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Does non-interest income make banks more risky? Retail- versus investment-oriented banks

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Non-technical Summary

In this paper, we analyze the impact of banks' non-interest income share on risk in the German banking sector for the period between 2002 and 2010. Using linear and quantile regression estimators, we find that the impact of non-interest income on risk depends on the business model of a bank. More specifically, while banks with a retail-oriented business model such as savings banks, cooperative banks and other retail-oriented banks become significantly more stable if they increase their share of non-interest income, investment-oriented banks become significantly *less* stable. In contrast to retail-oriented banks, the latter already generate a large share of their income from non-interest activities. The activities used to generate non-interest income significantly differ between retail- and investment-oriented banks as well.

Our results are in line with recent findings for the EU banking sector which indicate substantial benefits from income diversification for smaller and more retail-oriented banks. Larger and more investment-oriented banks, in contrast, should increase their share of interest income to become more stable. Our results may, thus, not only be relevant for Germany, but also for other European countries.

Our paper has two important implications. First, our results indicate that it might be beneficial for retail-oriented banks to increase their share of non-interest income to become more stable, since this allows them to better diversify their income structure and to become more resilient to overall economic conditions that affect their loan portfolio. Furthermore, a higher share of non-interest income makes them less dependent on maturity transformation and interest rate risk. Investment-oriented banks, in contrast, become significantly *less* stable if they increase their non-interest income share. They already have a large non-interest income share and engage in different activities than retail-oriented banks. To become more stable, these banks should increase their share of interest income. Overall, therefore, our results imply that banks are more stable if they have a more diversified income structure and depend neither heavily on interest nor on non-interest income. Second, the decomposition of non-interest income into fee and commission and trading income shows that impact on bank stability comes from fee and commission income. Trading income, which is significantly more volatile than fee and commission income, in contrast, has no significant effect on bank stability.

Nicht-technische Zusammenfassung

In der vorliegenden Arbeit untersuchen wir, ob deutsche Banken mit einem hohen Anteil an Nichtzinseinkommen im Verhältnis zu ihrem gesamten operativen Einkommen im Zeitraum zwischen 2002 und 2010 riskanter waren als solche mit einem geringen Anteil an Nichtzinseinkommen. Lineare Schätzverfahren und Quantilsregressionen deuten darauf hin, dass Banken mit einem *retail-orientieren* Geschäftsmodell wie beispielsweise Sparkassen, Kreditgenossenschaften sowie andere retail-orientierte Banken signifikant stabiler werden, wenn sie ihren Anteil an Nichtzinseinkommen am gesamten Einkommen erhöhen. Banken mit einem Fokus auf Investment Banking-Aktivitäten werden hingegen deutlich riskanter. Sie erzielen im Unterschied zu retail-orientierten Instituten einen deutlich höheren Anteil ihres Einkommens aus Nichtzinseinkommen. Darüber hinaus unterscheiden sich die Aktivitäten, mit denen retail- und investment-orientiere Banken ihre Nichtzinseinkommen generieren, deutlich.

Die Resultate der vorliegenden Arbeit stimmen mit aktuellen Ergebnissen für den EU Bankensektor überein. Danach profitieren insbesondere kleinere und stärker retail-orientere Banken von einer besseren Diversifikation ihres Einkommens. Größere Banken mit einer stärkeren Ausrichtung auf Investment Banking-Aktivitäten sollten hingegen ihr Zinseinkommen erhöhen, um stabiler zu werden. Die Ergebnisse dieser Arbeit könnten somit nicht nur für den deutschen Bankensektor von Relevanz sein, sondern auch für andere europäische Länder.

Die vorliegende Arbeit erlaubt zwei wichtige Schlussfolgerungen. Erstens deuten unsere Ergebnisse darauf hin, dass Banken, die sich auf das Einlagen- und Kreditgeschäft konzentrieren, von Diversifikationseffekten profitieren, wenn sie den Anteil des Nichtzinseinkommens im Verhältnis zu ihrem gesamten operativen Einkommen erhöhen. Das bedeutet, dass es für diese Banken sinnvoll sein kann, ihr Nichtzinsgeschäft auszuweiten, anstatt es zu reduzieren, wenn sie stabiler werden wollen. Banken mit einem Fokus auf Investment Banking-Aktivitäten werden hingegen deutlich riskanter, wenn sie sich stärker im Nichtzinsgeschäft engagieren. Sie erzielen bereits einen großen Teil ihrer Gewinne aus dem Nichtzinsgeschäft und verfolgen andere Geschäftsaktivitäten als retail-orientierte Banken. Um stabiler zu werden, sollten diese Banken den Anteil des Zinseinkommens am gesamten operativen Einkommen erhöhen. Insgesamt deuten unsere Ergebnisse somit darauf hin, dass Banken mit einer diversifizierten Einkommensstruktur, die weder einseitig von Zins- noch von Nichtzinseinkommen abhängig sind, weniger riskant sind. Zum anderen weisen unsere Ergebnisse noch darauf hin, dass der Einfluss des Nichtzinseinkommens auf die Stabilität einer Bank vom Provisionsgeschäft ausgeht. Das Handelseinkommen, das deutlich volatiler ist als das Provisionseinkommen, hat im Gegensatz hierzu keinen signifikanten Einfluss auf das Risiko einer Bank.

BUNDESBANK DISCUSSION PAPER NO 17/2013

Does non-interest income make banks more risky? Retail- versus investment-oriented banks

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Abstract

In this paper, we analyze the impact of banks' non-interest income share on risk in the German banking sector for the period between 2002 and 2010. Using linear and quantile regression estimators, we find that the impact of non-interest income on risk significantly differs depending on banks' overall business model. More specifically, we show banks with retail-oriented business model such as savings banks, cooperative banks and other retail-oriented banks become significantly more stable if they increase their share of non-interest income. Investment-oriented banks, in contrast, become significantly more risky. They do not only report a significantly higher share of non-interest income, but also differ in terms of their activities from retail-oriented banks. Overall, this indicates that retail-oriented banks should increase their share of non-interest income to become more stable. Investment-oriented banks, in contrast, should decrease it. Our results imply that banks are significantly less risky if they have a more balanced income structure and neither depend heavily on interest nor on non-interest income. Furthermore, they indicate that the impact of non-interest income on risk significantly depends on the activities used to generate non-interest income with retail-oriented activities being significantly less risky than investment-oriented activities such as those pertaining to capital markets activities.

JEL-Classification: G 20, G 21, G 28

Keywords: Banks, risk-taking, business model, non-interest income, diversification

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1. Introduction

The financial crisis of 2007/2008 has revealed the weaknesses of many banks‘ business models. In particular, investment-oriented banks were hit by the crisis due to their heavy reliance on wholesale funding and non-interest income that exposed them to greater income fluctuations than retail-oriented banks that provide traditional banking services such as lending and use customer deposits a primary source of funding. Due to pressure from investors and regulators many investment-oriented banks have started to change their business model. On the liability side, they have increased the share of customer deposits to put their funding on a more stable basis. On the asset side, they have cut back their trading activities and increased their lending to customers in order to reduce their reliance on non-interest income.

While these adjustments may make investment-oriented banks less risky, retail-oriented banks that generate the largest part of their income from interest may become more stable if they increase their non-interest income share as this allows them to better diversify their income structure and to offset declining interest margins. Figure 1, for example, shows that the net interest margin of German banks declined between 2003 and 2008, while the non-interest income margin increased up to 2006. Starting in 2008 this relationship has started to reverse with the non-interest margin starting to decline and the interest margin beginning to increase again. In the future, the net interest margin is, however, expected to decrease again as recent changes in banking regulations such as the introduction of a Liquidity Coverage Ratio (LCR) will likely increase the competition for deposits which should increase deposit rates. Lending rates, in contrast, will likely decrease, since many banks have increased their lending activities in response to changes in their business models. The process of disintermediation will also likely continue in the future and depress net interest margins further. This suggests that it may be beneficial for retail-oriented banks to increase their non-interest income activities to offset declining interest margins.

In this paper, we analyze the impact of banks' non-interest income share on risk in the German banking sector for the period between 2002 and 2010. Using linear and quantile regression estimators, we show that the impact of non-interest income on risk significantly differs between retail- and investment-oriented banks. More specifically, we find banks with a more traditional business model such as savings banks, cooperative banks and other retail-oriented banks become significantly more stable if they increase their share of non-interest income. Investment-oriented banks, in contrast, become significantly *more* risky. They do not only report a significantly higher share of non-interest income, but also differ in terms of their activities from retail-oriented banks. To the best of my knowledge, this is the first paper that shows that these differences have an important impact on how non-interest income affects bank risk-taking. Our results indicate that retail-oriented banks should increase their share of non-interest income to become more stable. Investment-oriented banks, in contrast, should decrease it. This implies that banks are significantly less risky if they have a more balanced income structure and neither depend heavily on interest nor on non-interest income. Furthermore, they suggest that the impact of non-interest income on risk significantly depends on the activities used to generate non-interest

income with retail-oriented activities being significantly less risky than investment-oriented activities such as those pertaining to capital markets activities.

Theory provides no clear prediction regarding the impact of non-interest income on risk.[2] On the one hand, does a higher share of non-interest income make banks less dependent on interest income and improve risk diversification which should make them more stable (Boyd et al., 1980). On the other hand, non-interest income is usually more volatile than interest income, because it is more difficult for borrowers to switch their lending relationship due to information costs (DeYoung and Roland, 2001). Non-interest income also increases operational leverage, since expanding into non-interest income may imply a rise in fixed costs (DeYoung and Roland, 2001). Financial leverage is also higher because regulators require banks to hold less capital against non-interest income activities (DeYoung and Roland, 2001). Both increases the volatility of non-interest income and makes it more risky than interest income.

Consistent with this view Altunbas et al. (2011) and Demirgüc-Kunt and Huizinga (2010) show that banks with a high share of non-interest income are more risky. Common to both studies is that they focus on listed banks which are larger and have a more investment-oriented business model than banks not listed. Since the majority of banks in the EU are not listed, Köhler (2012) includes a large number of unlisted banks to make more general conclusions about the impact of non-interest income on risk. In contrast to listed banks, unlisted banks such as savings and cooperative banks are usually smaller and have a more retail-oriented business model with a focus on lending and deposit-taking activities. Enlarging the sample of banks significantly changes the results. While the previous studies find that banks become more risky if they increase their share of non-interest income, Köhler shows substantial benefits from income diversification, in particular, for smaller banks (Köhler, 2012). Larger banks, in contrast, should increase their share of interest income to become more stable. They have a more investment-oriented business model and are more active in volatile and risky trading and off-balance sheet activities such as securitization which may increase risk. Previous research for Germany shows that banks have significantly higher risk-adjusted returns as well if they generate a large fraction of their income from non-interest income activities (Busch and Kick, 2009 and Busch, 2011). However, these studies also find that commercial banks have significantly more volatile returns if they are active in non-interest income activities and conclude that a strong engagement in fee-generating activities makes commercial banks more risky. Savings and cooperative banks, in contrast, are not affected.

Our paper is closely related to these papers. It examines the link between non-interest income and risk-taking for the German banking sector. Using data from the prudential database of the *Deutsche Bundesbank* (BAKIS) we are able to construct a dataset on banks' income structure for a large sample of savings banks, cooperative banks and other banks such as the big banks, the head institutions of the cooperative and savings banks sector, regional banks or other credit institutions for the period between 2002 and 2010. This allows us to investigate whether a higher share of non-interest income makes

[2] Non-interest income includes activities such as income from trading and securitization, investment banking and advisory fees, brokerage commissions, venture capital, and fiduciary income, and gains on non-hedging derivatives.

German banks more risky or whether it allows them to better diversify their income structure and to become more stable.

A priori, we would expect banks with a higher share of non-interest income to be more risky, since non-interest income is more volatile than interest income which is reflected in Figure 2, in particular for the group of big banks and other banks. The non-interest income of savings and cooperative banks, in contrast, is more stable. However, savings and cooperative banks' non-interest income also seems to be more correlated with their net interest income which reduces the potential for income diversification. Overall, therefore, there seems to be a trade-off between income volatility and correlation in non-interest income. While a higher share of non-interest income allows banks to better exploit diversification advantages due to lower correlations with banks' net-interest income, it also exposes them to significantly higher income volatility.

Our paper is different from Busch and Kick (2009) and Busch (2011) in three important aspects. First, while they have data up to 2007, we include the crisis years from 2008 to 2010. This allows us to examine whether a higher share of non-interest income has made banks more stable or more risky during the crisis. This is particularly important from the policy perspective as, for instance, recent proposals by the *Liikanen* Group (2012) on structural reforms in the EU banking sector have been made based on experience made during the crisis. Second, we show that the effect of a higher share of non-interest income on bank risk significantly differs depending on whether a bank has a more retail- or investment-oriented business model. The distinction is important because investment-oriented banks not only generate a significantly higher share of their operating income from non-interest income, but also differ in terms of their activities from retail-oriented banks. For example, while the latter usually earn account administration, insurance or consumer credit fees, investment-oriented banks derive most of their fee and commission income from underwriting, brokerage, treasury management, securitization and clearing and other transaction-related services. To my knowledge, this is the first paper that shows that these differences have an important impact on how non-interest income affects bank risk-taking.

Finally, we use quantile regression to examine the relationship between bank's business model and risk. Quantile regression gives a more complete picture on the effect of a set of regressors on the different quantiles of bank risk and allows us to examine whether the effect of non-interest income differs with to the level of risk (Koencker and Hallock, 2000). They are appropriate when a large degree of variation in the data suggests that there may be more than a single slope parameter describing the relationship between the dependent variable and the regressors. For example, as we will show later there is considerable heterogeneity in banks' business models not only across, but also within bank groups in Germany. There is also considerable variation in bank size as our dataset comprises a large number of small and retail-oriented banks such as savings and cooperative banks, but also large, investment-oriented banks such as the big banks and the head institutions of the cooperative and savings banks sector. Thus, numerous factors suggest that bank risk may vary considerably across the distribution. Quantile regressions better accommodate this heterogeneity and offer more detailed insights into the factors driving bank risk across the distribution. Therefore, quantile regression can be considered su-

perior to the previously used estimation techniques, since it provides more precise estimates of the impact of the determinants of bank risk.

We follow the literature and measure bank risk-taking with the Z-Score, defined as the number of standard deviations that a bank's return on asset has to fall for the bank to become insolvent (Laeven and Levine, 2009, Altunbas et al., 2011 and Demirgüc-Kunt and Huizinga, 2010 and Köhler, 2012). In addition, we examine the effect of a higher share of non-interest income on risk-adjusted returns and return volatility.

Our sample indicates considerable heterogeneity in risk-taking across banks. We show that this is due to differences in banks' non-interest income share. We find that the impact of non-interest income on risk significantly depends on banks' overall business model. More specifically, our results indicate that a higher share of non-interest income increases the stability of savings and cooperative banks. The other banks in our sample, in contrast, are not affected. This changes significantly, however, if we split the banks in this group based on their lending and deposit-taking activities into a group that comprises retail-oriented banks such as consumer credit and car finance banks and a group that contains investment-oriented banks such as the big banks and the head institutions of the cooperative and savings banks sector. While we confirm the diversification effect for the group of retail-oriented banks, investment-oriented banks become significantly less stable if they increase their non-interest income share.

Our findings are consistent with the hypothesis that a higher non-interest income share helps banks with a more retail-oriented business model such as savings banks, cooperative banks and other retail-oriented banks to better diversify their income structure and to become more resilient to overall economic conditions that affect their loan portfolio. Furthermore, a higher share of non-interest income makes them less dependent on maturity transformation and interest rate risk. Investment-oriented banks, in contrast, become significantly *more* risky if they increase their share of non-interest income. They already derive a large share of their income from non-interest income and undertake different activities than retail-oriented banks. The decomposition of non-interest income into fee and trading income shows that it is fee and commission income that affects bank risk. It makes up the largest part of non-interest income generated by German banks. Trading income which is significantly more volatile than fee income, in contrast, is much less important. This might explain why we find no significant effect of trading income on the stability and the volatility of the returns of the average bank in our sample.

We confirm our findings using quantile regressions. In contrast to OLS that estimates the conditional mean, quantile regression estimates the effect of the regressors on the dependent variable for different quantiles of the distribution. This allows us to analyze whether the impact of the non-interest income is non-linear. Our results indicate that the positive diversification effect of non-interest income on the stability of retail-oriented banks is particularly large for the more stable banks in our sample. Quantile regressions are also more robust to outliers than OLS because linear estimators would more likely

produce inefficient and biased estimates in the presence of outliers. Hence, quantile regressions allow more robust inference than OLS.

Our paper has three important implications. First, our results indicate substantial benefits from income diversification for savings, cooperative and other retail-oriented banks. This suggests that it might be beneficial for banks that have a more traditional business model and generate the largest part of their income from interests to increase their share of non-interest income to become more stable and *not* to decrease it. The opposite is the case for investment-oriented banks. They become *more* risky if they increase their non-interest income share. They already have a large non-interest income share. To become more stable, these banks should increase their share of net interest income. This implies that banks are more stable if they have a more diversified income structure and depend neither heavily on interest nor on non-interest income. Furthermore, they indicate that the impact of non-interest income on risk significantly depends on the activities used to generate non-interest income with retail-oriented activities being significantly less risky than investment-oriented activities such as those pertaining to capital markets activities.

Our paper is structured as follows. In the next section, we present the dataset. In Section 3 and 4, we take a first look at German banks' business models and present first descriptive statistics on the link between non-interest income and bank risk. The empirical model is presented in Section 5 and our baseline results in Section 6. In Section 7, we investigate whether our results are robust to the sample of banks chosen and address endogeneity issues. Quantile regressions are performed in Section 8. Section 9 summarizes our main findings and concludes.

2. Data

We use data from the prudential database (BAKIS) of the *Deutsche Bundesbank*. The panel includes cooperative banks and savings banks. However, we have also included the big banks, the head institutions of the savings ("Landesbanken") and cooperative banks as well as regional banks and other credit institutions. While savings and cooperative banks have a retail-oriented business model and focus on lending and deposit-taking activities, the other banks included have very different business models and provide services that range from more retail-oriented services such as consumer credit and car financing to more investment-oriented services such as clearing and transaction and other services pertaining to capital markets. To examine whether these differences matter for bank risk-taking, we later test whether the impact of non-interest income on risk differs between retail- and investment-oriented banks within this group. Specialized governmental credit institutions, real estate and mortgage banks and the German branches of foreign banks, in contrast, are excluded due to their distinct business model and business objectives.

We start with 17,516 observations for the period between 2002 and 2010. To assure that we have a sufficient number of observations to analyze bank risk-taking in the pre-crisis period and also include those banks that became insolvent during the crisis, we require each bank to report at least four observations between 2002 and 2006. This leaves us with 16,760 observations. The distribution of banks

and observations is presented in Table 1. Overall, we have 461 savings banks (4,026 observations), 1,291 cooperative banks (11,132) and 192 other banks (1,602) in our sample. To reduce outliers all observations are winsorized at the 1%- and 99%-level of their respective bank group (see also Busch and Kick, 2009).

3. Non-Interest Income

We first analyze the importance of non-interest income for German banks. In line with the literature (Altunbas et al., 2011, Demirgüc-Kunt and Huizinga, 2010 and Köhler, 2012) we measure the importance of non-interest income activities with the ratio of net non-interest income to total operating income (NNINC). Figure 3 shows the distribution of the non-interest income share across banks. The average share of non-interest income to total operating income is 22%. Non-interest income, however, considerably differs across banks ranging from banks having no non-interest income to banks generating almost all of their operating income from non-interest income activities. Overall, however, more than 50% of the banks included in our sample have an average non-interest income share of between 15% and 25%. This indicates that most banks generate the largest part of their income from traditional banking activities such as lending.

Table 2 presents further descriptive statistics on the income structure of German banks. It reveals at least two important findings. First, savings (20%) and cooperative banks (21%) report, on average, a significantly lower share of non-interest income to total operating income than the other banks included in our sample (36%). Second, the variation of the non-interest income share is much lower among savings and cooperative banks as indicated by the significantly lower standard deviation. This indicates that cooperative and savings banks have a similar business model. The business models of the other banks included, in contrast, considerably differ from each other and range from more retail-oriented banks that generate only a small share of their operating income from non-interest income activities to more investment-oriented bank that generate the largest part of their income from fees and commissions.

4. Non-Interest Income and Bank Risk

We next examine the relationship between the non-interest income share and bank risk. In line with the literature (Laeven and Levine, 2009, Altunbas et al., 2011 and Demirgüc-Kunt and Huizinga, 2010 and Köhler, 2012), our main indicator of bank risk is the Z-Score which is defined as follows:

$$Z-Score_{it} = \frac{ROA_{it} + CAR_{it}}{SDROA_i} \tag{1}$$

where ROA is the return on assets and CAR the ratio of total equity over total assets of bank *i* in year *t*. $SDROA$ denotes each bank's standard deviation of the ROA. It is calculated over the whole sample period. The Z-Score is the inverse of the probability of insolvency, i.e. a higher Z-Score indicates that a bank incurs fewer risks and is more stable. More specifically, it indicates the number of standard de-

viations below the expected value of a bank's return on assets at which equity is depleted and the bank is insolvent (Boyd et al., 1993). Because the Z-Score is highly skewed, we use the natural logarithm of the Z-Score in our empirical analysis.[3]

In addition, we use the following three risk-adjusted measures of bank performance and capital:

$$RAROA_{it} = \frac{ROA_{it}}{SDROA_i} \tag{2}$$

$$RAROE_{it} = \frac{ROE_{it}}{SDROE_i} \tag{3}$$

$$RACAR_{it} = \frac{CAR_{it}}{SDROA_i} \tag{4}$$

where $RAROA$ and $RAROE$ measure a bank's risk-adjusted returns. RAROA is the return-on-assets (ROA) divided by the standard deviation of the ROA (SDROA), while RAROE is calculated as the return-on-equity (ROE) divided by the standard deviation of the ROE (SDROE).[4] In addition, we divide the equity-to asset ratio (CAR) by SDROA ($RACAR$) to measure banks' leverage risk (Lepetit et al., 2008), i.e. whether banks hold sufficient capital relative to the risks they were taking. Note that RAROA and RACAR are the two components of the Z-Score.[5] Finally, we use the standard deviation of the ROA ($SDROA$) and the ROE ($SDROE$) to measure return volatility.

Table 3 shows descriptive statistics for Z-Score and the other indicators of bank risk and returns. The average Z-Score is 27.79 over all banks. Average values significantly differ across bank groups. For example, while savings and cooperative banks have an average Z-Score of 31.61 and 27.82, respectively, the other banks included report a significantly lower average Z-Score of 17.99. This indicates that cooperative and savings banks are more stable than all other banks in our sample. Differences in the Z-Score are primarily driven by a lower volatility of returns (SDROA) rather than by differences in the level of capitalization (CAR) and profitability (ROA). For instance, even though the other banks have a higher average level of capitalization and profitability than savings and cooperative banks, they are significantly less stable due to a higher standard deviation of returns (SDROA), which leads to lower risk-adjusted returns (RAROA and RAROE) and capital ratios (RACAR).[6] The descriptive analysis in the previous section suggests that this might be due to a higher non-interest income share of these banks.

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[3] We do not use loan loss provisions or non-performing loans to measure bank risk, since they are traditionally backward looking and highly procyclical (Laeven and Majnoni, 2003 and Bikker and Metzemakers, 2005). Furthermore, loan loss provisions only measure credit risk, while the Z-Score is an overall measure of bank risk capturing not only credit, but also liquidity and market risk that primarily arises from non-lending activities.

[4] This is similar to a market-derived Sharpe-Ratio, which is defined as the ratio of expected returns (less the risk-free rate) divided by the standard deviation of returns.

[5] See Stiroh and Rumble (2006), Demirgüc-Kunt and Huizinga (2010), Lepetit et al., 2008 and Barry et al. (2011) for a similar or the same decomposition of a bank's Z-Score.

[6] Please note that in Germany the standard deviation of returns might be low due to the use of hidden reserves which banks are allowed to build according to section 340f of the German Banking Code ("340f reserves") to smooth profits over time (also see Bornemann et al., 2012).

To illustrate the relationship between risk and non-interest income, we group all banks according to their non-interest income share into 10 groups each containing 10% of the observations. For each of these groups, we calculate the average Z-Score between 2002 and 2010 and plot it on a solid line in Figure 4. The figure indicates an inverse relationship between bank risk and non-interest income. While a higher non-interest income share makes banks more stable at low levels of non-interest income, bank stability decreases at high levels of non-interest income. This suggests that banks that either specialize in interest or non-interest activities are more risky. This supports the idea that banks with a diversified income structure are more stable.

The level of risk-taking may not only be determined by the share of non-interest income to total income, but also by other characteristics such as their size, funding structure, liquidity and profitability. Because all variables are interrelated, we include all of them in the subsequent empirical analysis. A detailed list of variables used in our analysis is presented in Table 4.[7] Descriptive statistics for all variables are shown in Table 5. They indicate large differences between savings and cooperative banks and all other banks not only with respect to their non-interest income share, but also with respect to their size, funding structure, liquidity and profitability.

5. Empirical Model

To analyze the impact of non-interest income on bank risk, we estimate the following regression model:

$$y_{it} = \alpha + \beta_1 NNINC_{it} + \beta_2 B_{it} + \alpha_i + \gamma_t + \epsilon_{it} \quad (5)$$

where y_{it} is either the Z-Score, the risk-adjusted ROA (RAROA) and ROE (RAROE), respectively, or the risk-adjusted capital ratio (RACAR) of bank i in year t. $NNINC$ denotes each bank's non-interest income share. B is a matrix of additional bank controls outlined below. α, β_1 and β_2 are coefficients. α_i is an unobserved bank-specific fixed effect and γ_t a year dummy. ϵ_{it} is the error term. All models are estimated with robust standard errors clustered at bank level.

In addition, we run cross-sectional regressions with the standard deviation of the ROA (SDROA) and ROE (SDROE), respectively, as dependent variable to explain whether a higher share of non-interest income to total operating income makes banks' returns more volatile.

$$y_i = \alpha + \beta_1 \overline{NNINC}_i + \beta_2 \bar{B}_i + \beta_3 SAVINGS_i + \beta_4 COOPERATIVE_i + \beta_5 PERIOD_i + \epsilon_i \quad (6)$$

where y_i is either the standard deviation of the return-on-assets (SDROA) or the standard deviation of the return-on-equity (SDROE) of bank i over the whole sample period. $\overline{NNINC}$ is the average non-interest income share and $\bar{B}$ are additional averaged bank controls. In the regression for the entire sample, we additionally include a dummy variable that indicates whether a bank is a savings (SAVINGS) and cooperative bank (COOPERATIVE), respectively. Finally, we follow Busch and Kick

(2009) and include a dummy variable for each period for which the standard deviation of bank *i* is calculated (PERIOD). This is important because the period over which we calculate the standard deviation is not the same for every bank in the sample.

6. Results

Our empirical analysis proceeds in steps. We first show the results for the entire sample and for each bank group separately. In the second step, we split the group of other banks based on their lending and deposit-taking activities into banks with a more retail- and more investment-oriented business model to analyze whether a higher share of non-interest income has a different impact on banks that concentrate on retail- or investment-banking. Endogeneity issues are addressed in Section 7. In Section 8, we run quantile regressions to test the robustness of our results and to find out whether the effect of non-interest income differs with the level of risk experienced. All variables used in the regression analysis are presented in Table 4. Descriptive statistics are shown in Table 5. The results of our baseline regressions are presented in Table 6.

Table 6 shows that a higher share of non-interest income makes savings and cooperative banks more stable as indicated by the significantly positive coefficient for NNINC in the regression for Z-Score. This is consistent with the view that non-interest income improves income diversification and makes a bank less dependent on overall economic conditions that affect their loan portfolio (Stiroh, 2004). Furthermore, banks with a higher share of non-interest income are also more independent of maturity transformation and changes in interest rate, which may reduce bank risk further. Finally, expanded product lines and cross-selling opportunities associated with greater non-interest income may allow banks to improve their risk-return trade-off (Stiroh, 2004).

Consistent with that we find that a higher share of non-interest income allows savings and cooperative banks to generate higher risk-adjusted returns (RAROA). A higher share of non-interest income also helps them to reduce their exposure to leverage risk (RACAR). In contrast, we find no evidence that savings and cooperative banks' returns will become more volatile if they increase their share of non-interest income to total operating income. The returns of the other banks included, in contrast, become significantly more volatile if they increase their share of non-interest income. However, we also find that these banks report a significantly higher risk-adjusted ROA. Overall, both effects seem to offset each other, as we do not find any significant link between NNINC and the Z-Score for the sample of other banks.

We test the robustness of our results later when we split the group of other banks based on their lending- and deposit-taking activities into retail- and investment-oriented banks. Moreover, we run quantile regressions for the entire sample and for each bank group separately. In contrast to OLS, quantile regressions are more robust to outlier observations. This might be particularly appropriate for the sample of other banks due to the large heterogeneity of their business model, size and other bank characteristics. More importantly, however, quantile regressions allow us to identify whether the impact of the non-interest income share is non-linear.

Bank risk not only depends on the non-interest income share, but also on other variables. Since these variables are not in the focus of our research, we will briefly summarize the main results. First, banks with higher net interest margins (NIM) and a higher level of cost-efficiency (CIR) are significantly more stable. Large banks (SIZE), in contrast, are significantly more risky. This is because large savings and cooperative banks have significantly lower risk-adjusted returns. Large other banks, in contrast, report significantly higher risk-adjusted returns. However, they are also exposed to a significantly higher level of leverage risk. Savings and cooperative banks that have a large share of customer loans to total assets (LOANS) are more stable as well. Other banks are not affected.[8] Banks with a larger buffer of liquid assets relative to their total assets (LIQUID) are not significantly more stable either. A larger share of customer deposits to total assets (DEPOSITS), in contrast, does matter. The effect on bank stability, however, differs across bank groups. While savings and cooperative banks become significantly more stable if a larger fraction of their funding comes from customer deposits, the other banks become significantly less stable. Overall, our findings are consistent with previous results for the German banking sector obtained by Busch and Kick (2009) and Busch (2011).

To sum up, our results indicate that the share of non-interest income to total operating income (NNINC) is an important determinant of bank risk. Consistent with the view that non-interest income allows retail-oriented banks to better diversify their income sources and to become more stable we find that savings and cooperative banks report significantly higher Z-Scores if they engage in non-interest income activities. This indicates that a higher share of non-interest income increases and *not* decreases the stability of savings and cooperative banks in Germany. In our model that includes all banks this effect would go unnoticed, since NNINC turns out to be insignificant. This indicates that the effect of non-interest income on bank risk can be better identified if the sample is split into savings, cooperative and other banks.

7. Robustness Tests

In this section, we test whether the results for the group of other banks are different if we distinguish between banks with a retail- and investment-oriented business model. Furthermore, we address endogeneity issues.

7.1 Retail-vs. Investment-Oriented Banks

Our results indicate that savings and cooperative banks will become significantly more stable if they increase their share of non-interest income. This is consistent with the view that retail-oriented banks benefit from a better diversification of income sources. In contrast, we find no effect of non-interest income on the stability of the other banks included. As argued above this group is very heterogeneous and comprises not only retail-oriented banks which might become more stable, but also investment-oriented banks whose stability might decrease if they increase their share of non-interest income to total operating income.

Hence, to test whether the effect of non-interest income differs between retail- and investment-oriented banks we split the group of other banks based on their lending and deposit-taking activities into two different groups. The first group comprises all banks that have a customer loan-to-total asset (LOANS) and customer deposit-to-total asset (DEPOSIT), respectively, of less than or equal to 50% that do not belong to the group of savings and cooperative banks.[9] This group comprises the big banks and the head institutions of the cooperative and savings banks, but also other banks such as clearing and transaction banks and banks that provide investment-oriented services such as those pertaining to capital market activities. Due to their primary business activities we call this group "*Investment-oriented banks*". The second group comprises all other banks. Consumer credit, car finance and other retail-oriented banks are included in this group. However, the group also comprises some banks that focus on private-banking. Due to their focus on retail- and private banking we call this group "*Retail-oriented banks*".

Both groups not only differ with respect to the importance of their lending and deposit-taking activities, but also in terms of their non-interest income share from each other. Interestingly, based on their median retail-oriented banks (24.63%) have a similarly low share of non-interest income than savings (20.13%) and cooperative banks (21.32%) as indicated in Table 7. The median non-interest income share of investment-oriented banks, in contrast, is significantly higher (40.64%). The decomposition of non-interest income also significantly differs with investment-oriented banks having a significantly larger trading income share than retail-oriented banks as we will show later. To find out whether these differences matter for bank risk we run separate regressions for retail- and investment-oriented banks.[10] The results are reported in Table 8.

They significantly differ from our results for the entire sample of other banks. While NNINC was insignificant in our previous regressions, it becomes significantly positive for Z-Score if we focus on retail-oriented banks. This is because a higher share of non-interest income allows them to generate higher risk-adjusted returns (RAROE) and to reduce their exposure to leverage risk (RACAR). As previously, we find that a higher non-interest income share makes their returns significantly more volatile (SDROA and SDROE). Overall, however, the positive effect of higher returns and capital outweigh the negative effect of more volatile returns. This suggests that the volatility of returns is not a sufficient indicator to assess the level of bank risk and supports the use of the Z-Score as our main indicator of bank risk.

Investment-oriented banks will have significantly more volatile returns as well if their share of non-interest income increases (SDROA and SDROE). However, in contrast to retail-oriented banks, they are more exposed to leverage risk indicating that they do not have sufficient capital relative to the risks they were taking (RACAR). This might be due to different activities retail- and investment-oriented banks undertake to generate their non-interest income. For example, while retail-oriented banks usually earn account administration, insurance or consumer credit fees in the case of retail banks and advisory fees in case of banks that focus on private banking, investment-oriented banks derive most their

[9] This papers' results hold if we increase the threshold and require investment-oriented commercial banks to not have a loan- and deposit-to asset ratio, respectively, of more than 20%, 30% or 40%, respectively.
[10] For brevity, we report the results for NNINC only. The results for the other control variables are available from the author upon request.

fees and commissions from underwriting activities, brokerage, treasury management, securitization and clearing and other transaction-related services. Since regulators require banks to hold less capital against such activities, investment-oriented banks can operate at a higher leverage which may increase their risk. Investment-oriented banks also report a significantly lower risk-adjusted ROE (RAROE) if their share of non-interest income increases. To sum up, while retail-oriented banks become more stable if they increase their share of non-interest income, investment-oriented banks become significantly *less* stable if they increase their share of non-interest income as indicated by the significantly negative coefficient for NNINC for Z-Score.

Overall, our results indicate that the impact of non-interest income on risk significantly differs depending on the overall business model of a bank. While banks that mainly focus on retail- and private-banking activities such as savings banks, cooperative banks and other retail-oriented banks benefit from the positive diversification effect of a higher share of non-interest income, investment-oriented banks become significantly less stable. Both groups do not only differ with respect to the importance of non-interest income from each other, but also in terms of their activities. Because the effect of non-interest income on stability significantly differs between retail- and investment-oriented banks, we adhere to the sample split in our subsequent empirical analysis.

7.2 Endogeneity

Endogeneity issues cannot be ruled out in any study on bank risk, since changes in risk may cause banks to adjust their activities. However, for several reasons we think that our results are not severely biased by endogeneity. First, our sample includes a large number of savings and cooperative banks whose primary business objective since they were established in the 19th century is to provide financial services to specific sectors and to improve financial access in selected geographical areas. Due to this focus they have a similar business model since decades and are traditionally more active in activities such as lending than the other banks.

Second, banks would only have adjusted their business model if they were aware of the risks they had been taking. This assumes that banks could correctly quantify the risks they incurred. This is questioned, because banks were usually assessing risk historically and were neglecting what appeared to be low probability, non-salient events that turned out to be significant (Shleifer, 2011). This suggests that banks were not fully aware of the risks they were taking.[11] And even if they were aware of their risks, they did not always adjust their business model to bank risk, because some banks were willing to be more exposed to crisis risks than others (Fahlenbrach et al, 2012). We control for this risk culture of a bank using bank-specific effects.

Third, investors that might force banks to adjust their business model were not fully aware of the risks either. Beltratti and Stulz (2012), for example, show that the banks that were valued highly by the market before the crisis, for instance, those banks with a successful securitization line of business, performed worse when the crisis hit. This indicates that investors were not fully aware of the risks banks

[11] See also Financial Stability Report of the Deutsche Bundesbank (2009).

were taking either and, thus, did not force banks to change their business model to reduce bank risk. In contrast, banks would most likely have been punished by their investors if they had changed their business model before 2008 to reduce their risk.[12]

Changes in business models are more likely after 2008, however, since the crisis has revealed the weaknesses of many banks' business models. Changes in business models are also necessary due to pressure from regulators to reduce their leverage and to put their funding on a more stable basis. Hence, to test whether this has biased our results, we drop all observations in 2009 and 2010 and re-estimate our model. The results are reported in Table 9. They confirm our findings. While savings banks, cooperative banks and retail-oriented banks become more stable if they generate a larger part of their income from non-interest income activities share, investment-oriented banks become significantly *less* stable.

Overall, we think that endogeneity problems are limited for our sample. And even if banks did adjust their business model and reduced their share of non-interest income in response to a higher level of risk-taking, this would have biased the coefficient for the non-interest income share (NNINC) in our regressions downward and not upward. This suggests that in the presence of endogeneity the positive effect of the non-interest income share on bank stability should be even larger.

8. Extensions

In this section, we test the robustness of our results using quantile regressions and analyze whether the impact of non-interest income on bank stability differs between fee and commission and trading income.

8.1 Quantile Regressions

In this section, we use the conditional quantile regression estimator developed by Koencker and Bassett (1978) and re-estimate our model. In contrast to OLS that estimates the conditional mean, quantile regression permits estimating conditional quantile functions, i.e. models in which quantiles of the dependent variable are expressed as functions of a set of explanatory variables (Koenker and Hallock, 2001). Thus, quantile regressions give a more complete picture of the effect of a set of regressors on the different quantiles of the dependent variable. This is particularly interesting from the financial stability perspective as it allows us to investigate whether the impact of the non-interest income share differs across the distribution of bank risk, i.e. we can analyze whether the impact of a higher share of non-interest income is non-linear.

Quantile regressions are appropriate when a large degree of variation in the data suggests that there may be more than a single slope parameter describing the relationship between the dependent variable

[12] This is consistent with the following statement by Peter Hahn, Former Citigroup Managing Director in a Report to the Treasury Committee of the British Parliament" *"If ... banks in 2005 decided to be more conservative and hold back in their activity, they more than likely would have had their CEO and board even replaced in 2006 for failing to take advantage of the opportunities, so the structure was one which was one widely supported by players, shareholders and everybody."* (House of Commons Treasury Committee, 2009).

and the regressors. Quantile regressions are, therefore, particularly suitable for our sample, since the descriptive analysis and our previous regressions have shown that savings, cooperative and the other banks differ considerably with respect to their risk-taking behavior and their characteristics. For example, savings, cooperative and other retail-oriented banks are usually less engaged in non-interest income activities than investment-oriented banks. These differences not only exist across groups. Even within these groups there is considerable heterogeneity among banks' business models as indicated by large variations in the non-interest income share. There is also considerable variation in the size of banks as our dataset comprises a large number of small and domestic-oriented banks, but also large, internationally oriented banks such as the big banks and the head institutions of the cooperative and savings banks sector. Thus, numerous factors suggest that bank risk varies considerably across the distribution. Quantile regressions accommodate the heterogeneity in our dataset better and offer more detailed insights into the factors driving bank risk across the distribution. Furthermore, it offers an estimation procedure that is more robust to outlier observations because linear estimators would more likely produce inefficient and biased estimates in the presence of outliers. Thus, quantile regressions allow more robust inference than OLS.

In order to analyze whether our assertion of systematic differences in the impact of our regressors on bank risk is correct, we estimate quantile regression models to obtain coefficients for the 10%, 25%, 50%, 75%, and 90% quantile. The results are reported in Table 10 next to our OLS results.[13] For brevity, we only show the results for banks' non-interest income share (NNINC).

The quantile regression results confirm our previous findings for savings banks, cooperative banks and retail-oriented banks. NNINC turns out to be significantly positive in the regression with Z-Score as dependent variable indicating substantial benefits from income diversification. In particular, the banks in the right tail of the distribution of Z-Score become more stable banks if they increase their share of non-interest income as indicated by the significantly higher quantile regression coefficient of NNINC for banks in the higher quantiles. Investment-oriented banks, in contrast, become significantly more risky if they increase their share of non-interest income consistent with our previous findings. Equality of coefficients tests, however, indicate that the coefficients are not significantly different across quantiles for this group reassuring that our quantile regression results are coherent with our OLS results. Overall, quantile regressions provide a more accurate picture of the underlying range of disparities in non-interest income that the classical estimation would have missed.

We also confirm our previous finding for the other indicators of bank risk and returns. First, while savings, cooperative and retail-oriented banks report significantly higher risk-adjusted returns if their share of non-interest income increases, investment-oriented banks have significantly lower risk-adjusted returns (RAROA and RAROE). They are also significantly more exposed to leverage risk if non-interest income increases (RACAR). Savings banks, cooperative and retail-oriented banks, in contrast, are significantly less exposed. This is particularly the case for retail-oriented banks in the right tail of the distribution of RACAR, i. e. the banks with a relatively low risk-adjusted capital ratio, as indicated by the significant equality test statistic. We also confirm our findings for the volatility of re-

[13]Standard errors are obtained using 1,000 bootstrap replications.

turns. More precisely, our findings suggest that the positive effect of a higher non-interest income share on the volatility of the ROA of retail- and investment-oriented banks is driven by the banks in the right tail of the distribution. This suggests that the OLS results for SDROA and SDROE are driven by the banks with very volatile returns. Equality tests indicate that the coefficients do not significantly differ across quantiles, however, indicating that our quantile regression results are coherent with our OLS results. Overall, the quantile regressions provide additional robust evidence that a higher share of non-interest income is associated with a greater stability of savings banks, cooperative banks and other retail-oriented banks. Investment-oriented banks, in contrast, become significantly less stable if they increase their share of non-interest income.

8.2 Trading and Fee and Commission Income

In the previous sections, we have implicitly assumed that the sources from which German banks generate their non-interest income are equal across bank groups. We now examine whether fee and commission income has a different impact on bank stability than trading income.

As a starting point, we break down banks' non-interest income into fee and commission and trading income. Table 7 shows that German banks generate most of their non-interest income from fees and commissions. This is particularly the case for savings and cooperative banks. The other retail-oriented banks show a similarly high provision and low trading income share as well.[14] Trading income is more important for investment-oriented banks. However, compared to fee and commission income their trading income share is still small. For example, while the average share of trading income to total operating income of investment-oriented banks is almost 5%, their average net fee and commission income share is, on average, almost 45%. However, we have also included some banks that report net trading income shares of almost 40%. Overall, therefore, there is much more heterogeneity in the fee and trading income shares among the other banks included in our sample than among savings and cooperative banks.

We use the greater heterogeneity among these banks to investigate whether fee and trading income have a different impact on risk. *A priori*, we would expect banks with a higher share of trading income to be more risky, since trading income is usually more volatile than fee and commission income. Fee and commission income, in contrast, may reduce income volatility, in particular, if it is stable over time. However, trading income is also less correlated with net interest income than fee and commission income which may increase the benefits from income diversification. To find out which effect dominates, we replace the non-interest income share (NNINC) by the share of net fee and commission income (COMMISSION) and net trading income to total operating income share (TRADING). The OLS and quantile regression results are reported in Table 11.

They confirm our findings and indicate significant differences between retail- and investment-oriented banks: While retail-oriented banks become more stable if they increase their non-interest income share

[14] For example, while the median provision income share is 19.73% (average share 19.74%) for cooperative and 21.02% (20.79%) for cooperative banks, retail-oriented banks have a median provision income share of 21.90% (29.83%).

as indicated by the significant and positive coefficient for COMMISSION in the regression with Z-Score as dependent variable, investment-oriented banks become significantly *less* stable. The results for our other indicators of bank risk and returns are also similar to our previous results. Overall, our results indicate that the effect of non-interest income on bank stability comes from fee and commission income. Trading income, in contrast, does not matter. The latter is more volatile, but also much less important, on average, than fee and commission income which might explain why trading income has no significant impact on the average bank in our sample. Quantile regressions confirm our previous findings.

In unreported regressions, we did several tests to check the robustness of our results with respect to TRADING. First, not all banks report a high trading income share. To test whether this biases our results, we exclude all banks from the sample that do not have any trading income. In addition, we drop all banks from the sample that do not report a net trading income share of 2.5% (75%-quantile) or more. We also drop all banks from the sample which either have a very low (25%-quantile) or very high share (75%-quantile) of non-interest and fee income share, respectively. In all regressions, TRADING is insignificant. The share of net fee and commission income (COMMISSION), in contrast, remains significantly positive in all regressions for Z-Score. The results for the remaining indicators of bank risk and returns are similar as well.

9. Conclusions

In this paper, we analyze the impact of banks' non-interest income share on risk in the German banking sector for the period between 2002 and 2010. Using linear and quantile regression estimators, we find evidence that the impact of non-interest income on bank risk depends on the business model of a bank. More specifically, while banks with a more traditional, retail-oriented business model such as savings banks, cooperative banks and other retail-oriented banks become significantly more stable if they increase their share of non-interest income, investment-oriented banks become significantly *less* stable. In contrast to retail-oriented banks, the latter already generate a large share of their income from non-interest activities. Furthermore, while retail-oriented banks usually earn account administration, insurance or consumer credit fees, investment-oriented banks derive most their fees from underwriting activities, brokerage, treasury management, securitization and clearing and other transaction-related services. These activities are usually more closely linked to market or cyclical evolution and, therefore, more volatile. Furthermore, since regulators require banks to hold less capital against such activities, investment-oriented banks can also operate at a higher leverage which makes them significantly more risky compared to retail-oriented banks. To my knowledge, this is the first paper that shows that these differences have an important impact on how non-interest income affects bank risk-taking.

Our results are in line with recent findings for the EU banking sector which indicate substantial benefits from income diversification for smaller and more retail-oriented banks (Köhler, 2012). Larger and more investment-oriented banks, in contrast, should increase their share of interest income to become

more stable. Our results may, thus, not only be relevant for German banking sector, but also for other European countries.

Our paper has two important implications. First, our results indicate that it might be beneficial for retail-oriented banks to increase their share of non-interest income to become more stable, since this allows them to better diversify their income structure and to become more resilient to overall economic conditions that affect their loan portfolio. Furthermore, a higher share of non-interest income makes them less dependent on maturity transformation and interest rate risk. Investment-oriented banks, in contrast, become significantly *less* stable if they increase their non-interest income share. They already have a large non-interest income share and engage in different activities than retail-oriented banks. To become more stable, these banks should increase their share of interest income. Overall, therefore, our results imply that banks are more stable if they have a more diversified income structure and depend neither heavily on interest nor on non-interest income. Furthermore, they indicate that the impact of non-interest income on risk significantly depends on the activities used to generate non-interest income with retail-oriented activities being significantly less risky than investment-oriented activities such as those pertaining to capital markets activities. Finally, the decomposition of non-interest income shows that impact on bank stability comes from fee and commission income. Trading income, which is significantly more volatile than fee and commission income, in contrast, has no significant effect on bank stability.

Literature

Altunbas, Y., Manganelli, S. and Marques-Ibanez, D. (2011), "Bank Risk During the Financial Crisis – Do Business Models Matter?", ECB Working Paper Series, No. 1394, European Central Bank, Frankfurt.

Barry, T. A., Lepetit, L. and Tarazi, A. (2011), "Ownership Structure and Risk in Publicly Held and Privately Owned Banks", *Journal of Banking and Finance*, Vol. 35, pp. 1327-1340.

Beltratti, A. and Stulz R. M. (2012), "Why Did Some Banks Perform Better During the Credit Crisis? A Cross-country Study of the Impact of Governance and Regulation", *Journal of Financial Economics*, Vol. 105(1), pp. 1-17.

Bikker, J. A. and Metzemaker, P. (2005), "Bank Provisioning Behavior and Procyclicality", *Journal of Financial Markets, Institutions and Money*, Vol. 15, pp. 141-157.

Bornemann, S., Kick, T., Memmel, C. and Pfingsten, A. (2012), "Are Banks Using Hidden Reserves to Beat Earnings Benchmarks", *Journal of Banking & Finance*, Vol. 36, pp. 2403-2415.

Boyd, J. H., Hanweck, G. A. and Pithyachariyakul, P. (1980), "Bank Holding Company Diversification", *in Proceedings from a Conference on Bank Structure and Competition*, May,

Boyd, J. H., Graham, S. L. and Hewitt, S. R. (1993), "Bank Holding Company Mergers with Nonbank Financial Firms: Effects on the Risk of Failure," *Journal of Banking & Finance*, Vol. 17, pp. 43-63.

Busch, R. and Kick, T. (2009), "Income Diversification in the German Banking Industry", Bundesbank Discussion Paper, No. 09/2009.

Busch, R. (2011), "Diversifikation von Einkommen und Kreditportfolien – Eine ökonometrische Analyse zu Rentabilität, Risiko und Effizienz im deutschen Bankenmarkt", Dissertation, Friedrich-Alexander-Universität Erlangen-Nürnberg.

Demirgüc-Kunt, A. and Huizinga, H. (2010), "Bank Activity and Funding Strategies: The Impact on Risk and Returns", *Journal of Financial Economics*, Vol. 98, pp. 626-650.

Deutsche Bundesbank (2009), „Financial Stability Report".

DeYoung, R. and Roland, K. P. (2001), "Product Mix and Earnings Volatility at Commercial Banks: Evidence from a Degree of Total Leverage Model", *Journal of Financial Intermediation*, Vol. 10, pp. 54-84.

Fahlenbrach, R., Prilmeier, R. and Stulz R. M. (2012), „This Time is the same: Using bank performance in 1998 to Explain bank Performance during the Recent Financial Crisis", The Journal of Finance, Vol. LXVII (6), pp. 2139-2185.

House of Commons Treasury Committee (2009), "Banking crisis: Reforming corporate governance and pay in the city", Ninth report of the Session 2008-09.

Koencker, R. and Bassett, G. (1978), "Regression Quantiles", *Econometrica*, Vol. 46(1), pp.33-50.

Köhler, M. (2012), "Which Banks are More Risky? The Impact of Loan Growth and Business Model on Bank Risk-Taking?", Discussion Paper, Deutsche Bundesbank, No. 33/2012.

Laeven, L. and Levine; R. (2009), "Bank Governance, Regulation and Risk-Taking", *Journal of Financial Economics,* Vol. 93(2), pp. 259-275.

Laeven, L. and Majnoni, G. (2003), "Loan Loss Provisioning and Economic Slowdowns: Too Much, Too Late?," *Journal of Financial Intermediation,* Vol. 12, pp. 178-197.

Lepetit, L., Nys, E., Rous, P. and Tarazi, A. (2008), "The Expansion of Services in European Banking: Implications for Loan Pricing and Interest Margins", *Journal of Banking and Finance*, Vol. 32, pp. 2325-2335.

Liikanen (2012), "High-Level Expert Group on Reforming the Structure of the EU Banking Sector".

Shleifer, A. (2011), "The transformation of Finance", Lecture at American Finance Association Meetings.

Stiroh, K. J. (2004), "Diversification in Banking: Is Non-Interest Income the Answer?", *Journal of Money, Credit, and Banking*, Vol. 36, pp. 853-882.

Stiroh, K. J. (2006), "New Evidence on the Determinants of Bank Risk", *Journal of Financial Service Research*, Vol. 30(3), pp. 237-263.

Stiroh, K. J. and Rumble, A. (2006), "The Dark Side of Diversification: The Case of US Financial Holding Companies", *Journal of Banking and Finance*, Vol. 30, pp. 2131-2161.

Appendix

Table 1: Bank Sample

Table 1 shows the distribution of observations across years for the entire sample as well as for savings, cooperative and other banks separately. Other banks are the four big banks, the head institutions of the savings and cooperative sector, regional banks and other credit institutions. We exclude real-estate and mortgage banks, specialized governmental credit institutions and the branches of foreign banks in Germany.

	All Banks	**Savings Banks**	**Cooperative Banks**	**Other Banks**
2002	1,927	459	1,289	179
2003	1,932	459	1,290	183
2004	1,939	461	1,291	187
2005	1,942	461	1,291	190
2006	1,894	454	1,255	185
2007	1,854	443	1,230	181
2008	1,801	435	1,195	171
2009	1,747	428	1,155	164
2010	1,724	426	1,136	162
Total	16,760	4,026	11,132	1,602
(in percent)	*(100%)*	*(24.02%)*	*(66.42%)*	*(9.56%)*

Table 2: Non-Interest Income Share

Table 2 shows descriptive statistics for the ratio of net non-interest income to total operating income come (NNINC) for the entire sample as well as for savings, cooperative and other banks separately. Other banks are the four big banks, the head institutions of the savings and cooperative sector, regional banks and other credit institutions. We exclude real-estate and mortgage banks, specialized governmental credit institutions and the branches of foreign banks in Germany. For a more detailed description of NNINC see Table 4.

	All Banks	Savings Banks	Cooperative Banks	Other Banks
Observations	16,760	4,026	11,132	1,602
Mean	22.37	20.21	21.08	36.73
Median	21.04	20.13	21.32	28.59
Standard Deviation	11.46	3.27	6.03	29.41
Maximum	99.26	28.15	35.06	99.26
Minimum	0.01	11.91	2.53	0.01
Equality of Means Test (t-value)				
Other Banks vs. Savings Banks	-35.12***			
Other Banks vs. Cooperative Banks	-49.39***			
Savings Banks vs. Cooperative Banks	-8.76***			

Table 3: Descriptive Statistics for Bank Risk and Returns

Table 3 shows descriptive statistics for different indicators of bank risk and returns. The Z-Score is defined as the ratio of the return on assets (ROA) plus the capital-to-asset ratio (CAR) divided by the standard deviation of the return on assets (SDROA). RAROA is the ratio of ROA over SDROA and RAROE is calculated as the return-on-equity (ROE) divided by the standard deviation of the ROE (SDROE). RACAR is the ratio of total equity divided by SDROA. Because SDROA and SDROE are calculated over the whole sample period, the number of observations is significantly smaller for SDROA and SDROE. For a more detailed description of the variables see Table 4. All variables are winsorized at the 1%- and 99%-level.

All Banks

	Obs.	Mean	Median	Std.Dev.	Max.	Min.
Z-Score	16,760	27.79	23.96	16.83	98.98	0.06
ROA	16,760	0.53	0.48	1.11	13.62	-18.77
CAR	16,760	6.49	5.67	5.55	85.22	1.06
RAROA	16,760	2.12	1.98	1.67	8.97	-2.89
RAROE	16,760	2.13	2.02	1.65	8.85	-2.76
RACAR	16,760	25.67	21.96	15.83	91.2	0.22
SDROA	1,944	0.48	0.26	1.65	38.13	0.06
SDROE	1,944	6.33	4.44	12.34	272.82	1.16

Savings Banks

	Obs.	Mean	Median	Std. Dev.	Max.	Min.
Z-Score	4,026	31.61	27.25	18.26	98.98	5.79
ROA	4,026	0.45	0.41	0.3	1.41	-0.06
CAR	4,026	5.05	4.95	1.06	8.14	2.86
RAROA	4,026	2.37	2.2	1.62	8.06	-0.23
RAROE	4,026	2.34	2.22	1.54	7.19	-0.27
RACAR	4,026	29.23	24.99	17.24	91.2	5.31
SDROA	461	0.23	0.2	0.13	0.75	0.06
SDROE	461	4.76	3.98	3.13	19.21	1.22

Cooperative Banks

	Obs.	Mean	Median	Std. Dev.	Max.	Min.
Z-Score	11,132	27.82	24.17	15.59	90.78	6.52
ROA	11,132	0.54	0.5	0.44	2.06	-0.96
CAR	11,132	6.1	5.87	1.44	11.12	3.29
RAROA	11,132	2.14	2	1.62	6.88	-2.38
RAROE	11,132	2.15	2.04	1.61	6.79	-2.37
RACAR	11,132	25.68	22.16	14.66	86.34	6.22
SDROA	1,291	0.31	0.27	0.18	1.01	0.07
SDROE	1,291	5.05	4.36	2.75	14.65	1.18

Other Banks

	Obs.	Mean	Median	Std. Dev.	Max.	Min.
Z-Score	1,602	17.99	12.99	17.4	89.68	0.06
ROA	1,602	0.68	0.53	3.37	13.62	-18.77
CAR	1,602	12.75	7.38	16.13	85.22	1.06
RAROA	1,602	1.4	1.05	1.96	8.97	-2.89
RAROE	1,602	1.46	1.09	2.02	8.85	-2.76
RACAR	1,602	16.62	11.57	16.42	83.19	0.22
SDROA	192	2.22	0.61	4.91	38.13	0.08
SDROE	192	18.72	9.11	36.09	272.82	1.16

Table 4: List of Variables

Table 4 shows the list of variables used in the regression analysis. All variables are winsorized at the 1%- and 99%-level. For descriptive statistics see Table 5.

Variable	Description
CAR	Winsorized fraction of total equity divided by total assets.
CIR	Winsorized fraction of the cost-income ratio
COOPERATIVE	Dummy variable that is one for cooperative banks and zero otherwise.
DEPOSITS	Winsorized fraction of the customer deposits divided by total assets
LIQUID	Wonsirized fraction of liquid assets divided by total assets. Liquid assets include cash.
LOANS	Winsorized fraction of total customer loans divided by total assets
NIM	Winsorized fraction of the net interest margin defined as the ratio of net interest income divided by total assets
NNINC	Winsorized fraction of abs(Net non-interest income)/abs(Total operating income)
COMMISSION	Winsorized fraction of abs(Net fee and commission income)/abs(Total operating income)
RACAR	Winsorized fraction of the capital ratio (CAR) divided by the standard deviation of the return on assets
RAROA	Winsorized fraction of the return-on-assets (ROA) divided by the standard deviation of the return on assets
ROA	Winsorized fraction of the return-on-assets (ROA)
SAVINGS	Dummy variable that is one for savings banks and zero otherwise.
SDROA	Winsorized fraction of the standard deviation of the return-on-asset (ROA)
SDROE	Winsorized fraction of the standard deviation of the return-on-equity (ROE)
SIZE	Winsorized fraction of the logarithm of total bank assets
TRADING	Winsorized fraction of abs(Net trading income)/abs(Total operating income)
ZSCORE	Winsorized fraction of the Z-score is defined as the ratio of the return on assets (ROA) plus the capital-to-asset ratio (CAR) divided by the standard deviation of the return on assets (SDROA).

Table 5: Descriptive Statistics

Table 5 shows descriptive statistics for the variables used in our regression analysis. CAR is the ratio of equity divided by total assets, DEPOSITS the ratio of customer deposits to total assets, COOPERATIVE a dummy variable for cooperative banks and LIQUID the ratio of liquid assets to total assets. LOANS is defined as the ratio of customer loans to total assets and NIM is the net interest margin. NNINC is the ratio of non-interest income to total operating income and OVERHEAD the ratio of overhead costs to total assets. ROA is the return on assets, RACAR the equity-to-asset ratio divided by the standard deviation of the ROA, RAROA the ROA divided by the standard deviation of the ROA (SDROA) and RAROE the return-on-equity (ROE) divided by the standard deviation of the ROE (SDROE). Z-SCORE is the ratio of the return-on-assets (ROA) plus the capital ratio (CAR) divided by the standard deviation of the return on assets (SDROA). The sample comprises cooperative banks, savings banks and other banks. Other banks are the four big banks, the head institutions of the savings and cooperative sector and regional banks. For a more detailed description of the variables used in our regression analysis see Table 4. All variables are winsorized at the 1%- and 99%-level.

	Obs.	Mean	Median	Std.dev.	Max.	Min.
CAR	16,760	6.49	5.67	5.55	85.22	1.06
CIR	16,760	75.67	73.02	33.62	788.05	10.92
COOPERATIVE	16,760	0.66	1.00	0.47	1.00	0.00
DEPOSITS	16,760	70.80	73.56	14.97	92.60	0.00
LIQUID	16,760	2.50	2.29	2.00	40.37	0.00
LOANS	16,760	57.12	59.08	15.48	99.65	0.00
NIM	16,760	2.53	2.53	0.76	11.74	-0.11
NNINC	16,760	22.37	21.04	11.46	99.26	0.01
RACAR	16,760	25.67	21.96	15.83	91.20	0.22
RAROA	16,760	2.12	1.98	1.67	8.97	-2.89
RAROE	16,760	2.13	2.02	1.65	8.85	-2.76
ROA	16,760	0.53	0.48	1.11	13.62	-18.77
ROE	16,760	8.92	8.39	9.07	87.01	-95.85
SAVINGS	16760	0.24	0.00	0.43	1.00	0.00
SDROA	16,760	0.46	0.26	1.54	38.13	0.06
SDROE	16,760	6.17	4.46	11.28	272.82	1.16
SIZE	16,760	12.94	12.86	1.51	19.87	7.20
ZSCORE	16,760	27.79	23.96	16.83	98.98	0.06

Table 6: Baseline Results

Table 6 shows the results of OLS regressions with different indicators of bank risk and returns as dependent variable. The Z-Score is defined as the ratio of the return on assets (ROA) plus the capital-to-asset-ratio (CAR) divided by the standard deviation of the return on assets (SDROA). RAROA is the ratio of ROA over SDROA and RAROE is calculated as the return-on-equity (ROE) divided by the standard deviation of the ROE (SDROE). RACAR is the ratio of total equity divided by SDROA. SDROE is the standard deviation of the ROE. SIZE is the logarithm of total assets, LOANS the ratio of customer loans divided by total assets, DEPOSITS customer deposits divided by total assets, CIR the cost-income ratio, NIM the net interest margin and LIQUID the ratio of liquid assets divided by total assets. For a more detailed description of the variables see Table 4. Descriptive statistics are shown in Table 5. All variables are winsorized at the 1% and 99%-level. All models are estimated with time/period dummies and standard errors clustered at bank level. ***/**/* indicate significance at the 1-/5-/10-% level.

	Z-Score	RAROA	RAROE	RACAR	SDROA	SDROE
			All Banks			
NNINC	0.001	0.002	-0.004	0.065 ***	0.028 ***	0.077
SIZE	-0.304 ***	-0.222 ***	0.005	-3.875 ***	-0.103 **	0.682
LOANS	0.001	-0.003	-0.009 ***	0.042	-0.009 ***	-0.017
CDEPTA	-0.003 ***	-0.000	-0.003	-0.017	-0.014 ***	0.035
CIR	-0.000	-0.004 ***	-0.004 ***	0.003	0.020 ***	0.137 *
NIM	0.101 ***	0.317 ***	0.249 ***	1.233 ***	0.233 ***	1.661 **
LIQUID	-0.001	-0.009	-0.010 *	0.005	-0.057	-0.480
SAVINGS					-0.428 ***	-9.467 ***
COOPERATIVE					-0.684 ***	-9.895 ***
Observations	16,760	16,760	16,760	16,760	1,944	1,944
Adj. R^2	0.29	0.18	0.16	0.24	0.36	0.19
			Savings Banks			
NNINC	0.008 ***	0.026 *	0.019	0.222 ***	0.003	0.136 *
SIZE	-0.117 ***	-0.606 **	-0.451 *	-1.620	0.002	-0.030
LOANS	0.002 ***	-0.007	-0.013 **	0.067 ***	-0.002 ***	-0.061 ***
CDEPTA	0.004 ***	0.009	0.000	0.149 ***	-0.001	-0.056 ***
CIR	-0.001 *	-0.051 ***	-0.054 ***	0.057 ***	-0.003 **	-0.049 *
NIM	0.141 ***	0.159	-0.043	4.397 ***	0.110 ***	1.322 *
LIQUID	-0.002 **	-0.014	-0.010	-0.017	-0.019 **	-0.152
Observations	4,026	4,026	4,026	4,026	461	461
Adj. R^2	0.50	0.31	0.30	0.51	0.08	0.09
			Cooperative Banks			
NNINC	0.006	0.016	0.009	0.132	-0.002	-0.011

	***	***		***	*	
SIZE	-0.124	-0.590	-0.439	-2.529	0.012	0.372
	***	***	***	***	*	***
LOANS	0.001	-0.012	-0.017	0.059	-0.002	-0.032
	**	***	***	***	***	***
CDEPTA	0.002	-0.001	-0.004	0.047	-0.003	-0.022
	***			***	***	
CIR	-0.000	-0.038	-0.042	0.046	0.001	0.006
		***	***	***		
NIM	0.140	0.491	0.272	3.087	0.171	1.417
	***	***	***	***	***	***
LIQUID	-0.000	0.000	0.001	0.010	-0.026	-0.222
					***	*
Observations	11,132	11,132	11,132	11,132	1,291	1,291
Adj. R^2	0.36	0.24	0.23	0.35	0.09	0.03
			Other Banks			
NNINC	-0.001	0.006	0.001	0.018	0.042	0.214
		*			***	**
SIZE	-0.344	-0.051	0.135	-2.970	-0.181	1.735
	***		*	***	**	**
LOANS	0.001	-0.000	-0.003	-0.016	-0.008	0.038
CDEPTA	-0.005	-0.001	-0.002	-0.088	-0.013	0.060
	***			**	**	
CIR	-0.000	-0.002	-0.002	-0.000	0.022	0.153
		***	***		***	
NIM	0.087	0.166	0.127	0.727	0.242	2.232
	***	***	***	***	**	**
LIQUID	-0.001	-0.004	-0.007	0.004	-0.080	-0.488
Observations	1,602	1,602	1,602	1,602	192	192
Adj. R^2	0.30	0.11	0.09	0.17	0.38	0.19
Time/ Period Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Clustering Level	Bank	Bank	Bank	Bank	Bank	Bank

Table 7: Net Fee and Commission Income and Trading Income

Table 7 shows descriptive statistics for the net non-interest income (NNINC), net fee and commission (COMMISSION) and net trading income to total operating income share (TRADING). The sample comprises savings banks, cooperative banks and retail- and investment-oriented banks. Investment-oriented banks are banks with a customer loans (LOANS) and customer deposit-to-total asset ratio (DEPOSIT), respectively, of less than 50% that do not belong to the group of savings and cooperative banks. All other banks belong to the group of retail-oriented banks. For a more detailed description of the variables see Table 4. Descriptive statistics are shown in Table 5. All variables are winsorized at the 1% -/99%-level.

Net Non-Interest Income Share

	Obs.	Mean	Median	Std. Dev.	Max.	Min.
All Banks	16,589	21.95	20.98	10.15	99.26	0.01
Savings Banks	4,026	20.21	20.13	3.27	28.15	11.91
Cooperative Banks	11,132	21.08	21.32	6.03	35.06	2.53
Retail-Oriented Banks	1,164	31.87	24.63	26.67	99.26	0.00
Investment-Oriented Banks	438	49.65	40.64	32.31	99.26	0.00

Net Provision Income Share

	Obs.	Mean	Median	Std. Dev.	Max.	Min.
All Banks	16,589	21.42	20.59	9.81	99.14	0.00
Savings Banks	4,026	19.74	19.73	3.26	27.28	11.50
Cooperative Banks	11,132	20.79	21.02	5.99	34.20	2.26
Retail-Oriented Banks	1,164	29.83	21.90	26.05	99.14	0.00
Investment-Oriented Banks	438	44.92	31.85	34.00	99.13	0.00

Net Trading Income Share

	Obs.	Mean	Median	Std. Dev.	Max.	Min.
All Banks	16,589	0.50	0.04	1.94	38.44	0.00
Savings Banks	4,026	0.44	0.18	0.73	4.45	0.00
Cooperative Banks	11,132	0.26	0.01	0.69	4.43	0.00
Retail-Oriented Banks	1,164	1.98	0.00	5.06	38.44	0.00
Investment-Oriented Banks	438	4.62	0.96	8.08	38.44	0.00

Table 8: Retail- and Investment-Oriented Banks

Table 8 shows the results of OLS regressions for retail- and investment-oriented banks. Investment-oriented banks are banks with a customer loans (LOANS) and customer deposit-to-total asset ratio (DEPOSIT), respectively, of less than 50% that do not belong to the group of savings and cooperative banks. All other banks belong to the group of retail-oriented banks. The Z-Score is defined as the ratio of the return on assets (ROA) plus the capital-to-asset ratio (CAR) divided by the standard deviation of the return on assets (SDROA). RAROA is the ratio of ROA over SDROA and RAROE is calculated as the return-on-equity (ROE) divided by the standard deviation of the ROE (SDROE). RACAR is the ratio of total equity divided by SDROA. SIZE is the logarithm of total assets, LOANS the ratio of customer loans divided by total assets, DEPOSITS customer deposits divided by total assets, CIR the cost-income ratio, NIM the net interest margin and LIQUID the ratio of liquid assets divided by total assets. For a more detailed description of the variables see Table 4. Descriptive statistics are shown in Table 5. All variables are winsorized at the 1%- and 99%-level. All models are estimated with time/period dummies and standard errors clustered at bank level. ***/**/* indicate significance at the 1-/5-/10-% level.

Retail-Oriented Banks

	Z-SCORE	RAROA	RAROE	RACAR	SDROA	SDROE
NNINC	0.004	0.012	0.006	0.065	0.040	0.172
	*	***		**	**	*
SIZE	-0.323	0.061	0.343	-3.702	-0.142	0.184
	***		***	***		
LOANS	0.001	-0.002	-0.006	0.030	-0.015	0.140
CDEPTA	-0.008	-0.010	-0.007	-0.093	-0.023	0.073
	***	***	*	*		
CIR	-0.001	-0.002	-0.002	-0.001	0.016	0.176
		***	***		*	
NIM	0.097	0.379	0.331	0.673	0.222	1.610
	***	***	***	**	**	
LIQUID	-0.001	-0.003	0.000	-0.001	0.018	0.766
Observations	1,164	1,164	1,164	1,164	135	135
Adj. R^2	0.26	0.17	0.13	0.15	0.13	0.20
Time/Period Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Clustering Level	Bank	Bank	Bank	Bank	Bank	Bank

Investment-Oriented Banks

	Z-SCORE	RAROA	RAROE	RACAR	SDROA	SDROE
NNINC	-0.010	-0.008	-0.009	-0.076	0.027	0.163
	**		**	*	***	***
SIZE	-0.658	-0.178	-0.039	-3.748	-0.033	1.958
	***			***		***
LOANS	0.011	0.014	0.011	0.030	0.010	0.049
	**					
CDEPTA	0.001	0.009	-0.000	0.003	-0.023	-0.142
					*	*
CIR	-0.001	-0.002	-0.002	-0.005	0.008	0.040
	***	***	***		***	***
NIM	-0.000	-0.050	-0.057	0.019	0.691	3.028
					**	**
LIQUID	0.005	-0.002	-0.004	0.048	0.025	0.125
Observations	438	438	438	438	57	57

Adj. R^2	0.44	0.14	0.13	0.18	0.68	0.29
Time/Period Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Clustering Level	Bank	Bank	Bank	Bank	Bank	Bank

Table 9: Results without 2009 and 2010

Table 9 shows the results of OLS regressions with different indicators of bank risk and returns as dependent variable. The sample period is from 2002 to 2008. The sample comprises savings banks, cooperative banks and retail- and investment-oriented banks. Investment-oriented banks are banks with a customer loans (LOANS) and customer deposit-to-total asset ratio (DEPOSIT), respectively, of less than 50% that do not belong to the group of savings and cooperative banks. All other banks belong to the group of retail-oriented banks. The Z-Score is defined as the ratio of the return-on-assets (ROA) plus the capital-to-asset ratio (CAR) divided by the standard deviation of the return-on-assets (SDROA). RAROA is the ratio of ROA over SDROA and RAROE is calculated as the return-on-equity (ROE) divided by the standard deviation of the ROE (SDROE). RACAR is the ratio of total equity divided by SDROA. SIZE is the logarithm of total assets, LOANS the ratio of customer loans divided by total assets, DEPOSITS customer deposits divided by total assets, CIR the cost-income ratio, NIM the net interest margin and LIQUID the ratio of liquid assets divided by total assets. For a more detailed description of the variables see Table 4. Descriptive statistics are shown in Table 5. All variables are winsorized at the 1%- and 99%-level. All models are estimated with time/period dummies and standard errors clustered at bank level. ***/**/* indicate significance at the 1-/5-/10-% level.

	Z-Score	RAROA	RAROE	RACAR	SDROA	SDROE
			All Banks			
NNINC	0.002	0.006	0.001	0.074 ***	0.012 ***	0.039 **
SIZE	-0.230 ***	-0.254 ***	-0.031	-3.790 ***	-0.062 ***	0.296 ***
LOANS	0.002	-0.003	-0.009 ***	0.063 *	-0.003 *	-0.018 *
DEPOSITS	-0.002 *	-0.002	-0.002	-0.041	-0.008 ***	-0.023 *
CIR	0.000	-0.004 ***	-0.004 ***	0.002	0.006 ***	0.022 **
NIM	0.057 ***	0.222 ***	0.170 ***	1.268 ***	0.150 ***	0.592 **
LIQUID	0.000	-0.005	-0.006	-0.014	-0.007	-0.089
SAVINGS					-0.380 ***	-4.019 ***
COOPERATIVE					-0.428 ***	-3.208 ***
Observations	13,289	13,289	13,289	13,289	1,944	1,944
Adj. R^2	0.26	0.15	0.15	0.23	0.48	0.20
	Z-Score	**RAROA**	**RAROE**	**RACAR**	**SDROA**	**SDROE**
			Savings Banks			
NNINC	0.006 ***	0.043 ***	0.042 ***	0.205 ***	-0.001	0.066
SIZE	-0.087 ***	-0.610 *	-0.472	-1.489	-0.006	-0.118
LOANS	0.003 ***	-0.011	-0.017 **	0.088 ***	-0.001	-0.047 ***
DEPOSITS	0.005 ***	0.008	0.002	0.172 ***	-0.001	-0.051 ***
CIR	-0.002 ***	-0.059 ***	-0.059 ***	0.029 ***	-0.001	-0.030
NIM	0.093 ***	0.044	-0.096	3.885 ***	0.044	0.188
LIQUID	-0.004 ***	-0.018	-0.009	-0.081 **	-0.016	-0.230
Observations	3,172	3,172	3,172	3,172	461	461
Adj. R^2	0.41	0.28	0.29	0.51	0.05	0.09

			Cooperative Banks			
NNINC	0.006	0.023	0.018	0.175	-0.006	-0.047
	***	***	**	***	**	*
SIZE	-0.120	-0.869	-0.752	-2.588	0.013	0.311
	***	***	***	***		***
LOANS	0.001	-0.016	-0.021	0.062	-0.002	-0.019
		***	***	***	**	*
DEPOSITS	0.000	-0.012	-0.012	0.042	-0.006	-0.041
		***	**	**	***	**
CIR	-0.000	-0.034	-0.037	0.059	0.001	-0.005
		***	***	***		
NIM	0.140	0.406	0.212	3.993	0.211	1.535
	***	***	**	***	***	***
LIQUID	-0.002	-0.002	0.001	-0.056	-0.036	-0.322
	*				***	**
Observations	8841	8841	8841	8841	1291	1291
Adj. R^2	0.33	0.20	0.19	0.36	0.11	0.03
			Retail-Oriented Banks			
NNINC	0.004	0.014	0.010	0.042	0.018	0.069
	*	***	**		***	*
SIZE	-0.285	0.045	0.279	-4.216	-0.090	0.820
	***		*	***	*	*
LOANS	0.003	0.000	-0.007	0.079	0.003	0.026
DEPOSITS	-0.006	-0.005	0.000	-0.181	-0.005	0.004
	***			**		
CIR	-0.000	-0.002	-0.002	-0.003	0.006	0.036
		**	***		**	**
NIM	0.044	0.376	0.352	0.493	0.108	0.544
	**	***	***		*	
LIQUID	-0.001	0.006	0.010	-0.056	-0.048	0.145
Observations	912	912	912	912	135	135
Adj. R^2	0.27	0.15	0.12	0.18	0.25	0.05
			Investment-Oriented Banks			
NNINC	-0.010	-0.015	-0.016	-0.070	0.025	0.189
	***	**	**	*	***	***
SIZE	-0.365	-0.351	0.079	-2.779	-0.101	1.524
	***			*		***
LOANS	0.009	0.018	0.014	0.069	0.020	0.097
	*					
DEPOSITS	-0.002	0.013	0.007	-0.046	-0.020	-0.080
		*			*	
CIR	-0.001	-0.003	-0.002	-0.003	0.008	0.030
	***	***	***		***	
NIM	-0.005	-0.096	-0.128	0.199	0.784	2.369
			**		***	*
LIQUID	0.005	0.000	-0.004	0.102	0.031	0.081
Observations	364	364	364	364	57	57
Adj. R^2	0.31	0.18	0.17	0.18	0.73	0.22
Time/Period Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Clustering Level	Bank	Bank	Bank	Bank	Bank	Bank

Table 10: Quantile Regressions

Table 10 shows the results of quantile regressions with different indicators of bank risk and returns as dependent variable. The sample comprises savings banks, cooperative banks and retail- and investment-oriented banks. Investment-oriented banks are banks with a customer loans (LOANS) and customer deposit-to-total asset ratio (DEPOSIT), respectively, of less than 50% that do not belong to the group of savings and cooperative banks. All other banks belong to the group of retail-oriented banks. For brevity, we report the results for the non-interest income share (NNINC) only. The coefficients not reported are SIZE, LOANS, DEPOSITS, CIR, NIM and LIQUID. For a more detailed description of the variables see Table 4. Descriptive statistics are shown in Table 5. All variables are winsorized at the 1%- and 99%-level. All models are estimated with time/period dummies. OLS standard errors are clustered at bank level, while the quantile regression standard errors are obtained using 1,000 bootstrap replications. Both are not reported for the sake of brevity.***/**/* indicate significance at the 1-/5-/10-% level.

		OLS/FE Regression	.10 Quantile	.25 Quantile	.50 Quantile	.75 Quantile	.90 Quantile	Equality of Coefficients
All Banks	Z-Score	0.001	0.000	0.001***	0.002***	0.002***	0.003***	17.71***
	RAROA	0.002	0.002**	0.004***	0.003***	0.002**	0.003*	2.40**
	RAROE	-0.004	-0.004***	-0.004***	-0.004***	-0.004***	-0.003***	0.31
	RACAR	0.065***	0.060***	0.062***	0.066***	0.072***	0.078***	7.50***
	SDROA	0.028***	0.002*	0.002**	0.003*	0.003	0.006	0.22
	SDROE	0.077	0.024*	0.029**	0.029	0.056*	0.035	0.31
Savings Banks	Z-Score	0.008***	0.006***	0.007***	0.008***	0.008***	0.010***	4.30***
	RAROA	0.026*	0.022***	0.025***	0.026***	0.026***	0.027***	0.09
	RAROE	0.019	0.015**	0.018***	0.022***	0.025***	0.027***	0.40
	RACAR	0.222***	0.211***	0.221***	0.216***	0.222***	0.218***	0.32
	SDROA	0.003	0.004**	0.004*	0.003	0.004	0.002	0.10
	SDROE	0.136*	0.040	0.073	0.142***	0.190**	0.097	1.57
Cooperative Banks	Z-Score	0.006***	0.006***	0.006***	0.006***	0.005***	0.005***	1.98*
	RAROA	0.016***	0.016***	0.017***	0.017***	0.018***	0.012***	1.55
	RAROE	0.009	0.005***	0.009***	0.008***	0.011***	0.006*	2.31*
	RACAR	0.132***	0.133***	0.129***	0.132***	0.134***	0.137***	0.82
	SDROA	-0.002*	0.001	-0.000	-0.000	-0.003*	-0.002	2.01*
	SDROE	-0.011	0.002	0.002	-0.003	-0.002	0.031	0.48
Retail-Oriented Banks	Z-Score	0.004*	0.003***	0.004***	0.004***	0.005***	0.004***	3.19**
	RAROA	0.012***	0.012***	0.011***	0.012***	0.012***	0.011***	0.18
	RAROE	0.006	0.007	0.007	0.006	0.007	0.006	0.28

			***	***	***	***	***	
	RACAR	0.065	0.093	0.072	0.064	0.061	0.049	3.02**
		**	***	***	***	***	***	
	SDROA	0.040	0.004	0.006	0.008	0.017	0.059	1.11
		**		**	**		**	
	SDROE	0.172	0.071	0.071	0.070	0.174	0.301	0.25
		*	**	**	*			
Investment-Oriented Banks	Z-Score	-0.010	-0.012	-0.011	-0.011	-0.009	-0.008	1.93
		**	***	***	***	***	***	
	RAROA	-0.008	-0.007	-0.007	-0.008	-0.009	-0.009	0.08
			***	***	***	***	**	
	RAROE	-0.009	-0.009	-0.007	-0.007	-0.009	-0.013	0.99
		**	***	***	***	***	***	
	RACAR	-0.076	-0.062	-0.072	-0.073	-0.085	-0.109	2.04*
		*	***	***	***	***	***	
	SDROA	0.052	0.009	0.003	0.032	0.085	0.077	1.92
		**				***	**	
	SDROE	0.388	0.049	0.059	0.119	0.254	0.546	0.57
		*					*	

Table 11: Results with Fee and Commission and Trading Income Share

Table 11 shows the results of quantile regressions for different indicators of bank risk and returns as dependent variable. Investment-oriented banks are banks with a customer loans (LOANS) and customer deposit-to-total asset ratio (DEPOSIT), respectively, of less than 50% that do not belong to the group of savings and cooperative banks. All other banks belong to the group of retail-oriented banks. For brevity, we report the results for only the net fee and commission income (COMMISSION) and net trading income share (TRADING) only. For a more detailed description of the variables see Table 4. Descriptive statistics are shown in Table 5. All variables are winsorized at the 1%- and 99%-level. OLS standard errors are clustered at bank level, while the quantile regression standard errors are obtained using 1,000 bootstrap replications. Both are not reported for the sake of brevity.***/**/* indicate significance at the 1-/5-/10-% level.

		Retail-Oriented Banks						
		OLS/FE Regression	**.10 Quantile**	**.25 Quantile**	**.50 Quantile**	**.75 Quantile**	**.90 Quantile**	**Equality of Coefficients**
Z-Score	COMMISSION	0.004 *	0.003 ***	0.004 ***	0.004 ***	0.005 ***	0.005 ***	2.64**
	TRADING	0.002	0.001	0.001	0.001	0.002	-0.003	0.82
RAROA	COMMISSION	0.011 ***	0.010 ***	0.011 ***	0.011 ***	0.011 ***	0.010 ***	0.26
	TRADING	0.019	0.008	0.010	0.013 **	0.023 ***	0.045 **	1.12
RAROE	COMMISSION	0.005	0.007 ***	0.006 ***	0.006 ***	0.006 ***	0.005 **	0.26
	TRADING	0.013	0.007	0.005	0.004	-0.003	0.031 *	0.85
RACAR	COMMISSION	0.064 **	0.091 ***	0.073 ***	0.064 ***	0.061 ***	0.051 ***	2.50**
	TRADING	0.060	0.131 ***	0.096 ***	0.060 ***	0.059 ***	0.026	1.94
SDROA	COMMISSION	0.039 **	0.003	0.006 *	0.008 *	0.017	0.054 *	0.86
	TRADING	0.104	0.015	0.007	-0.006	0.049	0.141	0.40
SDROE	COMMISSION	0.170	0.078 **	0.066 **	0.069 *	0.177	0.268	0.38
	TRADING	0.257	0.053	0.242	0.350	0.511	1.026	0.40

Investment-Oriented Banks

		OLS/FE Regression	.10 Quantile	.25 Quantile	.50 Quantile	.75 Quantile	.90 Quantile	Equality of Coefficients
Z-Score	COMMISSION	-0.012 ***	-0.014 ***	-0.013 ***	-0.012 ***	-0.011 ***	-0.011 ***	1.12
	TRADING	-0.003	-0.005	-0.006 **	-0.003	-0.001	-0.003	0.87
RAROA	COMMISSION	-0.007	-0.006 *	-0.006 ***	-0.008 ***	-0.008 ***	-0.007 *	0.31
	TRADING	-0.013	-0.020 *	-0.013 *	-0.013	-0.012	-0.015	0.13
RAROE	COMMISSION	-0.008 *	-0.008 **	-0.007 ***	-0.007 ***	-0.009 ***	-0.014 ***	1.11
	TRADING	-0.012	-0.026 **	-0.011	-0.004	-0.008	-0.011	0.93
RACAR	COMMISSION	-0.088 *	-0.071 ***	-0.081 ***	-0.085 ***	-0.098 ***	-0.116 ***	1.60
	TRADING	-0.021	-0.049	-0.021	-0.028	-0.027	-0.040	0.20
SDROA	COMMISSION	0.059 **	0.011	0.004	0.032	0.088 **	0.087 ***	1.57
	TRADING	-0.087	0.005	0.005	-0.007	0.005	-0.027	0.04
SDROE	COMMISSION	0.458 **	0.015	0.103	0.087	0.346	0.529 *	0.79
	TRADING	-1.181	-0.231	-0.199	-0.370	-0.693	-1.469	0.11

Figure 1: Development of Net Interest and Net Non-Interest Margins

Figure 1 shows the development of the average net interest margin and the average net non-interest margin of German banks between 2002 and 2010. The net interest margin is the ratio of net interest income divided by total assets, while the net non-interest income share is net non-interest income divided by total assets. The sample includes savings banks, cooperative banks and other banks. Other banks are the four big banks, the head institutions of the savings and cooperative sector, regional banks and other credit institutions. We do not include special purpose institutions, real-estate and mortgage banks and the German branches of foreign banks. Please note that the y-axes are scaled differently.

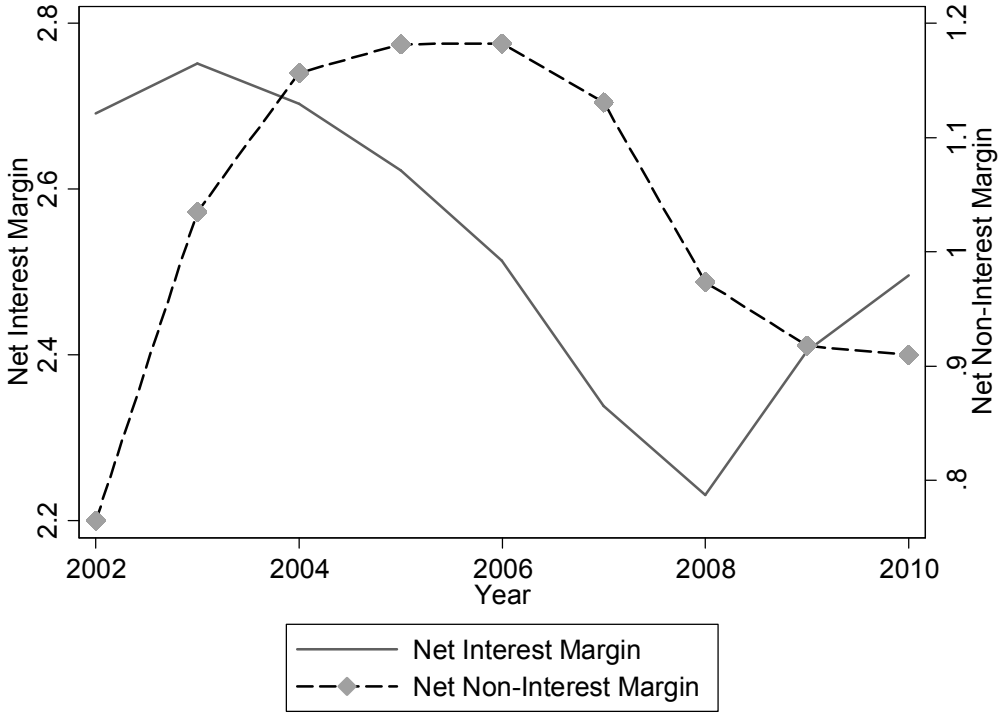

Figure 2: Development of Interest and Non-Interest Income

Figure 2 shows the development of total net interest income and total net non-interest income between 2002 and 2010 for the entire sample and for savings banks, cooperative banks and other banks separately. The sample includes savings banks, cooperative banks and other banks. Other banks are the four big banks, the head institutions of the savings and cooperative sector, regional banks and other credit institutions. We do not include special purpose institutions, real-estate and mortgage banks and the German branches of foreign banks. Please note that the y-axes are scaled differently.

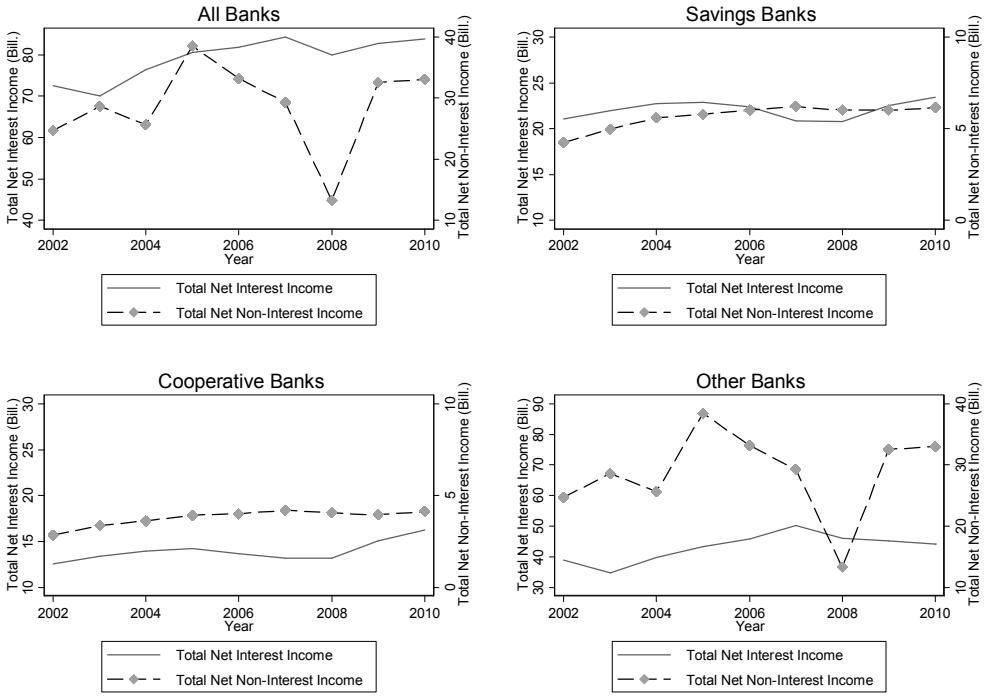

Figure 3: Distribution of Banks' Non-Interest Income Share

Figure 3 shows the distribution of banks' average non-interest income to total operating income share for the period between 2002 and 2010. The sample includes savings banks, cooperative banks and other banks. The sample includes savings banks, cooperative banks and other banks. Other banks are the four big banks, the head institutions of the savings and cooperative sector, regional banks and other credit institutions. We do not include special purpose institutions, real-estate and mortgage banks and the branches of foreign banks in Germany.

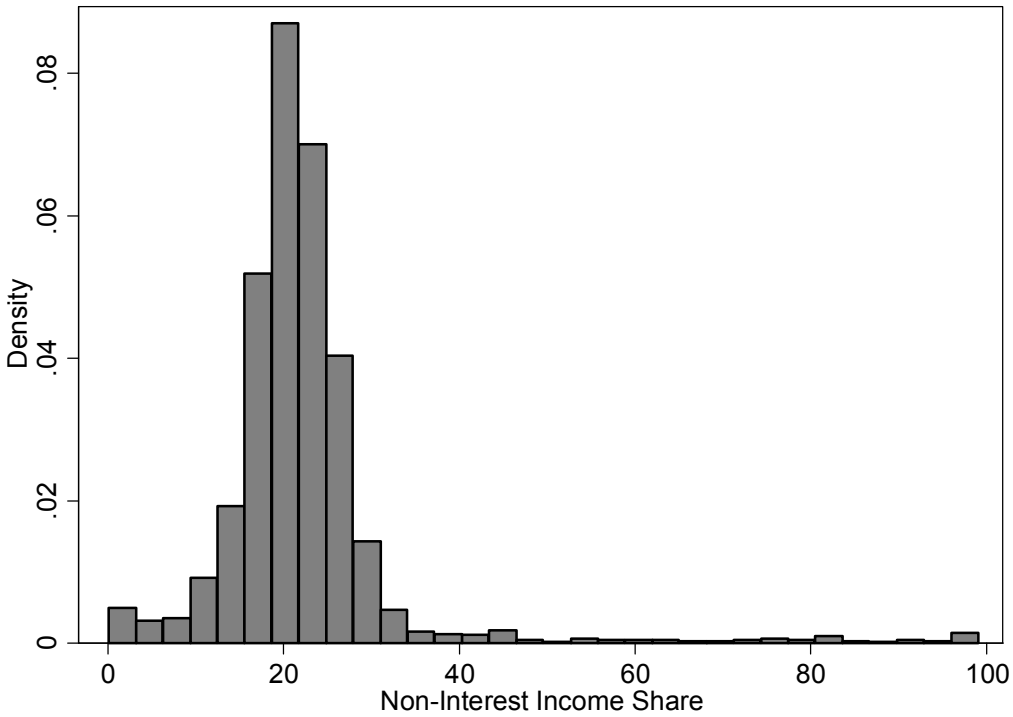

Figure 4: Non-Interest Income Share and Bank Risk-Taking

Figure 4 shows the relationship between banks' non-interest income share (NNINC) and the Z-Score. The Z-Score (ZSCORE) is defined as the ratio of the return on assets (ROA) plus the capital ratio (CAR) divided by the standard deviation of the return on assets (SDROA). Banks are divided according to their non-interest income share into 10 groups each containing 10% of observations. For each of these groups, we calculate the mean Z-Score plot them against the 10 bins of the distribution. The sample includes savings banks, cooperative banks and other banks. Other banks are the four big banks, the head institutions of the savings and cooperative sector, regional banks and other credit institutions.