 1.

<**Insert Table 1 around here**>

The other bank-specific variables capture various other dimensions of a bank's business model. In particular, we include proxies for leverage (capital-to-asset ratio), the funding structure (share of deposits in sum of deposits and money market funding), asset mix (loans to assets ratio), profitability (return-on-equity), annual growth in total assets as well as expected credit risk (Loan Loss Provision to Interest Income). These variables are often used in other studies; and the values are comparable to e.g.: Laeven and Levine (2009) or Beck, De Jonghe, and Schepens (2013). We winsorize all variables at the 1 percent level to mitigate the impact of outliers.

3 The impact of Bank Size and Non-Interest Income on Systemic Risk

Our first goal is to empirically show the impact of bank size, non-interest income, and their interaction on banks' Marginal Expected Shortfall. To that end, we estimate regressions corresponding with the following equation:

$$MES_{i,t+1} = \beta_1 Size_{i,t} + \beta_2 NII_{i,t} + \beta_3 Size_{i,t} \cdot NII_{i,t} + X_{i,t}\beta + u_i + v_{t+1} + \varepsilon_{i,t+1} \quad (2)$$

[8] In the robustness section, we decompose non-interest income in its constituents (i.e. commission and fee income, trading income and other operating income) and find similar results for each of the components. Moreover, we also resort to alternative datasources for US banks (regulatory filings of Bank Holding Companies, i.e. the FRY9C reports) that allow for an even finer decomposition. The results are robust to (i) using only US data and (ii) alternative non-interest income decompositions.

Next to including a proxy for bank size and non-interest income (NII), we control for various bank- and country-specific characteristics that may affect the Marginal Expected Shortfall. These are represented by the vector $X_{i,t}$ and are described in Section 2. In addition, we include bank (u_i) and year (v_{t+1}) fixed effects and cluster the standard errors at the bank level. Let us stress once more that we compute MES using the opposite of the returns such that a higher MES means a larger systemic risk exposure. The results are reported in Table 2 and we will focus our discussion only on the impact of the variables of interest, which corresponds with the coefficients $\beta_{1,}$ β_2 and β_3.

<Insert Table 2 around here>

In the first column, we report the results when imposing the constraint that there is no interaction effect between bank size and non-interest income, i.e. we impose that $\beta_3 = 0$. Hence, we impose additivity, which is the benchmark in the literature. We find that size has a positive effect on MES. Larger banks will experience a larger reduction in market value of their stock if there is a systemic event. The impact of NII on MES is negative and significant. Moreover, the correlation coefficient[9] of size and non-interest income (after the within transformation), is insignificant, reducing multicollinearity issues. The sign, significance and magnitude of this coefficient is in line with the results reported in Engle, Moshirian, Saghal, and Zhang (2012) in their specification including bank fixed effects. The economic magnitude of this estimated effect is small. A one standard deviation increase in the share of non-interest income in total income, holding all else equal, leads to an increase in MES of 0.1355 (i.e. the coefficient, -0.961, times the standard deviation of NII, 0.141). This is only a moderate impact on the MES, which has a

[9] A full correlation table is reported in the online appendix. In particular, we report the correlation coefficients of the raw, untransformed data as well as those of the data after the within transformation. The latter implies that we first subtract, for each variable, the bank-specific mean. This setup corresponds with our regression which includes bank fixed effects.

mean of 1.9 and a standard deviation of 2.4. In column 2, we relax the restriction that $\beta_3 = 0$ and find that the interaction coefficient is negative and strongly significant. While the sign and magnitude of the size coefficient are unaffected, we now obtain that the coefficient on the non-interest income share is positive, large and significant. Hence, we find that expanding into non-interest income leads to higher systemic risk exposures for small banks. For example, based on the results in column 2 of Table 2, a one standard deviation increase in non-interest income for a bank at the 5^{th} size percentile leads to a rise in the MES of 0.175, which corresponds with a 9.2% increase in MES for the average bank in our sample.[10] However, for larger banks the impact of non-interest income on MES becomes smaller and turns negative when ln(TA) equals 6.871, which corresponds with 963.7 million US$ (see bottom panel of Table 2). Figure 1 depicts the marginal effect of the non-interest income share on MES over the observed range of bank size in the sample.

<Insert Figure 1 around here>

For small banks, the effect is economically large and positive and significantly different from zero. Subsequently, there is a range of values of ln(TA)=$[5.86 - 7.66]$, around the "sign-switch point" of 6.871, at which the impact of NII is not significantly different from zero. The boundaries of this range correspond with the 14^{th} and 51^{th} percentile of bank size. Hence, for the 14% smallest banks in the sample, an increase in NII leads to an increase in MES. For the 49% largest banks in the sample, there is a significant impact of NII on MES as well, but it goes in the other direction. For larger banks, the impact is significantly sizeable and can become economically large (with point estimates exceeding -4). For example, a one standard deviation increase in non-interest income for a bank at the 95^{th} size percentile leads to a drop in the MES of 0.52,

[10] The standard deviation of the non-interest income share is 0.14. The $5th$ percentile of ln(total assets) is 5.15 in our sample. Using the coefficients from column 2 of Table 2, we can then calculate the impact as follows: $0.14 * (5.001 - 0.728 * 5.15) = 0.175$.

which corresponds with a 27.5% decrease in the MES for the average bank in our sample. Furthermore, the effect of a change in NII is twice as large for a bank with total assets of 207 billion US$ (=ln(TA) of 12.24) compared with a bank which has 14 billion US$ in Total Assets (=ln(TA) of 9.55). An equally large but opposite effect is observed for a small bank with total assets worth 66 Million US$ (=ln(TA) of 4.19) compared with a bank which has 14 billion US$ in Total Assets (=ln(TA) of 9.55). Hence, not controlling for the interaction effect between size and non-interest income may lead to misguided conclusions. The interaction term also rationalizes why the effect of NII seems small in column 1. The effect in the first column averages out and obscures the large positive effect of NII for small banks and large negative impact of NII for large banks.

In sum, we find that larger banks have a larger MES than small banks and that the effect of NII depends on the size of the bank. Alternative revenues increase the exposure to systemic risk for small banks, but reduce it for larger banks. Put differently, the dark side of diversification and innovation dominates for small banks, while for large banks the bright side of diversification outweighs the potential negative consequences. Furthermore, additional robustness checks, which will be discussed in Section 5, indicate that both the statistical significance as well as the economic magnitudes (particularly regarding the value of bank size at which the sign switch for non-interest income occurs) are robust to endogeneity concerns, additional (market-based) control variables, alternative risk measures, decomposing non-interest income in its subcomponents as well as several sample splits.

4 Conflicts of Interest: Exploiting Cross-country Heterogeneity

4.1 Theoretical Motivation and Empirical Proxies

We find that the bright side of diversification dominates the dark side for large banks, but not so for small banks. One potential reason is that large banks are, compared to small banks, typically subject to a larger scrutiny by various disciplining stakeholders. However, these stakeholders will only be able to properly discipline these banks when the information environment or institutional setting allows them to do this. If not, large banks do have incentives to abuse conflicts of interest. Mehran and Stulz (2007) and Saunders and Cornett (2014) conjecture that the scope for exploiting conflicts of interest is larger when (i) there is more asymmetric or imperfect information, (ii) reputation concerns and fear of litigation are low, and (iii) the banking sector is more concentrated (there is no alternative). We take advantage of our cross-country sample to exploit differences in institutional settings[11] across countries in each of these three dimensions. In particular, we measure imperfect or asymmetric information between a bank and other economic agents with three proxies. First, we employ a private monitoring index to analyze the strength of the information environment. The private monitoring index, taken from the Bank Regulation and Supervision database (Barth, Caprio, and Levine (2013)), ranges from 0 to 12, where larger

[11]Our cross-country sample offers the advantage that we can exploit variation in the institutional settings in which banks operate. We can therefore take a different approach compared to prior empirical research on conflicts of interest (for a survey of that literature, please see Drucker and Puri (2007)). Prior studies use detailed contract-level data (see e.g. Kroszner and Rajan (1994) or Puri (1996)) and investigate the actual realization of conflicts of interest. Institutional features will make the exploitation of conflicts of interest more likely in some countries than in others. Hence, we do not look at the actual exploitation of conflicts of interest, but at the scope for the realization of such conflicts.

values indicate greater regulatory empowerment of the monitoring of banks by private investors. Put differently, it captures how heavily regulators and policy makers try to incentivize private investors to monitor financial institutions. For example, it will be easier for private investors to monitor financial institutions when the latter have to provide more detailed information on their activities, are required to obtain certified audits and are rated by external agencies. More and better information on a banks' activities should then reduce information asymmetry problems between banks and the public/outside investors, which in turn reduces the probability that the dark side of diversification will be able to manifest itself. Second, a well-developed credit register will provide detailed information to supervisors and participating banks on other banks' credit quality by gathering data on the amount borrowed by each firm, default rates on loans, and so on. Hence, these registers should reduce the potential private information advantage and mitigate overall information asymmetries. To measure the information content of credit registries, we use the credit depth of information index. This is an indicator from the World Bank Doing Business database that takes into account the rules affecting the scope, accessibility, and quality of credit information available through public or private credit registries. The index ranges between 0 and 6, with a higher value indicating that more information is available. Thirdly, we also include a proxy for Official Supervisory Power, also constructed by Barth, Caprio, and Levine (2013). The index measures the degree to which the country's bank supervisory agency has the authority to take specific actions. The official supervisory index has a maximum value of 14 and a minimum value of 0, where larger numbers indicate greater power.

Reputation concerns will be low whenever fraudulent actions will remain undetected or are not penalized. We hypothesize that bank fraud is more likely and reputation concerns are lower in countries in which corruption levels are higher. We use the Heritage Freedom from Corruption Index to measure how corrupt a government is.[12] The index ranges between 0 and 100, where a

[12]Bank fraud data is available (see e.g. the proxy of corruption in bank lending used by Beck, Demirguc-Kunt, and

higher index indicates less corruption.

Finally, in concentrated markets, banks should be less concerned with reputation concerns and market retaliation as there are no or fewer alternatives to go to. Bank market concentration is proxied by the Herfindahl-Hirschman concentration index (HHI). This index measures market concentration by summing the squares of the market shares (based on total assets) of all banks (listed and privately held) in a country. The higher the index, the more concentrated the banking market. Summary statistics of these variables are reported in the bottom panel of Table 1.

4.2 Setup and Results

To measure the impact of the institutional setting on the interaction effect, we expand Equation 2 by adding the country-specific factors of interest (one-by-one) and their interaction terms with bank size and diversification:

$$MES_{i,t+1} = \beta_1 \mathrm{Si}\,ze_{i,t} + \beta_2 NII_{i,t} + \beta_3 Z_{i,t} + \beta_4 \cdot Interactions_{i,t} + X_{i,t}\beta + u_i + v_{t+1} + \varepsilon_{i,t+1} \quad (3)$$

$MES_{i,t+1}$, $\mathrm{Si}\,ze_{i,t}$ and NII are defined as in the previous section. $Z_{i,t}$ is one of the country-specific variables under investigation, $Interactions_{i,t}$ is a vector including all interaction terms between bank size, non-interest income and the country-specific characteristic, and $X_{i,t}$ is a group of bank specific and macro-economic control variables. Additionally, we also control for bank (u_i) and time (v_{t+1}) fixed effects. Estimating this equation allows us to analyze the impact

Levine (2006)), but unfortunately only for a single year (2000), whereas the freedom from (government) corruption indicator is time-varying and measured annually. We find that the correlation between corruption in bank lending in and the freedom from government corruption in the year 2000 is negative and significant (-68%). Similarly, Barth, Lin, Lin, and Song (2009) show in a regression framework with control variables that measures of macro-corruption are significantly related to corruption in bank lending.

of country-specific characteristics on the relationship between non-interest income and systemic risk, while taking into account that the impact could differ for either small or large banks.[13] The impact of the five aforementioned country-specific proxies on the relationship between bank diversification and systemic risk is reported in Table 3. We report both the regression results (left panel) and the marginal effect of NII on MES for different values of the country-specific variables (right panel). The triple interaction term (in bold) has the expected sign and is significant in three out of four cases. This provides support for the hypothesis that an institutional environment that facilitates the potential for conflicts of interest makes it more likely that an increase in non-interest income leads to a higher MES for larger banks as well. To facilitate the interpretation and provide insights in the economic magnitudes of the effects, we will mainly focus on the marginal effects that are reported in the right panel. We calculate the marginal effect of a change in diversification on systemic risk exposures for countries that have a low, median or a high level of the country-specific proxy of the scope for conflicts of interest. The low group is based on the country at the 10^{th} percentile of the country-specific proxy, the median group is based on the country at the 50^{th} percentile and the high group is based on the country at the 90^{th} percentile. At the same time, we calculate the effect for each subgroup for three types of banks (small, median, large), based on the 10^{th}, 50^{th} and 90^{th} percentile of bank size in our sample. For each bank size-country characteristic combination, the marginal effect is given in the first column, while the second column shows the corresponding p-value (in italics). Furthermore, the last column shows the difference (and the corresponding p-value) between the impact of diversification for

[13] Lee, Hsieh, and Yang (2014) provide evidence that the relationship between revenue diversification and bank performance/risk depends upon country characteristics. We differ from Lee, Hsieh, and Yang (2014) in at least three dimensions. That is, they only look at a sample of 29 Asia-Pacific countries, focus on the country-heterogeneity in the impact of diversification on bank performance (irrespective of bank size) and explain the cross-country variation in that relationship with differences in financial structures and reforms (bank- or market-based systems).

banks in the low country group and banks in the high country group (for a given size). Similarly, the last row shows the differences for banks operating in the same country group but belonging to a different size group (low versus high).

<Insert Table 3 around here>

The results in Table 3 reveal a couple of interesting patterns. First, all proxies confirm that an environment more conducive to the realization of conflicts of interests leads to a larger impact of non-interest income on MES (irrespective of bank size), i.e. high-low (in the last column of the RHS panel) is negative for the first four proxies and positive for the last one (concentration). This implies that diversification into non-interest income activities will lead to higher systemic risk exposures in countries with non-transparent information environments, weaker supervisory power, more corruption or high concentration. Second, in line with our previous findings, the results in Table 3 confirm that the effect of non-interest income depends on the size of the bank. However, in addition to the results in the previous section, the results in Table 3 also illustrate that the average negative relation between non-interest income and MES for large banks, e.g. depicted to the right of the turning point in Figure 1, masks cross-country variation. The average negative effect is the result of a significant positive or non-significant negative relationship for banks operating in institutional settings conducive to conflicts of interest (e.g., low information, 4.778^{***}, high corruption, -0.913, or high concentration, 1.93) and a significant and large negative relationship for banks operating in institutional settings mitigating conflicts of interest (e.g. more information, -4.266^{***}, low corruption, -3.928^{***}, or low concentration, -3.773^{***}). Third, there is no statistically significant difference in the impact of the NII-share on MES for large versus small banks in countries with non-transparent information environments, more corruption or high concentration. The p-values of a differential response for large versus small banks is at least 0.20 when there is low information sharing, high corruption or high concentration.

In sum, we document that the sign switch disappears if the institutional setting facilitates the materialization of conflicts of interest[14]. Hence, it will lead to negative effects of scope expansion for both small and large banks. However, an environment with more information sharing, more private monitoring, stronger supervisory monitoring, less corruption or more competition, works as a disciplining device for large banks and induces them to differentiate and innovate for the better cause. For small banks, on the other hand, the effect remains negative and does not vary with these institutional features.

Overall, the results in this section confirm that the scope for conflicts of interests has a sizeable impact on the multiplicative effect of bank size and diversification on systemic risk. If the institutional environment favors exploiting conflicts of interest, then diversification or innovation will lead to higher systemic risk exposures, both for large and small banks. On the other hand, diversification into non-interest income activities (innovation) could have a bright side for systemic stability in countries with transparent information environments, strong supervisors, less corruption or lower bank market concentration. Our results also indicate that the scope for conflicts of interest matters more for large banks. This is consistent with the idea that the larger scrutiny, by various disciplining stakeholders, to which large banks are typically subject, can only play its role in an environment that forces banks to be more transparent about their activities.

4.3 Economic Magnitudes

What do the results reported in Table 3 and discussed above imply quantitatively and qualitatively? Using the depth of information sharing indicator as an information environment proxy,

[14] Supervisory power is the exception to this general finding. The impact of NII on MES is negative for large banks irrespective of the strength of supervisory power. However, the gap between large and small banks' their impact of NII on MES is increasing in supervisory power strength, indicating that stronger supervisors are especially beneficial for disciplining the behavior of large banks.

our results indicate that a one standard deviation in the non-interest income ratio leads a to jump in the MES ranging between 0.29 (for small banks) and 0.67 (for large banks)[15] when the potential scope for asymmetric information and conflicts of interest is high. For large banks, this increase in MES with 0.67, corresponds with a 35 percent increase of the average MES. On the other hand, when banks are operating in a highly transparent information environment, a one standard deviation increase in the non-interest income ratio would lead to a change in the MES ranging between 0.07 (for small banks) and -0.60 (for large banks), indicating that diversification can potentially contribute to a more stable banking system when the information environment is well developed. The impact of the information environment is also economically large. The differences between the impact of a change in diversification are reported in the high-low column and indicate that the impact of an increase in diversification is always significantly more positive (hence more risk) in countries with an underdeveloped information environment. Further focussing on the depth of information sharing, our results show that a one standard deviation increase in the non-interest income ratio for a median sized bank operating in a low information environment raises the MES with 0.43. This corresponds with a 23 percentage increase in MES for the average bank in our sample, or, put differently, a 19 percent standard deviation increase in the MES. If that same bank would be operating in a highly transparent information environment, a standard deviation increase in the non-interest income ratio would lead to a reduction in the MES with 10 percent, which equals an 8 percent standard deviation decrease in MES. A similar and even stronger effect is found for large banks. The results for large banks indicate that a one standard deviation increase in the non-interest income ratio for a large bank operating in a low

[15]The standard deviation of the non-interest income ratio in our sample is 0.14. Based on the results in Table 3, the impact of a one standard deviation increase for a large bank operating in a low information environment thus equals $0.14 * 4.778 = 0.67$, which equals 35 percent of the average MES (1.92) or 28 percent of its standard deviation (2.35) in our sample. We make similar computations throughout this subsection.

information environment raises the MES with 0.67 ($= 0.14 * 4.77$), which corresponds with a 35 percent increase in MES for the average bank in our sample. At the other extreme, if the same bank is operating in a country with a well developed credit register, a one standard deviation increase in the non-interest income ratio leads to a drop in MES of 0.60 ($= 0.14 * -4.26$), which equals a reduction in average MES of 31 percent.

The results for the other information environment proxy (the private monitoring index), the freedom from corruption index and bank concentration are qualitatively similar. Banks operating in countries in which the potential scope for asymmetric information problems is lower will benefit more from an increase in diversification - in terms of systemic risk - compared to banks operating in a country with highly opaque information environments. For example, a standard deviation increase in the non-interest income ratio of a median sized bank operating in a country with a low private monitoring (freedom of corruption) index, leads to an increase in the MES with 7 (1.5) percent, while a similar raise in non-interest income would lead to a decrease in MES with 12 (8) percent if that bank would be operating in a highly transparent environment. For medium-sized and large banks, an improvement in the strength of supervisory power leads to a significant lower impact of NII on MES. The differential impact of a one standard deviation increase in NII on MES for a median-sized bank operating in a high versus low supervisory environment is -0.19 $(= 0.14 * -1.352)$, whereas a similar computation for large banks yields an effect that is twice as large ($0.14 * -2.673 = -0.37$), indicating that supervisory power is more effective for disciplining large banks' behaviour. The difference in impact between high and low concentrated markets is reported in the last two columns in the HHI panel of Table 3. The difference is always positive and significant, and ranges between 1.25 for small banks and 5.70 for large banks. More specifically, a standard deviation increase in the non-interest income ratio for small (large) banks operating in a concentrated banking environment leads a to jump in the MES of 0.29 (0.27), which corresponds with an increase of around 16 (14) percent for the average bank in our sample. On the other hand, when a similar small (large) bank operates in an unconcentrated banking market, a standard deviation increase in the non-interest income ratio leads to a change in the MES of 0.11 (-0.53). This lends support to the idea that concentrated banking markets can suffer from too-important-to-fail problems, which will give banks an incentive to opt for more risky assets when they decide to (further) diversify their revenue stream.

5 Robustness Tests[16]

In this section, we briefly discuss the results of a large number of additional tests and specifications, which indicate that the statistical significance as well as the economic magnitudes that we find in our analyses are robust. First of all, we subject the baseline regression (column 2 of Table 2) to a number of robustness tests to make sure that our results are not driven by omitted variables, endogeneity issues, the chosen systemic risk measure or (implicit or explicit) bail-out guarantees for large banks. In our baseline specification in column 2, we include bank-fixed effects to control for unobserved bank heterogeneity. To show that this is indeed important, we first relax this assumption in column 3 in which we include country fixed effects, but no bank fixed effects. We observe a substantial drop in the R-squared from 57% in column 2 to 48% in column 3, indicating a large scope for an omitted variable bias at the bank level. Admittedly, bank fixed effects only capture time-invariant bank-specific omitted variables, such as ownership or management who jointly decide on the risk profile as well as the business model. It can still be that there are time-varying omitted bank characteristics that drive both MES and the decision

[16]A more detailed discussion as well as additional tables are available on request or can be found on the authors' personal webpages.

to diversify. In column 4, we report the results from an instrumental variable specification. We instrument NII and the interaction terms with their lag and a bank level operating cost ratio. The rationale behind this instrument is based on the theories of Rajan, Servaes, and Zingales (2000) and Scharfstein and Stein (2000), which both imply that in more diversified firms weaker divisions will potentially get cross-subsidized by stronger ones, which will impact the cost level of diversified firms. The statistical tests validate the choice of our instrument set and indicate robustness. In subsequent tests, we analyze the robustness of the results when using alternative dependent variables. We find similar results when using respectively a systemic risk contribution measure ($\Delta CoVaR$, Adrian and Brunnermeier (2009)), total bank risk (total volatility of bank returns) or an alternative MES (that includes the bank itself in the banking index). The results in columns 5 to 7 indicate that the finding is not measure-specific, but also carries over to other risk measures that have been often used in the empirical literature relating non-interest income to bank risk (see e.g. Stiroh (2006)) or focusing on systemic risk (see, e.g., Brunnermeier, Dong, and Palia (2012)). The largest banks (which are usually also more diversified) may benefit from implicit government guarantees (bailing out big banks) encouraging risk-taking, possibly affecting our baseline result. Unreported regressions show that our results are unaffected when including size squared or a dummy variable that is one for banks that are large with respect to the home country's GDP (as a proxy for being too-big-to-fail). Our results are also robust to (i) excluding the US banks from the sample, (ii) employing weighted least squares such that each country-year combination gets equal weight, (iii) splitting the sample in a pre-2007 crisis and a post-crisis period, (iv) using commercial banks only, (v) using bank holding companies only, (vi) dropping mergers and acquisitions (by excluding banks that shrink or grow substantially, (vii) bank exits.

We also analyze whether the results are robust to using alternative proxies for non-traditional banking activities. First of all, we examine whether the interaction effect is driven by a particular subcomponent of non-interest income. In columns 2 to 4 of Table 4, we focus on three non-interest income components which are available for our worldwide sample of banks. They are respectively fee income share, trading income share or other (non-interest) income share. For each component, the outcome is qualitatively similar to our baseline result. We always find a positive direct effect of the non-interest income component on MES, while the interaction term is negative. In an unreported regression, we include all three shares and their interactions with size simultaneously and find similar results. We also analyze US bank holding companies separately using Center for Research in Security Prices (CRSP) and FR9YC data, which are more detailed and allow for alternative groupings of non-interest income components. Our initial result also holds when using these alternative data sources. Moreover, we also differentiate between a volatile and stable part of non-interest income as Calomiris and Nissim (2014) or a decomposition into traditional fee income, fee for services income and stakeholder income as in DeYoung and Torna (2013). These unreported tests also confirm the presence of a significant interaction effect of bank size and non-interest income on systemic risk exposures and this for each of the subcomponents.

<Insert Table 4 around here>

Furthermore, we also construct two revenue diversification measures. $Div(HHI) = 1 - \left(\frac{interest\ income}{total\ income}\right)^2 - \left(\frac{non\ interest\ income}{total\ income}\right)^2$, is a diversification measure based on the Herfindahl-Hirschman index (see e.g. Elsas, Hackethal, and Holzhauser (2010)). We also follow Laeven and Levine (2007) and define revenue diversification as follows:

$Div(LL) = 1 - \left|\frac{interest\ income - non\ interest\ income}{total\ income}\right|$. The results using these diversification measures rather than the non-interest income share are very similar as can be seen from the results reported in columns 5 and 6 of Table 4. Finally, in column 7, we use another proxy for the shift to non-traditional banking, which is the ratio of the total off-balance sheet position to total assets. Note that off-balance sheet items are also not necessarily only non-traditional banking activities as it may also contain the committed but unused component of credit lines or other credit-related commitments. As with the NII share, we find a positive and significant coefficient on the ratio of OBS to total assets and a negative and significant interaction effect with bank size. Moreover, we find that the value of bank size at which the relationship between MES and OBS-to-total assets switches from being positive to being negative is very similar to the one obtained in the baseline specification reported in column 1 of Table 4.

Next to analyzing the robustness of the result to using alternative proxies for diversification, we also investigate whether the results hold when we use a relative size measure (market share within a country) rather than absolute size. The results are reported in the last column of Table 4. We find a positive and significant effect on NII and market share and a negative and significant interaction effect, which is further evidence of the robustness of our baseline specification. Using alternative setups in which we replace market share with a binary classification of banks whose assets are above or below the median (or mean) bank's assets (in a country year) yield similar results.

Our last set of (unreported) robustness checks deals with the analysis of the triple interaction effect. In the absence of an exogenous cross-country shock to the scope for conflicts of interest, we have to resort to another external validation technique. In particular, we design a placebo test by examining whether other country characteristics, which are not directly related to exploiting conflicts of interests, would also lead to a significantly different interaction effect. In particular, we examine whether we find similar patterns while including proxies of (i) the level of deposit insurance, (ii) restrictions on the permissible range of activities, (iii) herding of activities, (iv) crisis times, (v) monetary policy conditions, (vi) GDP per capita. In general, we do not find that the impact of NII-share on MES differs depending on the value of these country characteristics. The non-significant triple interaction results in these specifications make it less likely that the results in the Section 4 are driven by other country-specific factors or that the obtained results are random and obtained by chance.

6 Conclusion

Bank supervisors across the globe pay special attention to financial institutions that are seen as both large and complex entities as they pose a challenge to financial stability. However, how size and scope interact in their impact on systemic risk is ignored in the academic literature. Our results indicate that scope expansion and innovation (venturing into non-traditional banking activities) is less detrimental for systemic risk the larger the bank is and even becomes beneficial (i.e. reduces systemic risk exposures) for medium sized and large banks. Furthermore, we show that country characteristics that affect the scope for and realization of conflicts of interest mitigate the impact of this interaction effect. The results in this paper can help in evaluating suggested policy reform proposals that followed the global financial crisis. This paper documents that an increase in size leads to larger systemic risk exposures. Hence, scaling down the size of the banks will lead to less systemic risk. Furthermore, from a systemic risk point of view, forcing banks to go back to the basic activities is unambiguously good for small banks, irrespective of the institutional setting. On the other hand, systemic risk exposures may increase if large banks are ring-fenced, depending on the institutional setting. For large banks, ring fencing their activities may lower systemic risk, if they operate in an environment that facilitates the exploitation of conflicts of interest. Hence, improving information disclosure, both within and outside the financial system might be a substitute for restricting large banks' permissible range of activities. If large banks are forced to disclose more information, they will have less incentives to exploit the bad side of non-interest income generating activities. Put differently, information disclosure and less concentration might make it more likely that the bright side of innovation and diversification will prevail over the bad side.

This paper identifies a negative interaction effect between size and non-interest income in their relationship with systemic risk. We document that this pattern is also prevalent for the constituents of the non-interest income share, i.e. commission and fee income, trading income as well as other non-interest income. Moreover, the observed relationships (also those for the subcomponents) are similar in a sample of US banks only, even when using a finer split of the non-interest income generating activities. In future work, it may be worthwhile to focus exclusively on the US market and exploit the richness of the databases on US bank holding companies. For example, one may analyze how ownership structure and internal governance mechanisms, such as executive compensation or institutional ownership, may help in mitigating the relationship between conflicts of interest and risk-taking incentives in large banking groups. Data availability is the main limiting factor to analyze these issues in a large cross-country sample as ours. Alternatively, one may try to exploit plausibly exogenous regulatory changes at the state level (if any) to explore which specific source of revenue is most affected by the scope for conflicts of interest.

References

Acharya, V., L. H. Pedersen, T. Philippon, M. Richardson, 2012. Measuring Systemic Risk. CEPR Discussion Papers 8824.

Adrian, T., M. Brunnermeier, 2009. CoVar. Federal Reserve Bank of New York Staff Report Nr 348.

Baele, L., O. De Jonghe, R. Vander Vennet, 2007. Does the stock market value bank diversification?. Journal of Banking and Finance 31(7), 1999–2023.

Barth, A., I. Schnabel, 2013. Why banks are not too big to fail. Evidence from the CDS market. Economic Policy 28(74), 335–369.

Barth, J. R., J. Caprio, Gerard, R. Levine, 2013. Bank Regulation and Supervision in 180 Countries from 1999 to 2011. National Bureau of Economic Research Working Paper Series No. 18733.

Barth, J. R., C. Lin, P. Lin, F. M. Song, 2009. Corruption in bank lending to firms: Cross-country micro evidence on the beneficial role of competition and information sharing. Journal of Financial Economics 91(3), 361–388.

Beck, T., O. De Jonghe, G. Schepens, 2013. Bank competition and stability: Cross-country heterogeneity. Journal of Financial Intermediation 22(2), 218–244.

Beck, T., A. Demirguc-Kunt, R. Levine, 2006. Bank supervision and corruption in lending. Journal of Monetary Economics 53(8), 2131–2163.

Boot, A., L. Ratnovski, 2013. Banking and Trading. IMF Working Paper 12/238.

Brunnermeier, M., G. Dong, D. Palia, 2012. Banks non-interest income and systemic risk. American Finance Association 2012 Chicago Meetings Paper.

Calomiris, C. W., D. Nissim, 2014. Crisis-related shifts in the market valuation of banking activities. Journal of Financial Intermediation 23(3), 400–435.

Cerasi, V., S. Daltung, 2000. The optimal size of a bank: Costs and benefits of diversification. European Economic Review 44(9), 1701–1726.

De Jonghe, O., 2010. Back to the basics in banking? A Micro-Analysis of Banking System Stability. Journal of Financial Intermediation 19(3), 387–417.

DeLong, G. L., 2001. Stockholder gains from focusing versus diversifying bank mergers. Journal of Financial Economics 59(2), 221–252.

Demirguc-Kunt, A., H. Huizinga, 2013. Are banks too big to fail or too big to save? International evidence from equity prices and CDS spreads. Journal of Banking and Finance 37(3), 875–894.

Demsetz, R., P. Strahan, 1997. Diversification, Size and Risk at Bank Holding Companies. Journal of Money, Credit and Banking 29(3), 300–313.

Dewatripont, M., J. Mitchell, 2005. Risk-taking in Financial Conglomerates. Unpublished manuscript.

DeYoung, R., G. Torna, 2013. Nontraditional Banking Activities and Bank Failures During the Financial Crisis. Journal of Financial Intermediation 22(3), 397–421.

Drucker, S., M. Puri, 2007. Chapter 5 - Banks in Capital MarketsElsevier San Diego pp. 189–232.

Elsas, R., A. Hackethal, M. Holzhauser, 2010. The anatomy of bank diversification. Journal of Banking and Finance 34(6), 1274–1287.

Engle, R. F., F. Moshirian, S. Saghal, B. Zhang, 2012. Pick your poison: Systemic risk and banking activity. Unpublished manuscript.

Fahlenbrach, R., R. Prilmeier, R. M. Stulz, 2012. This Time Is the Same: Using Bank Performance in 1998 to Explain Bank Performance during the Recent Financial Crisis. The Journal of Finance 67(6), 2139–2185.

Flannery, M., S. Kwan, M. Nimalendran, 2004. Market evidence on the opaqueness of banking firm's assets. Journal of Financial Economics 71(3), 419–460.

Freixas, X., G. Loranth, A. D. Morrison, 2007. Regulating financial conglomerates. Journal of Financial Intermediation 16(4), 479–514.

Goddard, J., D. McKillop, J. O. S. Wilson, 2008. The diversification and financial performance of US credit unions. Journal of Banking and Finance 32(9), 1836–1849.

Hughes, J. P., L. J. Mester, 1998. Bank Capitalization and Cost: Evidence of Scale Economies in Risk Management and Signaling. Review of Economics and Statistics 80(2), 314–325.

Ibragimov, R., D. Jaffee, J. Walden, 2011. Diversification disasters. Journal of Financial Economics 99(2), 333–348.

Kroszner, R. S., R. G. Rajan, 1994. Is the Glass-Steagall Act Justified? A Study of the U.S. Experience with Universal Banking Before 1933. The American Economic Review 84(4), 810–832.

Laeven, L., R. Levine, 2007. Is there a diversification discount in financial conglomerates?. Journal of Financial Economics 85(2), 331–367.

——— , 2009. Bank governance, regulation and risk taking. Journal of Financial Economics 93(2), 259–275.

Lee, C.-C., M.-F. Hsieh, S.-J. Yang, 2014. The relationship between revenue diversification and bank performance: Do financial structures and financial reforms matter?. Japan and the World Economy 29(0), 18–35.

Mehran, H., R. M. Stulz, 2007. The economics of conflicts of interest in financial institutions. Journal of Financial Economics 85(2), 267–296.

Milbourn, T., A. W. A. Boot, A. V. Thakor, 1999. Megamergers and expanded scope: Theories of bank size and activity diversity. Journal of Banking and Finance 23(2-4), 195–214.

Puri, M., 1996. Commercial banks in investment banking conflict of interest or certification role?. Journal of Financial Economics 40(3), 373–401.

Rajan, R., H. Servaes, L. Zingales, 2000. The Cost of Diversity: The Diversification Discount and Inefficient Investment. The Journal of Finance 55(1), 35–80.

Saunders, A., M. M. Cornett, 2014. Financial Institutions Management: A Risk Management Approach vol. 8th Edition. McGraw-Hill, .

Scharfstein, D. S., J. C. Stein, 2000. The Dark Side of Internal Capital Markets: Divisional Rent-Seeking and Inefficient Investment. The Journal of Finance 55(6), 2537–2564.

Stiroh, K., 2006. A portfolio view of banking with interest and noninterest activities. Journal of Money, Credit and Banking 38(5), 1351–1361.

Stiroh, K., A. Rumble, 2006. The dark side of diversification: The case of U.S. Financial Holding Companies. Journal of Banking and Finance 30(8), 2131–2161.

van Oordt, M. R. C., 2013. Securitization and the dark side of diversification. Journal of Financial Intermediation forthcoming.

Wagner, W., 2010. Diversification at Financial Institutions and Systemic Crsises. Journal of Financial Intermediation 19(3), 373–386.

Table 1: Summary Statistics

This table shows the total sample summary statistics for the bank- and country-specific variables used throughout the paper. Bank specific data is retrieved from the Bureau Van Dijck Bankscope database. The full sample contains 16507 bank-year observations over the period 1996-2010 (as the accounting data are lagged one year with respect to the market-based risk measure). For each variable, we report five statistics, which are calculated at the bank-year level: the mean and standard deviation of the variables as well as the 5th, 50th and 95th percentile. All variables are winsorized at the one percent level. The summary statistics for the country-specific variables are calculated at the country-year level. The full sample contains 869 country-year observations over the period 1996-2010. The first three country-specific variables, GDP per Capita, Annual GDP Growth and the CPI Rate are used as macro-economic control variables throughout the paper. Data for these variables is retreived from the WDI database at the World Bank. The other four country-specific variables are proxies for the information environment in a country. The Depth of Information Sharing indicator is retrieved from the World Bank Doing Business database. The Private Monitoring index and Official Supervisory Power Index are taken from the Bank Regulation and Supervision database (see Barth et al. (2013)). The Freedom of Corruption index is taken from the Heritage foundation, whereas the Herfindahl-Hirschman concentration index (HHI) is calculated based on total asset data retrieved from the Fitch/Bureau Van Dijk Bankscope database.

Variable	Mean	Standard Deviation	5^{th} Percentile	Median	95^{th} Percentile
Bank Variables					
Marginal Expected Shortfall	1.924	2.354	-0.435	1.323	6.550
Ln(Total assets)	8.004	2.078	5.153	7.638	11.972
Non-Interest Income Share	0.186	0.141	0.033	0.158	0.435
Capital-to-Assets Ratio	9.565	5.969	3.870	8.650	17.500
Share of Deposit Funding	0.924	0.128	0.709	0.969	1.000
Loans to Total Assets	0.623	0.159	0.325	0.647	0.842
Return-on-Equity	8.274	15.389	-14.910	10.240	24.610
Annual Growth in Total Assets	0.096	0.212	-0.142	0.059	0.441
Credit Risk	0.192	0.321	0.000	0.098	0.690
Country Variables					
GDP per Capita	8.83	1.356	6.237	9	10.518
GDP Growth - Annual	3.531	3.666	-2.75	3.75	8.9
CPI Inflation Rate	4.637	7.951	0	2.64	13.59
Depth of Information Sharing	4.012	1.788	0	4	6
Private Monitoring	8.232	1.382	6	8	10
Official Supervisory Power	10.981	2.410	6	11	14
Freedom from Corruption	54.839	24.328	22	50	93
HHI Concentration	0.208	0.159	0.048	0.159	0.555

Table 2: Baseline Regression: The interaction between Size and Non-Interest Income

This table contains estimation results for the baseline specification and robustness tests on the baseline. The dependent variable is the Marginal Expected Shortfall, which corresponds with a bank's average equity loss per dollar in a given year conditional on the market experiencing one of its 5 per cent lowest returns in that given year. We take the opposite of the returns such that a higher value for MES implies a higher systemic risk exposure. The MES is regressed on bank size, the non-interest income share, their interaction and control variables (capital-to-asset ratio, the share of deposits in sum of deposits and money market funding, the loans to assets ratio, return-on-equity, annual growth in total assets, loan loss provision to interest income, GDP per capita, GDP growth and CPI inflation). All independent variables are winsorized at the one percent level and are lagged one year to mitigate reverse causality. We include bank fixed effect as well as time dummies in all specifications (except column 3, where we include country rather than bank fixed effects). Standard errors are robust and clustered at the bank level. At the bottom of the table, we also report the value of bank size at which the relationship between the non-interest income share and MES switches sign. The different specifications are as follows. In column 1, we impose the interaction effect to be zero. Column 2 is the baseline regression in which we add an interaction effect between size and non-interest income. In column 3, we include country rather than bank fixed effects. Column 4 reports results of an instrumental variable setup, in which we instrument the non-interest income share and the interaction term. As instruments, we use the lagged values of these two variables as well as a cost ratio. In columns 5 to 7, we replace MES with alternative risk measures. We respectively use delta CoVaR, annual stock return volatility, or MES computed when including the bank itself in the banking sector index as alternative risk measures.

					Alternative dependent variables		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	MES	MES	MES	MES	d(CoVaR)	TV	MES (incl)
Ln(Total assets)	0.839***	0.994***	0.702***	0.919***	15.791***	0.128**	1.002***
	(0.090)	(0.095)	(0.111)	(0.102)	(2.202)	(0.065)	(0.102)
Non-Interest Income Share	-0.961***	5.001***	4.308***	5.611***	176.969***	2.772***	6.383***
	(0.288)	(1.071)	(0.747)	(1.948)	(31.085)	(0.675)	(1.137)
Ln(TA) * Non-Interest Income Share		-0.728***	-0.470***	-0.880***	-23.001***	-0.359***	-0.910***
		(0.135)	(0.118)	(0.237)	(3.984)	(0.076)	(0.137)
Observations	16507	16507	16507	15522	13358	16506	16505
Adjusted R-squared	0.568	0.570	0.479	0.185	0.925	0.600	0.587
Bank Fixed Effects	YES	YES		YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES
Country Fixed Effects			YES				
Bank-specific Controls	YES	YES	YES	YES	YES	YES	YES
Macro-economic variables	YES	YES	YES	YES	YES	YES	YES
MFX(NII)=0 for lnTA		6.871	9.164	6.379	7.694	7.717	7.013
MFX(NII)=0 for TA		963.7	9549	589.2	2195	2246	1111
Kleibergen-Paap F-stat				67.50			
Hansen J p-value				0.137			

Robust standard errors in parentheses, clustered at the bank level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3: Country factors that facilitate exploiting conflicts of interest

The table below documents the impact of country characteristics on the relationship between size, diversification and systemic risk. We exploit four different country characteristics that all affect the extent to which potential conflicts of interest are more likely to materialize. The measures are (i) the depth of information sharing, (ii) the level of private monitoring, (iii) supervisory power, (iv) the freedom from corruption, and (v) concentration. The table consists of two panels. The left panel shows the results for regressions of our systemic risk indicator (MES) on bank size, non-interest income diversification, the country variable in question and all possible interactions between these three variables. Furthermore, we also include a range of bank-specific and macro-economic control variables (capital-to-asset ratio, the share of deposits in sum of deposits and money market funding, the loans to assets ratio, return-on-equity, annual growth in total assets, loan loss provision to interest income, GDP per capita, GDP growth and CPI inflation) and bank and time fixed effects in our regressions. All standard errors are clustered at the bank level. In the right panel, we report information on the marginal effect of a change in NII share on the Marginal Expected Shortfall for nine cases. We distinguish between small, median and large banks as well as countries with a low, median or a high level of the country-characteristic. The size classification (small, median, large) is based on the 10th, 50th and 90th percentile of bank size in our sample. The country classification (low, median and high) is based on the country at the 10th, 50th and 90th percentile of the country-specific proxy. We also report the difference between the marginal effect of NII on MES in the high and low group and large vs small banks. The (difference in the) marginal effect(s) is given in the first column, while the second column shows the corresponding p-value (italics). Calculations of these marginal effects are based on the regression results in the left panel. For each country characteristic, we create a separate subpanel, which are all constructed similarly.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	MES	MES	MES	MES	MES
Ln(Total assets)	0.716***	0.132	0.659***	0.974***	1.087***
	(0.167)	(0.225)	(0.181)	(0.187)	(0.103)
Non-Interest Income Share	-1.922	-5.152	2.929	1.612	6.124***
	(3.551)	(4.754)	(3.245)	(3.341)	(1.484)
Ln(TA)*Non-Interest Income Share	0.785	1.098*	-0.143	-0.126	-1.008***
	(0.488)	(0.625)	(0.443)	(0.441)	(0.191)
Country characteristic*Ln(TA)	0.0551**	0.105***	0.0334**	0.000252	-0.764***
	(0.0271)	(0.0217)	(0.0133)	(0.00222)	(0.268)
Country characteristic*Non-Interest Income Share	1.206*	1.269**	0.278	0.0464	-9.540
	(0.705)	(0.509)	(0.291)	(0.0481)	(6.218)
Country characteristic*Ln(TA)*Non-Interest Income Share	**-0.278*** **	**-0.224*** **	**-0.0668**	**-0.00856**	**2.406*** **
	(0.0954)	**(0.0680)**	**(0.0408)**	**(0.00655)**	**(0.911)**
Depth of Information Sharing	-0.140				
	(0.223)				
Private Monitoring		-0.675***			
		(0.166)			
Supervisory Power			-0.256**		
			(0.103)		
Freedom from Corruption				-0.00103	
				(0.0187)	
HHI					4.049**
					(1.965)
Observations	15,252	15,646	14,325	16,507	16,507
Adjusted R-squared	0.573	0.573	0.577	0.570	0.572
Bank Fixed Effects	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES
Control Variables	YES	YES	YES	YES	YES
Cluster	BANK	BANK	BANK	BANK	BANK
Nr Countries	76	72	70	76	76

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Marginal Effect of NII on MES if....								
Depth of Information Sharing								
	Low		Median		High		High-Low	
Small banks	2.061	*.031*	1.108	*.012*	.472	*.375*	-1.589	*.182*
Median bank	3.107	*0*	.432	*.201*	-1.352	*0*	-4.458	*0*
Large banks	4.778	*.004*	-.648	*.334*	-4.266	*0*	-9.043	*0*
Large-Small	2.717	*.202*	-1.756	*.044*	-4.738	*0*		
Private Monitoring								
	Low		Median		High		High-Low	
Small banks	1.103	*.135*	1.184	*.017*	1.265	*.006*	.162	*.823*
Median bank	.591	*.268*	-.253	*.471*	-1.097	*.001*	-1.689	*.003*
Large banks	-.226	*.818*	-2.549	*0*	-4.871	*0*	-4.646	*0*
Supervisory Power								
	Low		Median		High		High-Low	
Small banks	1.448	*.004*	1.186	*.004*	.923	*.066*	-.525	*.36*
Median bank	.051	*.893*	-.625	*.044*	-1.301	*.001*	-1.352	*.005*
Large banks	-2.181	*.001*	-3.517	*0*	-4.854	*0*	-2.673	*.012*
Large-Small	-3.629	*0*	-4.703	*0*	-5.777	*0*		
Freedom from Corruption								
	Low		Median		High		High-Low	
Small banks	.909	*.245*	.896	*.071*	.876	*.097*	-.034	*.973*
Median bank	.208	*.684*	-.246	*.448*	-.974	*.019*	-1.182	*.099*
Large banks	-.913	*.402*	-2.073	*.001*	-3.928	*0*	-3.016	*.078*
Large-Small	-1.822	*.241*	-2.969	*.001*	-4.804	*0*		
HHI								
	Low		Median		High		High-Low	
Small banks	.832	*.082*	1.179	*.004*	2.086	*0*	1.254	*.061*
Median bank	-.941	*.004*	-.119	*.689*	2.026	*.001*	2.967	*0*
Large banks	-3.773	*0*	-2.193	*0*	1.93	*.119*	5.703	*0*
Large-Small	-4.605	*0*	-3.372	*0*	-.156	*.91*		

Table 4: Baseline Regression: The interaction between Size and Non-Interest Income

This table contains estimation results for robustness checks with respect to the proxy for non-traditional banking activities. The column title refers to which proxy of non-traditional banking activities is used in that specification. In column 1, we reproduce the baseline regression where the proxy for non-traditional banking activities is the non-interest income share. In columns 2 to 4, we investigate the impact of each of the components of the non-interest income share. We replace the non-interest income share variable with its 3 subcomponents, respectively being fee income share, trading income share and other non-interest income share. In columns 5 and 6, we replace the NII share with two measures of revenue diversification. The first one is (1- the Herfindahl-Hirschman index), labelled Div(HHI). The second one is a diversification measure in line with Laeven and Levine (2007), labelled Div(LL). Both measures are constructed such that higher values correspond with more diversification. In column 7, we replace the non-interest income share with the ratio of Off-balance sheet items to total assets. Finally in the last column, we repeat the baseline but replace bank size with market share. In all specifications, the dependent variable is the Marginal Expected Shortfall, which corresponds with a bank's average equity loss per dollar in a given year conditional on the market experiencing one of its 5 per cent lowest returns in that given year. We take the opposite of the returns such that a higher value for MES implies a higher systemic risk exposure. The MES is regressed on bank size, a proxy for non-traditional banking activities, their interaction and control variables (capital-to-asset ratio, the share of deposits in sum of deposits and money market funding, the loans to assets ratio, return-on-equity, annual growth in total assets, loan loss provision to interest income, GDP per capita, GDP growth and CPI inflation). All independent variables are winsorized at the one percent level and are lagged one year to mitigate reverse causality. We include bank fixed effect as well as time dummies in all specifications (except column 3, where we include country rather than bank fixed effects). Standard errors are robust and clustered at the bank level. At the bottom of the table, we also report the value of bank size at which the relationship between the proxy for the non-traditional banking activities and MES switches sign.

	Baseline	Revenue constituents (MES on LHS)			Diversification		Off-balance		Baseline
	NII share	Fee Inc.	Trading Inc.	Other Inc.	Div(HHI)	Div(LL)	OBS		Market Share
Ln(Total assets)	0.994***	0.897***	0.871***	0.901***	1.064***	1.016***	0.999***	Market Share	8.203***
	(0.095)	(0.098)	(0.091)	(0.096)	(0.099)	(0.095)	(0.104)		(1.403)
Proxy for non-traditional banking	5.001***	4.703***	9.532***	4.853***	5.646***	3.304***	1.215***	NII Share	1.473***
	(1.071)	(1.760)	(2.853)	(1.375)	(1.116)	(0.632)	(0.421)		(0.253)
Ln(TA)	-0.728***	-0.568***	-1.161***	-0.666***	-0.769***	-0.446***	-0.166***	Market Share	-17.720***
x Proxy for non-traditional banking	(0.135)	(0.201)	(0.333)	(0.178)	(0.142)	(0.078)	(0.047)	x NII Share	(5.354)
Observations	16507	15345	16507	15345	16490	16490	13552		16507
Adjusted R-squared	0.570	0.582	0.568	0.583	0.569	0.569	0.589		0.259
Bank Fixed Effects	YES	YES	YES	YES	YES	YES	YES		NO
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES		YES
Bank-specific Controls	YES	YES	YES	YES	YES	YES	YES		YES
Macro-economic variables	YES	YES	YES	YES	YES	YES	YES		YES
MFX(NII)=0 for lnTA	6.871	8.285	8.212	7.286	7.346	7.402	7.308	MFX(NII)=0 for MS	8.3%

Robust standard errors in parentheses, clustered at the bank level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Figure 1: Marginal Effect of Non-Interest Income on the Marginal Expected Shortfall

This graph plots the marginal effect (fitted coefficient) of the Non-Interest Income share on Marginal Expected Shortfall over the observed Size range. The graph is based on the estimation results of the baseline specification on the full sample as in column 2 of Table 3. The coefficient of the Non-Interest Income Share is 5.001 and the coefficient of the interaction with bank size is -0.728. The solid line represents this estimated linear relationship over the observed (in our sample) range of ln(Total Assets). The dotted lines correspond with the 95 percent confidence bounds. The solid line crosses the X-axis at 6.871, corresponding with a value of total assets of 963.7 million US dollars (expressed in 2007 values).