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International Banking and the Allocation of Risk

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International Banking and the Allocation of Risk*

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Abstract

Macroeconomic risks could magnify individual bank risk. Mitigating the influence of economy-wide risks on banks could therefore be very important to maintain a smooth-running banking system. In this paper, we explore the extent to which macroeconomic risks affect banks. We use a bank-level dataset on over 2,000 banks worldwide for the years 1995-2002 to study the effect of macroeconomic volatility, the openness of the banking system, and banking regulations on bank risks. Our measure of bank risk is the volatility of banks' pre-tax profits. We find that macroeconomic volatility increases banks' profit volatility and that international openness of the banking system lowers bank risk. We find no impact of banking regulation on profit volatility. Our findings suggest that if policymakers want to lower bank risk, they should seek to lower macroeconomic volatility as well as increase openness in the banking system.

Key words: international banking, macroeconomic volatility, banking risk

JEL classification: F37, F41, G21

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1 Motivation

Banks play an important role in the allocation of risk in an economy. Through monitoring their customers and pooling risks, they contribute to an improved allocation of financial resources and of risks (Diamond, 1984). At the same time, banks themselves are exposed to macroeconomic risks. We determine the degree to which banks are exposed to macroeconomic risks. We then analyze factors that could influence this risk, namely regulatory and bank-level factors as well as the growing internationalization of the banking industry.

Our research is related to three strands of literature. (See Table 1 for an overview of earlier literature.) One strand of literature studies the determinants of risks in banking. These papers use different measures of bank risks. Nier and Baumann (2003) focus on insolvency risk and show that moral hazard is prevalent in banking and that market discipline plays a role in mitigating banks' risk of insolvency. De Nicolò (2001) finds that insolvency risk and return volatility increase in the size of banks. A higher degree of financial development at the country-level lowers insolvency risk. Also, stricter regulation on permissible activities increases insolvency risk. Greater possibilities for diversification in universal banks are a potential explanation for this finding. González (2005) examines the link between bank charter value and risk-taking. He finds that fewer regulatory restrictions increase banks' charter value. A higher charter value in turn has a disciplining effect on banks' risk-taking incentives. The negative relationship between bank charter value and risk taking is supported by the findings of Keeley (1990), Demsetz et al. (1996), and Gropp and Vesala (2004). However, none of these studies analyzes the impact of the internationalization of the banking system on bank risk though.

A second strand of the literature assesses the impact of the internationalization of banks on risk-taking. Amihud et al. (2001) find that banks exposing themselves to more systematic risk at home also expose themselves to more systematic risk in the world market. Moreover, cross-

border bank mergers have little impact on risk. Following mergers, systematic risk shifts but total risk remains unaffected. Méon and Weill (2005) find that there are potential gains in risk diversification from cross-border mergers. Even within the EU they find opportunities for diversification since business cycles are imperfectly correlated. Buch and DeLong (2006) find that improved banking regulation influence changes in risk following mergers. Our research differs from these papers because we do not focus on the risk effects of mergers, but rather on the influence of macroeconomic conditions on bank risk.

A third strand of the literature uses stock market data to analyze cyclical behavior of bank risk. Baele and Vander Vennet (2005) study the exposure of banks to business cycle developments. They find that bank stock returns are more volatile and sensitive to shocks during business cycle troughs. Hyytinen (2002) studies the evolution of bank risks during the crises of the Scandinavian banking systems. He finds that bank return variation during the crises was mostly systematic and not idiosyncratic.

In this paper, we combine these different strands of the literature. Our baseline model of bank risk is similar to the frameworks used by Nier and Baumann (2003) and De Nicolò (2001). We use a larger sample, both in terms of the number of banks included and the years covered. We additionally go beyond their work by asking whether the riskiness of banks depends on the openness of the banking system. In contrast to earlier literature, we do not rely on stock-market based measures of bank risk, but we use the volatility of banks' profits. This has the advantage that we can include information on a larger set of banks, since not all banks in our data set are publicly-traded.

Our set of explanatory variables includes data that are measured at the bank-level as well as at the country-level for the years 1995 to 2002. In contrast to previous studies, we take these different levels of aggregation of the explanatory variables explicitly into account by estimating a linear mixed effects model.

We find that macroeconomic volatility increases banks' profit volatility. Furthermore, economic openness of the banking system lowers banks' risk. We find no impact of stricter banking regulation on profit volatility.

In the following second part, we describe the data and methodology that we are using. We also give an overview of the regressions we run and the variables we use. Part three presents regression results. Part four provides robustness tests, and part five concludes.

2 Data and Methodology

2.1 Data

Our dependent variable is bank risk, defined as the volatility of banks' profit growth. In cross-sectional analysis, we examine the effect of macroeconomic volatility, openness of the banking system, and strictness of banking regulation on bank risk.

Bank-Specific Variables

Our main source for bank-specific variables is Bankscope. From Bankscope, we retrieve data on all banks worldwide, measured in US dollars. We include the log of total assets to control for the size of banks. Furthermore, banks that grow faster are likely to increase their exposure to more risky ventures. Therefore, we include banks' asset growth. The variable return on equity (ROE) follows the same reasoning if banks are facing a trade-off between risk and return. We also include the log of loan loss provisions and the market share of a bank's deposits to see if they exert a stabilizing role on bank's profit volatility. Finally, we control for the share of problem loans that a bank has.

We clean the data in the following way:

Some banks present both consolidated and unconsolidated accounts. In order to eliminate double entries, we keep only those banks with the consolidation codes C1 (unconsolidated and companion is not on the disc), C2 (unconsolidated and companion is on the disc), U1

(consolidated and companion is not on the disc or if the bank does not publish consolidated accounts), and A1 (companion is not on disk).

As we describe below (Section 2.2), our measure of bank risk requires sufficiently long data strings for each bank. To avoid changes in the sample composition over time, we create a balanced panel by keeping observations for the years 1995-2002 only. We restrict our sample to those banks which have a full set of entries for bank assets for this period. This guarantees that our sample is not influenced by entry and exit of banks. We also drop banks with negative equity as these banks are likely to be on the verge of bankruptcy. However, we do not loose more than 67 banks or about 3% of the total observations.

Our final sample contains more than 2,000 banks (see Table 2). The largest number of banks come from the United States (381 banks), followed by France (171), Germany (170), and Switzerland (141). To check whether our final results are driven by the presence of US banks, we run all regressions also excluding banks from the US. The main qualitative results are unchanged.

Country-Specific Variables

We use five different groups of country-specific variables. First, we use different measures of macroeconomic volatility. These include the volatility of GDP growth, exchange rate volatility, deposit rate volatility, and inflation volatility. Like profit volatility (see Section 2.2), the macroeconomic volatilities are calculated using rolling volatilities over a five-year timeframe. Data come from the World Development Indicators (WDI) provided by the World Bank.

Second, we include structural indicators of the countries' financial systems. To account for the size of the banking system, we include the ratio of the assets of deposit money banks to GDP. To account for the importance of non-bank financial intermediation, we include the size of the stock market. These data are taken from Beck et al. (2005).

Third, since we lack information on the international exposure of banks measured at the bank-level, we use a variable measuring the international openness of the banking system as a whole. Specifically, we calculate gross foreign assets (measured as the sum of claims and liabilities vis-à-vis non-residents). These data are available for a sub-set of less than 20 OECD countries and have been taken from the publication "Bank Profitability – Financial Statements of Banks" of the OECD. In addition, we include measures of the openness the country as a whole. We use indexes on economic and political globalization provided by the Swiss Institute for Business Cycle Research (KOF). (For details see Dreher (2006).) Economic globalization is an index including information on flows of goods, capital and services as well as information on restrictions like hidden import barriers, tariff rates, taxes on international trade, and capital account restrictions. The index runs from 0 to 10, a higher index denoting a higher degree of economic integration. Political globalization is an index including information on the diffusion of government policies, including the absolute number of embassies in a country, the number of international inter-governmental organizations, and the absolute number of U.N. Security Council Missions participated in. The index also runs from 0 to 10.

Finally, we include two variables proxying for the structure of the deposit insurance system. One is a 0/1 dummy indicating whether deposit insurance premia are risk adjusted. The other one is a 0/1 dummy indicating whether the deposit insurance system requires co-insurance. Both variables take a higher value if the deposit insurance system is geared more towards a reduction in risk.

2.2 Measuring Banking Risks

Different measures of bank risk have been used in the literature. Nier and Baumann (2003) use the ratio of non-performing loans to total loans, the amount of loan loss provisions, the standard deviation of weekly equity prices as well as beta risk and idiosyncratic risk. Beta risk

is obtained from a regression of bank returns on market returns, and idiosyncratic risk is the residual from this regression. Amihud et al. (2001) use similar, stock-market based measures of total risk, i.e. the variance of acquirer stock returns relative to the variance of the market, as well as systematic or beta risk. De Nicolò (2001) focuses on insolvency risk, which is defined as the probability that losses exceed equity as given by the number of standard deviations a return realization has to fall in order to deplete equity.

Since we do not want to restrict our analysis to listed banks, we cannot use measures of risk that require stock market data. Hence, we use the volatility of the growth rates of banks' pre-tax profits ($\Delta\Pi_{ijt}$), as given by:

$$\sigma\left(\Delta\Pi_{ijt}\right)=\left[\frac{1}{5}\sum_{n=1}^{5}\left(\Delta\Pi_{ij,t-n}-\overline{\Delta\Pi}_{ij,t-n}\right)^{2}\right]^{1/2}. \qquad (1)$$

Although the time window of five years that we choose might appear short, it is common in the literature studying macroeconomic volatility (see, e.g. Bekaert et al. (2004) for consumption data or Comin and Philippon (2005) for a study of the output volatility of non-financial firms). In banking, a similar measure of bank risk has been used by Craig and dos Santos (1997) who use the standard deviation and the coefficient of variation of bank profitability.

Our final dataset still contains a number of outliers. In order to keep as many observations as possible while correcting for extreme outliers, we truncate measures for volatility and growth at +/– 200%. Similar problems with outliers arise for the returns on equity and assets provided by Bankscope. We thus truncate measures of return on assets (return on equity) which are above or below 200%. Overall, we do not omit more than 10 entries in each case. Descriptive statistics of all variables used can be found in Table 4.

2.3 Methodology

Our aim is to compute the "exposure" of individual banks to macroeconomic risks. Hence, we estimate the following equation

$$\sigma(\Delta\Pi_{ijt}) = \beta_0 + \beta_1\sigma(\Delta s_{jt}) + \beta_2 X_{it} + \beta_3 X_{jt} + \beta_4 X_j + \varepsilon_{ijt} \qquad (2),$$

where $\sigma(\Delta\Pi_{ijt})$ is a measure of the profit volatility of bank *i* in country *j* at time *t*, $\sigma(\Delta s_{jt})$ is exchange rate volatility in country *j*, X_{it} is a vector of time-varying bank-specific control variables, X_{jt} is a vector of time-varying country-specific control variables, X_j is a vector of time-invariant country-specific control variables, and ε_{ijt} is the error term. We measure volatility over a rolling window of five years, and we have a maximum of eight years of observations for the bank-specific variables. Therefore, our model has a time series dimension of $t = 3$.

We also test whether an increasing degree of internationalization of the banking system affects bank risk. Internationalization is measured by variables indicating the openness of the country for foreign capital, and through an index indicating political integration. We thus augment equation (2) with measures of openness:

$$\sigma(\Delta\Pi_{ijt}) = \beta_0 + \beta_1\sigma(\Delta s_{jt}) + \beta_2 X_{it} + \beta_3 X_{jt} + \beta_4 X_j + \beta_5 Open_{jt} + \varepsilon_{ijt} \ . \qquad (3)$$

Equations (2) and (3) comprise variables which vary at the bank-level as well as variables which vary at the country level. Therefore, we cannot rely on a standard OLS estimator since it does not distinguish between the within-subject and between-subject variances in the data. In our application, fitting an OLS regression would be misleading since the assumption of residuals that are independently and identically distributed would be violated. Instead, we use a mixed effects approach, which takes these differences in variances into account. To understand why this is the case, consider the variance-components model, a very simple and

special case of linear mixed-effects models.[1] For ease of notation, we suppress the time index. Suppose we want to measure

$$y_{ij} = \beta + \varsigma_j + \varepsilon_{ij}, \tag{4}$$

where y_{ij} is our measure of bank risk for bank *i* in country *j*. β constitutes the overall mean of our variable of interest, while ς_j is the difference between the overall mean and country *j*'s mean measurement. ε_{ij} is the measurement error for bank *i* in country *j*. ς_j has zero mean across countries, while ε_{ij} has zero mean across banks *and* countries. We will now consider ς_j to be random intercepts, which are independently normally distributed, $\varsigma_j \sim N(0, \varphi)$. They are independent of the ε_{ij}, which are also independent normal: $\varepsilon_{ij} \sim N(0, \theta)$. Let us now define

$$\xi_{ij} \equiv \varsigma_j + \varepsilon_{ij}, \tag{5}$$

which consists of the two error components defined above. Since these are independent, the total variance can be written as the sum of the variance components:

$$Var(y_{ij}) = Var(\beta + \varsigma_j + \varepsilon_{ij}) = Var(\varsigma_j + \varepsilon_{ij}) = \varphi + \theta. \tag{6}$$

These different variance components are the reason why we cannot use standard OLS, but refer to the class of linear mixed models.

In general, linear mixed effects models can be written as

$$\mathbf{y}_j = \mathbf{X}_j\boldsymbol{\beta} + \mathbf{Z}_j\mathbf{b}_j + \boldsymbol{\varepsilon}_j, \tag{7}$$

where $\mathbf{y}_j$ is a vector of responses, $\mathbf{X}_j$ is the fixed-effects design matrix, $\boldsymbol{\beta}$ are the fixed effects, $\mathbf{Z}_j$ is the random-effects design matrix, $\mathbf{b}_j$ are the random effects, and $\boldsymbol{\varepsilon}_j$ is a vector of errors such that

$$\begin{bmatrix} \mathbf{b}_j \\ \boldsymbol{\varepsilon}_j \end{bmatrix} \sim N\left(\mathbf{0}, \begin{bmatrix} \mathbf{G} & \mathbf{0} \\ \mathbf{0} & \sigma^2_{\varepsilon_j}\mathbf{I}_n \end{bmatrix}\right),$$

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[1] See Demidenko (2004) or Rabe-Hesketh/Skrondal (2005) for an overview of mixed models.

where the elements of **G** are the variance components. The model is estimated by maximum likelihood.

3 Estimation Results

Our analysis proceeds in four steps. First, we run the baseline regression. We then check for the robustness of our results by changing our measures of macroeconomic volatility. In a next step, we study the impact of internationalization on bank risk. Finally, we augment our baseline regression by variables that proxy bank regulation. All regressions are run for two country samples – OECD countries and non-OECD countries. These sample splits allow analyzing whether differences in macroeconomic volatilities across these sets of countries as well as in the structure of the banking systems have an impact on our results.

The results of the baseline specification can be found in Table 5. It includes the size of the bank, as measured by the log of total assets, the return on equity (ROE), a bank's asset growth, and the exchange rate volatility. The first thing to notice is that the coefficients of the variables from the baseline specification are fairly stable. The size of the bank enters with a significantly negative sign for the OECD group. This partly confirms our expectations that larger banks should be better able to cushion against deteriorations in credit market conditions and thus exhibit lower volatility (see, e.g. Nier and Baumann 2003, or Baele and Vander Vennet 2005). The result is very much in line with De Nicolò (2001), who finds the effects of size to differ across countries, and he even finds evidence for a positive link for some countries.

We expect a positive coefficient for the return on equity (ROE) if banks face a risk-return trade-off. However, the coefficient is negative and statistically significant for both country groups. We also estimate the equation with return on assets (ROA) without any change in results.

We also expect a positive coefficient on asset growth. Banks that grow faster are likely to increase their exposure to more risky ventures. Hence, we expect a positive correlation between volatility and growth. However, we find a negative coefficient for OECD countries that is significantly different from zero, indicating that faster-growing banks in OECD countries have lower profit volatility. To explain this result, we note that the descriptive statistics show that asset growth was, on average, very low during the time period considered and even slightly negative for the OECD sample. This might partly be the result of the bursting stock market bubble at the end of the 1990s. We re-run the baseline regression, eliminating banks with negative asset growth. This reduces the sample size by about one third. The respective coefficient remains negative, but it becomes insignificant.

Exchange rate volatility is used as one proxy for macroeconomic risk. Since our dependent variable is calculated using profits denominated in USD, volatility might result from the fact that the national currency fluctuates with respect to the USD.[2] Therefore, we include a measure of exchange rate volatility to account for this problem. We expect a positive sign on the respective coefficient. This is indeed the case for the OECD group.

3.1 Macroeconomic Volatility

The analysis so far has shown that the volatility of banks' profits and thus risikiness of banks depends on bank-specific variables and, to some extent, on exchange rate volatility. Next, we take a closer look at the question to what extent banks are exposed to different types of macroeconomic risks. Essentially, we use our baseline regression results that were presented in Table 5 and successively replace the proxy for macroeconomic volatility from the baseline specification (exchange rate volatility) by other proxies for macroeconomic volatility. As for exchange rate volatility, the expected sign for these other proxies is always positive. We do

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2 A preferable approach to account for exchange rate volatility would be to compute the effect of exchange rate changes on banks' profits directly. However, since we lack data on the original currency of denomination of banks' income statements, we resort to this more indirect strategy of including exchange rate volatility as a regressor.

not include different proxies for macroeconomic volatility simultaneously to avoid problems of multicollinearity. Results are presented in Table 6.

We first replace exchange rate volatility by the volatility of GDP growth as a general proxy for macroeconomic risk. If GDP growth fluctuates significantly, this should transmit into higher fluctuations of banks' profit volatility. Therefore, we expect a positive sign. We then replace exchange rate volatility by deposit rate volatility and inflation volatility. Both variables can be seen as proxies of the instability of monetary conditions and for uncertainty about price developments and macroeconomic risk in general.

The first thing to notice from Table 6 is that adding other proxies for macroeconomic volatilities hardly affects the significance of the other variables. However, only the coefficient on the volatility of GDP growth is positive and significantly different from zero. The coefficient is much larger for non-OECD countries, implying that banks in these countries are affected more by fluctuations in GDP growth than their OECD counterparts.

3.2 Openness

The previous analysis has shown that banks are exposed to volatility of output and exchange rates. One way of laying off risks could be international diversification. In this section, we thus explore the link between openness and profit volatility of banks. Results are presented in Table 7.

Since we lack bank-specific measures of openness, we measure the degree of openness of the banking system as a whole through gross foreign assets, calculated as the sum of claims and liabilities vis-à-vis non-residents. The expected sign on this variable is not clear a priori. On the one hand, banking systems that are more integrated into international capital flows should have lower risks through asset diversification. On the other hand, greater financial integration also increases the exposure to international shocks. Since we lack information on gross foreign assets for non-OECD countries, results are reported only for the OECD sample.

For gross foreign assets, we find a negative coefficient for OECD countries, indicating that an increased openness of the banking system decreases profit volatility of banks. However, the respective coefficient is not significantly different from zero at the 5% level.

Another measure of openness comes from the KOF index of globalization (Dreher 2006). Recall that a higher index denotes a higher degree of economic integration. By the same reasoning as above, the expected sign is not clear a priori. The estimated coefficient is negative and statistically different from zero for the OECD sample, indicating that economic globalization helps to reduce bank risk.

The last measure of openness refers to political globalization. This measure is also taken from Dreher (2006). We would expect a negative coefficient on the respective coefficient for less developed countries, since political globalization and stability is crucial to bank stability. For OECD countries, we find that political globalization does lower bank risk. However, for non-OECD countries, the coefficient on political globalization is quite large and positive. This result indicates that banks in less developed countries do not benefit from stable political conditions.

3.3 Banking Regulation

Banks' incentives to lay off macroeconomic risks through international diversification are also affected by the regulatory system. In a next step, we include two variables proxying for the structure of the deposit insurance system and thus for the regulatory incentives to take on risks. These measures are taken from Barth et al. (2001). One is a 0/1 dummy, indicating whether deposit insurance premia are risk-adjusted. The other one is a 0/1 dummy, indicating whether the deposit insurance system requires co-insurance. Since both variables take a higher value if the deposit insurance system is geared more towards a reduction in risk, we expect a negative sign.

We show the results in Table 8. Neither of the bank regulation variables is statistically significant, indicating that banking regulation does not greatly influence bank risk.

4 Robustness Tests

To check the robustness of our results, we include different variables at the bank level as well as at the country level into our baseline specification. Results are presented in Table 9. We find our results from the baseline specification to be quite robust.

We first add the log of loan loss provisions. We expect a negative sign on this variable since, in the case of a credit default, loan loss provisions should exert a stabilizing role on profit volatility. However, the variable is not significant.

Next, we add a bank's market share in the deposit market as measured by the deposits of a certain bank divided by the sum of the deposits of all banks. We expect a negative relationship since banks with a large market share would probably be more stable. However, we find that a bank's market share does not influence the bank's profit volatility.

We then add a variable that proxies the size of the banking system, calculated as the ratio of assets of deposit money banks over GDP. The variable is taken from Beck et al. (2005). We expect a negative impact on bank volatility since larger financial markets should provide more opportunities to diversify risk. The coefficient is indeed negative and highly significant for the OECD group, but insignificant for the non-OECD group.

We also include the ratio of stock market capitalization to GDP as a proxy for the size of the stock market. This variable is taken from Beck et al. (2005). Paralleling our reasoning for the size of the banking system, we would expect a negative sign. Indeed, the variable, as was the case for the size of the banking system, enters with a negative coefficient for both country groups, although it is only significantly different from zero for OECD countries.

We also add the share of problems loans, expecting it to enter with a positive sign. The coefficient is indeed rather large and positive, and it enters significantly for the OECD sample.

5 Summary

The aim of this paper has been to analyze the factors that affect the risk of banks and, in particular, the exposure of banks to macroeconomic volatility. Using a large bank-level dataset for the second half of the 1990s, we have studied the impact of bank-specific and country-specific factors on the riskiness of banks. We have analyzed the exposure of banks to macroeconomic risks as well as the impact of international openness and of banking regulation on bank risk taking. Bank risk has been measured through the volatility of banks' pre-tax profits.

Our study has four main findings. First, we find that larger banks have less volatility of profits than smaller banks. This finding is in line with studies of the volatility of non-financial firms, which typically find a negative correlation between size and (output) volatility. Furthermore, this result confirms earlier studies using stock market based measures of bank risk. However, we find no significant link between asset growth and volatility for banks.

Second, banks are exposed to different kinds of macroeconomic risks. We find a large and positive effect of the volatility of GDP growth. This effect is especially pronounced for non-OECD countries. Higher volatility of exchange rates also increases the volatility of banks' profits, while higher volatility of interest rates and inflation do not have a significant impact on banks' risks.

Third, we find a significant impact of the international openness of banking systems on banks' profit volatility. Larger gross foreign assets of the banking system as a whole decrease

bank-specific profit volatility in OECD countries. For both OECD and non-OECD countries, we find that economic globalization lowers banks' risk.

Finally, banking regulation does not seem to affect the volatility of banks' profits, contrasting the view that banks in countries with a sound banking regulation are less prone to crises. However, this result is in line with earlier literature finding it hard to establish a clear effect of banking regulation on the riskiness of banks.

Our findings suggest that economic policy has an impact on bank risk. A reduction in the volatility of GDP growth reduces bank risk in both OECD and non-OECD countries. In this sense, the so-called Great Moderation, i.e. the reduction in output volatility that could be observed across many developed market economies in the past decade, has contributed to lower bank risks. The Great Moderation, in turn, has been the result of smaller macroeconomic shocks and improved economic policy, notably monetary policy (Stock and Watson 2002). At the same time, output volatility in developing countries typically exceeds that of developed market economies, partly because of differences in economic policy. Improving fiscal policy, reforming the financial sector, and structural reforms aimed at lowering exposure to terms-of-trade shocks are among the policies towards greater macroeconomic stability (see, e.g., IMF 2005). Our results also suggest that some policy measures take effect in reducing bank risk only once a certain threshold level of economic development has been passed. Greater economic and political openness as well as lower exchange rate volatility, for instance, contribute to a reduction in bank risk only in our sample of OECD countries.

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Table 1: Overview of Previous Literature

Author(s)	Country sample and time period	Sample size	Method	Findings
Amihud et al. (2001)	33 countries, 1985-1998	214 bank mergers	event study methodology	Cross-border bank-mergers do not lead to lower risk relative to banks in the acquirer's home market.
Baele / Vander Vennet (2005)	Europe, January 1990 – May 2004	316 listed banks	regime-switching model	Conditional volatility and sensitivity to shocks of bank stock returns are higher during business cycle troughs. There is a strong link between bank performance and capital adequacy.
Buch / DeLong (2006)	68 countries, 1998 - 2002	81 cross-border bank mergers	event study	Strong bank supervision seems to lower total risk in the respective country.
De Nicolò (2001)	21 industrialized countries, 1988 - 1998	826 banks	cross-sectional regressions; pooled regressions	Insolvency risk increases in bank size, while charter value decreases in bank size.
Demsetz et al. (1996)	United States, 1986 - 1994	100 bank holding companies	fixed and random effects models	High franchise values cause banks to hold more capital and take on less risk. There is a negative relationship between the franchise value and both the systematic and idiosyncratic risk.
Gonzáles (2005)	37 countries, 1995 - 1999	324 banks	two-stage least squares; random effects model	Higher regulatory restrictions lead to increased bank risk through the lowering of banks' charter values.
Gropp / Vesala (2004)	15 EU countries, 1992-1998	128 banks, balanced panel of 896 observations	fixed effects model	Deposit insurance can reduce moral hazard. A safety net that is limited can cause smaller banks with low charter value to take on less risk.
Hyytinen (2002)	Finland, Norway, Sweden, 1983/87 - 1997	104 observations	smooth transition regression, nonparametric kernel method, breakpoint analysis	Bank return volatility during the crises period was mostly systematic. It was not until the peak of the crises that the path of certain risk parameters reflected the developments that took place within the banking industry.
Keeley (1990)	United States, 1970 - 1986	150 largest bank holding companies	simultaneous equations	Increased competition due to market liberalization caused values of bank charters to decline, thus providing an incentive for excessive risk taking.
Méon / Weill (2005)	15 EU countries, 1960-1995	52 banking groups	scoring model	There are potential gains in risk diversification from cross-border mergers in the EU.
Nier / Baumann (2003)	32 countries, 1993 - 2000	729 banks	instrumental variable FGLS	A government safety net in the banking sector creates moral hazard. Market discipline can help to mitigate bank risk.

Table 2: Number of Banks by Country

	Number of banks	% of total		Number of banks	% of total
			Malaysia	27	1.16
Argentina	46	1.97	Malta	7	0.3
Australia	23	0.99	Mexico	30	1.29
Austria	33	1.42	Morocco	8	0.34
Bahamas	15	0.64	Netherlands	34	1.46
Barbados	3	0.13	New Zealand	8	0.34
Belgium	29	1.24	Nicaragua	8	0.34
Botswana	4	0.17	Norway	12	0.51
Brazil	87	3.73	Panama	34	1.46
Bulgaria	17	0.73	Paraguay	19	0.81
Canada	37	1.59	Philippines	20	0.86
Chile	21	0.9	Poland	26	1.11
Cote D'ivoire	7	0.3	Portugal	17	0.73
Czech Republic	14	0.6	Romania	15	0.64
Denmark	55	2.36	Singapore	11	0.47
Dominican Rep.	11	0.47	Slovak Rep	8	0.34
El Salvador	6	0.26	Slovenia	15	0.64
Fiji	1	0.04	South Africa	17	0.73
France	171	7.33	South Korea	15	0.64
Germany	170	7.29	Spain	68	2.92
Greece	8	0.34	Sweden	6	0.26
Hong Kong	37	1.59	Switzerland	141	6.05
Hungary	20	0.86	Tanzania	10	0.43
Indonesia	26	1.11	Thailand	8	0.34
Ireland-Rep	22	0.94	Turkey	1	0.04
Italy	94	4.03	Uganda	7	0.3
Japan	109	4.67	United Kingdom	115	4.93
Kenya	27	1.16	United States	381	16.34
Lebanon	52	2.23	Uruguay	11	0.47
Luxembourg	92	3.95	Venezuela	12	0.51
Malawi	4	0.17	**Total**	**2,332**	**100**

Table 3: Data Definitions and Sources

Variable	Definition and Data Source
Bank-specific variables	
Size of banks	Log of total assets, Bankscope
Asset growth	Asset growth of total bank assets, Bankscope
Return on equity (ROE)	Return on equity, Bankscope
Loan loss provisions	Loan loss provisions of individual banks, Bankscope
Market share deposits	Bank's market share of deposits calculated as deposits by a certain bank divided by the sum of the deposits of all banks, Bankscope
Share of problem loans	Problem loans over total loans, Bankscope
Regulations	
Risk-adjusted premia	0/1 dummy indicating whether deposit insurance premia are risk adjusted, Barth et al. (2001)
Coinsurance	0/1 dummy indicating whether the deposit insurance system requires coinsurance, Barth et al. (2001)
Country-specific variables	
Exchange rate volatility	Volatility of the real exchange rate, World Development Indicators (WDI)
Inflation volatility	Volatility of CPI inflation, World Development Indicators (WDI)
Deposit rate volatility	Volatility of deposit rate, deposit rate, World Development Indicators (WDI)
Volatility of GDP growth	GDP growth, World Bank, World Development Indicators (WDI)
Size of the banking systems	Ratio of assets of deposit money banks over GDP, Beck et al. (2005)
Size of the stock market	Ratio of stock market capitalization over GDP, Beck et al. (2005)
International openness	
Gross foreign assets	Sum of claims and liabilities vis-à-vis non-residents in % of balance sheet total, OECD Bank Profitability – Financial Statements of Banks
Economic globalization	Cross-border flows of goods, capital and services and information and perceptions that accompany market exchanges, Dreher (2006)
Political globalization	Diffusion of government policies, Dreher (2006), , including absolute number of embassies in a country, the number of international inter-governmental organizations, and the absolute number of U.N. Security Council Missions participated in

Table 4: Descriptive Statistics

Variable	Number of observations		Mean		Standard deviation		Minimum		Maximum	
	OECD	Non-OECD	OECD	Non-OECD	OECD	Non-OECD	OECD	Non-OECD	OECD	Non-OECD
Log assets	13,390	4,375	14.17	12.89	2.05	1.89	6.79	6.86	20.70	19.29
Asset growth	11,513	3,734	-0.04	2.37	4.50	20.55	-83.38	-142.53	171.26	200.00
Return on equity	13,003	4,233	9.68	10.64	19.07	29.65	-200.00	-200.00	200.00	191.45
Log loan loss provisions	9,808	3,511	8.72	8.10	2.30	2.19	1.34	0.88	16.76	15.41
Market share deposits	13,280	4,314	0.02	0.06	0.06	0.11	0.00	0.00	1.00	1.00
Share of problem loans	5,805	1,689	0.04	0.18	0.15	0.79	0.00	0.00	7.75	29.05
Gross foreign assets	6,261	0	60.58		39.38		11.80		159.73	
Size of the banking system	12,592	3,814	1.01	0.58	0.39	0.42	0.17	0.04	1.78	1.90
Size of the stock market	13,352	3,765	1.00	0.63	0.64	0.82	0.03	0.00	3.11	3.75
Economic globalization	13,390	3,898	4.73	3.72	1.11	1.10	3.30	1.00	9.26	6.90
Political globalization	13,390	3,898	4.10	2.07	1.29	1.11	0.41	0.11	5.72	4.20
Risk-adjusted premia	13,158	2,288	0.32	0.20	0.47	0.40	0.00	0.00	1.00	1.00
Coinsurance	13,158	2,288	0.29	0.10	0.45	0.30	0.00	0.00	1.00	1.00
Exchange rate volatility	4,005	1,170	1.13	8.81	2.94	19.63	0.12	0.13	28.05	91.34
Deposit rate volatility	2,377	1,138	1.57	5.74	2.56	9.86	0.14	0.13	16.10	40.73
Volatility of GDP growth	5,882	1,811	1.21	3.26	0.87	2.11	0.20	0.44	7.03	8.80
Inflation volatility	4,005	1,048	2.49	4.34	5.82	19.15	0.10	0.07	21.36	147.75

Table 5: Baseline Regressions

Results presented in this table are based on a maximum likelihood estimation using a linear mixed effects model with a full set of time dummies. In each regression, the dependent variable is the volatility of banks' profits as measured by the standard deviation of banks' profit growth with a moving time window over five years for the sample period 1995-2002. We split the sample into OECD countries and non-OECD countries. We report the number of observations in each regression and the number of country groups. The Wald chi-squared statistic gives the overall significance of the specification being tested. Standard errors are given in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

	OECD: volatility of bank profit growth	Non-OECD: volatility of bank profit growth
Log assets	-0.11*	0.05
	[0.06]	[0.25]
Return on equity	-0.03***	-0.04**
	[0.01]	[0.02]
Asset growth	-0.17**	0.02
	[0.08]	[0.33]
Exchange rate volatility	0.21***	-0.02
	[0.07]	[0.04]
Number of observations	3780	1068
Number of groups	27	32
Wald chi-squared	42.94	5.38
p-value	0.00	0.50

Table 6: Regressions Including Volatilities of Macroeconomic Aggregates

Results presented in this table are based on a maximum likelihood estimation using a linear mixed effects model with a full set of time dummies. In each regression the dependent variable is the volatility of banks' profits as measured by the standard deviation of banks' profit growth with a moving time window over five years for the sample period 1995-2002. We successively add proxies for macroeconomic volatility. We split the sample into OECD countries and non-OECD countries. We report the number of observations in each regression and the number of country groups. The Wald chi-squared statistic gives the overall significance of the specification being tested. Standard errors are given in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

	Volatility of bank profit growth					
	OECD	Non-OECD	OECD	Non-OECD	OECD	Non-OECD
Log assets	-0.10*	-0.13	-0.11	0.09	-0.11*	0.19
	[0.06]	[0.25]	[0.09]	[0.26]	[0.06]	[0.26]
Return on equity	-0.03***	-0.03*	-0.03***	-0.04**	-0.03***	-0.03**
	[0.01]	[0.02]	[0.01]	[0.02]	[0.01]	[0.02]
Asset growth	-0.15*	0.21	-0.20*	0	-0.14*	0.09
	[0.08]	[0.32]	[0.11]	[0.34]	[0.08]	[0.35]
Volatility of GDP growth	0.67***	1.08***				
	[0.25]	[0.32]				
Deposit rate volatility			0.16	-0.08		
			[0.11]	[0.08]		
Inflation volatility					-0.08	0
					[0.12]	[0.03]
Number of observations	3780	1068	2194	1041	3780	984
Number of groups	27	32	22	30	27	31
Wald chi-squared	51.26	17.21	21.51	6.34	33.85	5.06
p-value	0.00	0.01	0.00	0.39	0.00	0.54

Table 7: Regressions Including Measures of Openness

In this table, we report results from the basic specification augmented by the proxies for the openness of the banking system as well as the economy as a whole. Results presented in this table are based on a maximum likelihood estimation using a linear mixed effects model with a full set of time dummies. In each regression, the dependent variable is the volatility of banks' profits as measured by the standard deviation of banks' profit growth with a moving time window over five years for the sample period 1995-2002. We successively add proxies for the openness of the banking system. We split the sample into OECD countries and non-OECD countries. We cannot estimate the influence of gross foreign assets on the volatility of banks in non-OECD countries due to the lack of data. We report the number of observations in each regression and the number of country groups. The Wald chi-squared statistic gives the overall significance of the specification being tested. Standard errors are given in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

	Volatility of bank profit growth				
	OECD	OECD	Non-OECD	OECD	Non-OECD
Log assets	-0.07	-0.11*	0.23	-0.11*	0.19
	[0.09]	[0.06]	[0.26]	[0.06]	[0.26]
Return on equity	-0.03***	-0.03***	-0.03**	-0.03***	-0.03*
	[0.01]	[0.01]	[0.02]	[0.01]	[0.02]
Asset growth	-0.07	-0.17**	0.07	-0.18**	0.2
	[0.12]	[0.08]	[0.35]	[0.08]	[0.35]
Exchange rate volatility	-0.11	0.21***	-0.01	0.20***	-0.03
	[0.13]	[0.07]	[0.04]	[0.07]	[0.04]
Gross foreign assets	-0.01				
	[0.01]				
Economic globalization		-0.69*	-0.59		
		[0.37]	[0.74]		
Political globalization				-0.53*	1.60**
				[0.31]	[0.68]
Number of observations	1229	3780	982	3780	982
Number of groups	16	27	30	27	30
Wald chi-squared	17.75	48.11	5.94	47.93	11.15
p-value	0.01	0.00	0.55	0.00	0.13

Table 8: Regressions Including Banking Regulation

Results presented in this table are based on a maximum likelihood estimation using a linear mixed effects model with a full set of time dummies. In each regression the dependent variable is the volatility of banks' profit growth as measured by the standard deviation of banks' profits with a moving time window over five years for the sample period 1995-2002. We successively add dummies that proxy the regulation of banks. We split the sample into OECD countries and non-OECD countries. We report the number of observations in each regression and the number of country groups. The Wald chi-squared statistic gives the overall significance of the specification being tested. Standard errors are given in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

	Volatility of bank profit growth			
	OECD	Non-OECD	OECD	Non-OECD
Log assets	-0.10*	0.47	-0.10*	0.48*
	[0.06]	[0.29]	[0.06]	[0.29]
Return on equity	-0.03***	-0.06***	-0.03***	-0.07***
	[0.01]	[0.02]	[0.01]	[0.02]
Asset growth	-0.18*	-0.18	-0.18*	-0.50
	[0.09]	[0.58]	[0.09]	[0.52]
Exchange rate volatility	0.20***	-0.09	0.20***	-0.07
	[0.07]	[0.11]	[0.07]	[0.11]
Risk-adjusted premia	-0.96	3.00		
	[1.19]	[2.11]		
Coinsurance			-1.11	-1.38
			[0.99]	[1.92]
Number of observations	3713	545	3713	545
Number of groups	25	12	25	12
Wald chi-squared	42.05	19.01	42.99	17.28
p-value	0.00	0.01	0.00	0.02

Table 9: Robustness Tests

Results presented in this table are based on a maximum likelihood estimation using a linear mixed effects model with a full set of time dummies. In each regression the dependent variable is the volatility of banks' profits as measured by the standard deviation of banks' profit growth with a moving time window over five years for the sample period 1995-2002. We split the sample into OECD countries and non-OECD countries. In some equations individual explanatory variables are dropped since they are highly collinear with variables from the Baseline specification. We report the number of observations in each regression and the number of country groups. The Wald chi-squared statistic gives the overall significance of the specification being tested. Standard errors are given in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

	Volatility of bank profit growth									
	OECD	Non-OECD	OECD	Non-OECD	OECD	Non-OECD	OECD	Non-OECD	OECD	Non-OECD
Log assets			-0.15**	0.12	-0.10*	0.26	-0.11*	0.02	-0.02	0.28
			[0.06]	[0.29]	[0.05]	[0.28]	[0.06]	[0.28]	[0.06]	[0.36]
Return on equity	-0.04***	-0.05***	-0.03***	-0.04**	-0.03***	-0.04**	-0.03***	-0.03*	-0.04***	-0.04*
	[0.01]	[0.02]	[0.01]	[0.02]	[0.01]	[0.02]	[0.01]	[0.02]	[0.01]	[0.02]
Asset growth	-0.18**	0.15	-0.18**	0.01	-0.19**	0.09	-0.18**	0.06	-0.20***	0.15
	[0.08]	[0.34]	[0.08]	[0.34]	[0.08]	[0.36]	[0.08]	[0.38]	[0.08]	[0.54]
Exchange rate volatility	0.27***	-0.01	0.21***	-0.02	0.23***	-0.01	0.24***	-0.02	0.51***	-0.15
	[0.06]	[0.04]	[0.07]	[0.04]	[0.06]	[0.04]	[0.07]	[0.04]	[0.08]	[0.15]
Loan loss provisions	-0.01	0.2								
	[0.05]	[0.24]								
Market share deposits			3.07	-3.1						
			[2.43]	[4.75]						
Size of the banking system					-2.78***	-2.17				
					[0.91]	[2.01]				
Size of the stock market							-1.12**	-0.63		
							[0.54]	[1.00]		
Share of problem loans									2.14**	0.51
									[0.84]	[1.77]
Number of observations	2819	900	3744	1050	3780	950	3780	945	1820	644
Number of groups	26	32	27	32	27	29	27	26	21	22
Wald chi-squared	73.37	9.73	44.47	6.09	56.78	6.09	51.26	4.39	95.91	5.70
p-value	0.00	0.14	0.00	0.53	0.00	0.53	0.00	0.73	0.00	0.58

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