Systemic Risk and Bank Consolidation: International Evidence*

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Abstract This paper analyzes the systemic risk effects of bank mergers in order to test the "concentration-fragility" against the "concentration-stability" hypothesis. As a unique feature of this study, we propose to measure the systemic risk of a financial institution by its Systemic Crash Probability (SCP), i.e. the lower tail dependence between the bidding bank's stock return and a relevant bank index. We then use the banks' SCP and their Marginal Expected Shortfalls (MES) in order to capture any (positive or negative) merger-related changes in systemic risk. In our empirical analysis on a dataset of 440 international domestic and cross-border mergers that took place between 1991 and 2009 we find clear empirical evidence for a significant increase in both the idiosyncratic default and the systemic risk of acquirers following bank mergers thus confirming the "concentration-fragility" hypothesis. Controlling for possible reverse causality, we show that idiosyncratic default risk is only one of several factors driving the increases in systemic risk caused by bank mergers. Finally, we show that a higher bidder profitability, cross-border diversification and mergers in less concentrated financial sectors shield bidders from increases in systemic risk.

Keywords: M&A, Banks, Consolidation, Systemic Risk, Systemic Crash Probability, Marginal Expected Shortfall, Distance to Default.

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1 Introduction

The on-going consolidation in banking has been a distinctive feature of the financial industry over the past decades leading to the creation of several large national and international financial institutions (see e.g. Boyd and Graham, 1991 and 1996; Berger et al., 1995; Berger et al., 1999; ECB, 2000; OECD, 2000; Group of Ten, 2001). Apart from studying wealth effects, recent empirical research has also addressed the possible positive and negative impacts of mergers on the acquiring banks' risk: On the one hand, bank mergers can decrease an individual bank's risk as consolidation can lead to an increase in the diversification of the company's assets and loan portfolio. Similarly, banks could be inclined to merge in order to become too big to fail thus reducing their individual default risk (see Segal, 1974; Vander Vennet, 1996; Craig and Cabral dos Santos, 1997; Berger, 2000). As a result, the acquiring banks' individual risk should decrease as a result of a merger. On the other hand, bank mergers could be motivated by regulatory incentives thus inducing an increase in the idiosyncratic risk of the bidding bank (see Vallascas and Hagendorff, 2011). Consequently, both theoretical and empirical results on the expected *idiosyncratic* risk effects of bank mergers are ambiguous (see e.g. Mishra et al., 2005; Amihud et al., 2002; Vallascas and Hagendorff, 2011).

At the same time, however, consolidation could have both positive and negative effects on financial stability and *systemic risk* as well. As consolidated banks usually become more similar, the whole financial system could become more vulnerable to idiosyncratic or macroeconomic shocks (see De Nicolò and Kwast, 2002). Furthermore, a bidding bank's aspiration to become too big to fail could also result in an increase in systemic risk (see Mishkin, 1999). In contrast, larger and more diversified banks may enhance their risk-return profiles and their profits thus reducing systemic risk because of higher capital buffers (see Freixas and Rochet, 1997). In summary, a bank merger might increase (or decrease) a bank's idiosyncratic risk while at the same time having uncertain side-effects on the stability of the financial system.

To the best of our knowledge, this paper is the first to analyze the systemic risk effects of bank mergers and its determinants. While previous studies have investigated the influence of bank consolidation on the bidder's systematic risk (beta factor) or default risk, we are the first to measure the impact of bank mergers on two conceptually similar measures of systemic risk: First, we propose a novel measure of systemic risk called Systemic Crash Probability capturing the lower tail dependence of an individual bank with respect to a bank sector index (in other words a bank's and the sector's joint probability to crash together). Second, we employ the Marginal Expected Shortfall by Acharya et al. (2010) and find comparable results for the two measures of systemic risk. We regress the changes in systemic risk as well as measures of systematic and default risk on a set of idiosyncratic and macroeconomics control variables making this the first comparative study of the different determinants of the idiosyncratic and systemic risk effects of bank consolidation. Next, we argue that the idiosyncratic default risk as measured by a bank's distance to default is only one of several drivers of systemic risk changes around bank mergers and employ the change in default risk as an explanatory variable in our cross-sectional regressions. Finally, we address concerns of possible reverse causality between systemic and default risk by using instrument variable regressions.

In summary, we specifically seek answers to the following main questions:

1. Does consolidation in the banking sector increase or decrease the systemic risk of acquirers?

2. What factors drive the merger-induced changes in systemic risk?

3. Are the changes in systemic risk driven by the same determinants as idiosyncratic default and systematic risk and if not, how are they interrelated?

4. Does the idiosyncratic default risk of a bidder equal its systemic risk or is systemic risk (at least partly) determined by the bidder's default risk?

We undertake a number of analyses on different types of merger-related risk effects to answer each of the questions. First, we proxy the systematic risk of the bidding bank by the use of its beta factor as proposed by Amihud et al. (2002). Second, we follow Vallascas and Hagendorff (2011) by using Merton's distance to default for measuring the changes in the idiosyncratic default risk induced by the merger. Third, we propose the novel measure of Systemic Crash Probabilities (SCP), i.e. the lower tail dependence coefficient between an individual bank's stock return and a market index, in order to capture any (positive or negative) merger-related changes in systemic risk. Intuitively, the SCP of a bank simply reflects the propensity of the bank's stocks to crash together with the market. Fourth, to complement our analysis of systemic risk, we compute the bidding bank's Marginal Expected Shortfall (MES, see Acharya et al., 2010) and compare the results to the corresponding results on the merger-induced changes in the banks' SCP.

In order to answer the question, whether mergers generally have positive or negative effects on either idiosyncratic or systemic risk (or both), we apply the mentioned methodologies on a dataset of 440 international domestic and cross-border mergers that took place between 1991 and 2009.

The results of our empirical analysis show that, in contrast to the branches of literature on default and systematic risk, we find clear empirical evidence for a significant increase in both the default and systemic risk of acquirers following bank mergers thus confirming the "concentration-fragility" hypothesis. Controlling for reverse causality stemming from possible endogeneity, we show that the idiosyncratic default risk of a bidder is one of several determinants of the merger-related increases in systemic risk. Moreover, we show that a higher bidder profitability, cross-border diversification and mergers in less concentrated financial sectors shield bidders from increases in systemic risk. Finally, our cross-sectional results emphasize the finding that the changes in bidders' systematic, default and systemic risk are driven by different sets of explanatory variables. In summary, these results show that results from previous studies on the determinants of a bidding bank's default or systematic

risk cannot be generalized to the case of systemic risk.

The remainder of this article is structured as follows. Section 2 presents related theoretical and empirical literature on the wealth and risk effects of bank mergers and the consequences for financial stability. Section 3 discusses the methodology employed in the empirical study. Section 4 presents the data as well as the results of the empirical study. Concluding remarks are given in Section 5.

2 Related Literature

Theoretical as well as empirical literature on the effects of bank mergers on idiosyncratic and systemic risk are inconclusive.

On the one hand, several authors have argued that consolidation in banking leads to decreases in idiosyncratic bank risk and could improve the overall stability of the financial system. As mentioned above, the theoretical reasons for this risk reduction are usually based on the notion that bank mergers are accompanied by loan-portfolio risk and geographical diversification (see Boyd and Prescott, 1986). This argument is confirmed e.g. by Mishra et al. (2005) who find a merger-related reduction in both idiosyncratic and systemic risk for a small sample of US bank mergers. Furthermore, Emmons et al. (2004) find a decrease in the default probabilities of US banks as a result of a more diversified portfolio after a merger. Also, as consolidated banking systems might facilitate collusion, the remaining (monopolistic) banks could increase profits and thus reduce their vulnerability to external shocks (see Boyd et al., 2004; Uhde and Heimeshoff, 2009). In the work by Boot and Thakor (2000), the authors argue that larger banks tend to limit their credit extension by providing credit to borrowers of higher quality which in turn increases their profitability and decreases insolvency risk. Moreover, bank mergers might be motivated by the banks' wish to decrease costs for monitoring competitors (see Allen and Gale, 2000). In addition to this, Benston et al. (1995) argue that mergers in the 1980's were motivated by risk reduction after

analyzing the banks' correlations. In a simulation, Hughes et al. (1999) find that interstate expansion of U.S. banks should lead to reductions in the banks' default risk. Other studies like e.g. Amihud et al. (2002) and Craig and Santos (1997), however, find empirical results contradicting a risk-reducing effect of bank mergers. Most recently, Vallascas and Hagendorff (2011) find no indication for a reduction of the individual default risk at European acquiring banks. As a result, bank mergers do not nessesarily have to reduce the acquiring banks' individual risk. At the same time, as noted by e.g. Acharya et al. (2010), changes in the default risk of isolated financial institutions can but do not necessarily have to coincide with changes in systemic risk. It is this conjecture that we test later on in our empirical study by including the merger-related changes in bidders' default risk as an exogeneous variable in our regression of systemic risk while controlling for reverse causality.

On the other hand, the question whether these risk reductions at individual banks also cause an increase (or decrease) in systemic risk, has not been answered equivocally in literature. First, a bank's motive to merge in order to become too big to fail should clearly increase systemic risk as the bank's individual risk is socialized in case of the bank's default. Even more important, public safety net guarantees could also lead to a moral hazard problem tempting bank managers to invest too riskily. Moreover, the decrease in the costs for monitoring competitors could be exceeded by the increase in monitoring problems concerning the customer base and operating cost structure of the target thus increasing individual default and systemic risk (this problem is even more severe for cross-border mergers, see Winton, 1999). A similar argument is brought forward by Caminal and Matutes (2002) who show that monopolistic banks are more likely to originate risky loans which can destabilize the whole financial system. Similarly, the collusion of banks in the aftermath of bank mergers could further destabilize the financial system as joint defaults of customers become more likely (see Boyd and De Nicoló, 2006). Further results by De Nicoló (2004) underline the "concentration-fragility" hypothesis by presenting empirical evidence for a positive relationship between concentration and banking system fragility using the Z-score methodology.

Results by Carbo-Valverde et al. (forthcoming) even suggest that European bank mergers between 1993 and 2004 were primarily driven by the bidders' wish to shift risk onto EU safety nets. Finally, Boyd and Graham (1991, 1996) also find weak evidence for a negative influence of concentration on financial stability by testing whether large banks fail more frequently than smaller ones.

In contrast to the "concentration-fragility" hypothesis, advocates of the "concentration-stability" view argue that consolidation in banking coincides with a decrease in the individual acquiring banks' risk and consequently a decrease in systemic risk. A theoretical motivation for this hypothesis is due to Freixas and Rochet (1997) as well as Allen and Gale (2000, 2004) who argue that monopolistic banks may provide higher capital buffers which can serve as a cushion against external shocks to the financial system. Other studies by Keeley (1990), Boot and Greenbaum (1993) and Matutes and Vives (2000) stress the notion that an increased charter value may prevent the banks' managers from excessively taking risks and thus deteriorating bank asset quality (see also Besanko and Thakor, 1993). Furthermore, credit rationing in the form of dealing more qualitative credit investments (see Boot and Thakor, 2000) as well as better loan portfolio diversification (see Diamond, 1984; Boyd and Prescott, 1986) can lead to a better financial soundness of individual institutions and the financial system itself. Also, the supervision and regulation of more consolidated financial systems could be easier and more effective due to the reduced number of market participants thus leading to a decrease in systemic risk. Finally, empirical studies by Beck et al. (2006a, 2006b), Schaeck et al. (2009) and Schaeck and Čihák (2010) find no evidence in favor of the "concentration-fragility" hypothesis.

The *empirical research* on bank mergers has mainly concentrated on the detection and explanation of the wealth effects at consolidated financial institutions (see e.g. Buch and DeLong, 2004; Rossi and Volpin, 2004). In contrast to the analysis of wealth effects, the effects of bank mergers on the acquiring banks' risk have not been studied empirically in detail. Few examples of empirical studies relating to the risk effects of mergers are due to

Craig and Cabral dos Santos (1997), Amihud et al. (2002), Bharath and Wu (2005) and Vallascas and Hagendorff (2011). In these studies, the risk effects of bank mergers are proxied by estimating the acquiring bank's Z-score, the acquiring bank's stock volatility, its beta factor, its distance to default (DD) or the implied volatility of at-the-money call options on the equity of the acquirer. As systemic risk describes the possibility of a joint crash of an individual bank together with the rest of the financial system, however, systemic risk constitutes an extreme event that can hardly be measured by volatilities or beta factors estimated from the complete underlying distribution. More advanced concepts like extreme value theory (and the closely connected copula theory) that try to measure the dependence between the acquiring bank and the financial system in the tails of their joint return distribution, however, have not been used yet in the analysis of bank mergers. Similarly, the measures of systemic risk that have been proposed in the wake of the recent financial crisis (see Adrian and Brunnermeier, 2010; Acharya et al., 2010) have not yet found their way into the M&A literature. As a consequence, the impact of bank consolidation on systemic risk as well as the nexus between idiosyncratic and systemic risk effects of bank consolidation at the firm level have not been empirically analyzed before (Beck et al., 2006a, e.g., only investigate the impact of bank sector concentration on financial stability). Finally, up to this date no study has tried to identify the idiosyncratic or macroeconomic determinants of a bank merger's systemic risk effects. The aim of this paper is to fill all three gaps.

In summary, both the theoretical and empirical literature are unclear on the effects of consolidation in banking on the idiosyncratic and systemic risk of the acquiring bank.

3 Data and methodology

3.1 METHODOLOGY

We analyze the risk effects of bank mergers by the use of four different methodologies. To be precise, we measure the idiosyncratic default, systematic and systemic risk effects of

the acquirers in domestic and cross-border mergers of international banks.

3.1.1 *Systematic risk*

First, we analyze the changes in the acquiring bank's systematic risk after completion of the deal compared to its systematic risk prior to the acquisition. More precisely, under the framework of the CAPM, a change in the acquirer's systematic risk is described by a change in its *beta factor* relative to a relevant market portfolio. We thus follow Amihud et al. (2002) by measuring the acquiring bank's beta factor relative to region-specific bank sector indices. The estimated regression model is

$$R_{i,t} = \alpha_i + \alpha_{1,i} D_t + \beta_i R_{m,t} + \gamma_i R_{m,t} D_t + \varepsilon_{i,t} \tag{1}$$

with $R_{i,t}$ being the daily log return on the ith bank's stock at trading day t, $R_{m,t}$ being the daily log return on the market portfolio, D_t being a dummy variable taking on the values $D_t = 0$ for days $t \in [-180; -11]$ relative to the merger announcement (pre-merger period) and $D_t = 1$ for days $t \in [+11; +180]$ relative to the merger completion (post-merger period) and $\varepsilon_{i,t}$ being the error term. As market portfolios, we use region-specific bank sector indices which are computed in the following way: First, all mergers were assigned to one of nine regions (Africa, Central Asia, South East Asia, Pacific, North America, South America, Eastern Europe, Western Europe, Middle East) according to the acquirer's home country. For each region, we compute a region-specific index by including the returns of all banks whose headquarters are located in that respective region and for which capital market data are available from Datastream. The returns are then weighted according to the banks' market values (in US dollars) in order to get the region-specific bank sector index.

We are then interested in the change in the beta factor given by

$$\Delta\beta_i := \beta_{i,post} - \beta_{i,pre} = \gamma_i. \tag{2}$$

To test the hypothesis that the mean of the changes in the acquirers' beta factors is different from zero, we employ a standard t-test.

3.1.2 *Default risk*

Furthermore, we follow Vallascas and Hagendorff (2011) and proxy the merger-related changes in the default risk of the acquiring bank by computing its *industry-adjusted distance to default* (IADD) (see also Akhigbe et al., 2007; Gropp et al., 2009). Starting point for the analysis of default risk is the notion that a firm's securities can be priced as contingent claims on the value process of the firm (see Merton, 1974). Thus, the distance to default can be derived from comparing the market value of a company's assets and the book value of its liabilities. More formally, Merton's distance to default is defined as

$$DD_t := \frac{\ln\left(V_{A,t}/L_t\right) + \left(r_f - 0.5\sigma_{A,t}^2\right)T}{\sigma_{A,t}T} \tag{3}$$

where $V_{A,t}$ is the market value of assets, L_t is the book value of the bidding bank's total liabilities, r_f is the risk-free rate (proxied by the yield on two-year German government bonds), $\sigma_{A,t}$ is the annualized asset volatility at t, and T is the time to maturity which is set to one year.

We follow Akhigbe et al. (2007), Vassalou and Xing (2004), Hillegeist et al. (2004) and Vallascas and Hagendorff (2011) in computing estimates for the variables $V_{A,t}$ and $\sigma_{A,t}$ by the use of an iterative procedure based on the Black-Scholes model. To be precise, the market value of the bidding bank's equity is expressed as a call option on the market value of the bank's total assets and the volatility of the equity value is expressed via the optimal hedge ratio as a function of the volatility of the total assets' market value. We then follow Vallascas and Hagendorff (2011) in their choice of starting values for $\sigma_{A,t}$ and employ a Newton search algorithm for estimating $V_{A,t}$ and $\sigma_{A,t}$ (see Vallascas and Hagendorff, 2011 for details concerning the details of the iterative procedure).

After estimating the distance to default both in the pre-merger period $[-180; -11]$ and the post-merger period $[+11; +180]$ for the bidding banks,[i] we are then able to proxy the merger-related changes in the bidding banks' default risk by computing the changes in their pre- and post-merger distances-to-default via

$$\Delta DD_{bidder} := DD_{bidder;[+11;+180]} - DD_{bidder;[-180;-11]}. \tag{4}$$

Moreover, it can be argued that general industry trends in the financial sector rather than consolidation are responsible for changes in the bidding banks' default risk. To control for such a confounding influence, we compute both a value-weighted as well as an equal-weighted distance to default index in which we include all banks from the bidding bank's home region (i.e. in the same manner as for the estimation of the changes in systematic risk). The changes in the market's distance to default are then subtracted from those of the bidding banks yielding the changes in industry-adjusted distances-to-default $\Delta IADD$ given by

$$\begin{aligned} \Delta IADD &:= \Delta DD_{bidder} - \Delta DD_{index} \qquad (5) \\ &= DD_{bidder;[+11;+180]} - DD_{bidder;[-180;-11]} - \left(DD_{index;[+11;+180]} - DD_{index;[-180;-11]}\right). \end{aligned}$$

3.1.3 *Systemic Crash Probabilities*

In the next step of our analysis, we measure the merger-induced changes in the systemic risk of the bidder by computing the pre- and post-merger *Systemic Crash Probabilities* of the bidder's stock returns with respect to a region-specific bank sector index.

Early studies on systemic and systematic risk effects have employed correlation analyses interpreting an increase in bidder-market correlations as an indication of an increase in

[i] We follow Amihud et al., 2002, in their choice of the estimation window length in order to compare their results with ours. Again, the pre-merger period is chosen relative to the merger announcement and the post-merger period relative to the merger completion.

systematic risk (see e.g. Amihud et al., 2002). Several recent papers from the financial economics literature, however, have criticized the use of correlation due to its missing capability of modelling nonlinear dependencies in the context of the analysis of systemic risk and have proposed the use of extreme value theory (see e.g. Bae et al., 2003; Gropp and Moerman, 2004), copula functions (see e.g. Chan-Lau et al., 2004, Rodriguez, 2007, and Weiß forthcoming) or Marginal Expected Shortfall measures (see e.g. Acharya et al., 2010, and Adrian and Brunnermeier, 2010) instead.

Following Rodriguez (2007) and Weiß (forthcoming), we argue that the systemic risk of a bank is manifested in its propensity to experience joint extreme adverse effects with the market. A concept which is able to capture exactly this type of extreme dependence, is the concept of lower tail dependence.[ii] Intuitively, the lower tail dependence between two random variables describes the probability that an observation of the random variables joint distribution will lie in the distribution's extreme lower tail. When analyzing two samples of financial returns, the lower tail dependence between the two then captures the returns' joint propensity to crash together. Formally, the lower tail dependence coefficient (lower tail dependence or LTD in short) is defined as (see e.g. Nelsen, 2006, for a rigorous discussion of copulas and the concept of lower tail dependence)

$$LTD_{1;2} := LTD(X_1; X_2) = \lim_{u \downarrow 0} P\left(X_2 \leq F_2^{-1}(u) | X_1 \leq F_1^{-1}(u)\right), \tag{6}$$

with $u \in (0; 1)$ being a quantile. Note that the concepts of tail dependence and copulas are interlinked (under certain regularity conditions) via the relationship (see McNeil et al., 2005)

$$LTD_{1;2} = \lim_{u \downarrow 0} \frac{C(u, u)}{u} \tag{7}$$

[ii] A similar reasoning underlies the studies by Ruenzi and Weigert (2011) who employ the lower tail dependence of individual stocks and a respective market portfolio as a proxy for a crash risk premium in Fama French-type regressions and Beine et al. (2010) who measure stock market comovements by analyzing the stock markets' respective lower tail dependence.

where C is the unique copula of the joint distribution of the vector $(X_1; X_2)$. Also, the lower tail dependence coefficient can be extracted from the so called lower tail copula of C which is defined by

$$\Lambda_L(x, y) := \lim_{t \to \infty} tC(x/t, y/t) \tag{8}$$

as a function on $\overline{\mathbb{R}}_+^2$ via

$$LTD = \Lambda_L(1, 1). \tag{9}$$

In contrast to previous studies by Rodriguez (2007), Weiß (forthcoming) and Ruenzi and Weigert (2011), we do not employ copulas in order to estimate the LTD coefficients indirectly. Instead, we directly estimate the coefficient of lower tail dependence by the use of a nonparametric estimator proposed by Schmidt and Stadtmüller (2006) (see Appendix A for a detailed formal description of the nonparametric estimator). Note that our nonparametric approach circumvents the (error-prone) necessity of choosing a parametric copula from which the coefficient of lower tail dependence is extracted. Our results are thus independent of a parametric specification of the full dependence structure between the two variables. Consequently, our results should be more reliable than those obtained by Rodriguez (2007), Weiß (forthcoming) or Bühler and Prokopczuk (2010).

To measure the changes in a bidding bank's systemic risk, we estimate the changes in the lower tail dependence between the bidder's stock returns and the returns on the relevant region-specific bank sector index, i.e. the changes in its Systemic Crash Probabilities. To be precise, we estimate

$$\Delta SCP_i := SCP_{i;[+11;+180]} - SCP_{i;[-180;-11]} \tag{10}$$

where $SCP_{i;[+11;+180]}$ and $SCP_{i;[-180;-11]}$ describe the LTD between bank i and the relevant region-specific bank sector index in the post- and pre-merger period respectively. As the nonparametric estimators of the coefficients of tail dependence require the input of bivariate i.i.d. samples, we filter the data with the help of GARCH(1,1) models with t-distributed innovations. The lower tail dependence coefficients are then estimated from the standardized

residuals from the fitted GARCH(1,1) models (see e.g. Dias and Embrechts, 2009, for a similar approach) in both the pre- and post-merger periods.

3.1.4 *Marginal Expected Shortfall*

Finally, as a complement to our analysis of SCP, we also measure the bidders' changes in their so-called *Marginal Expected Shortfall*. Following Acharya et al. (2010), we first define the *Systemic Expected Shortfall* of a bank i ($i = 1, \ldots, n$) as

$$SES_i := \mathbb{E}\left[za^i - w_1^i | W_1 < zA\right] \tag{11}$$

with w_1^i being the bank's equity, a^i being the bank's assets, z being a critical threshold fraction of the bank's assets a^i, $W_1 := \sum_{i=1}^n w_1^i$ being the aggregate equity and $A := \sum_{i=1}^n a^i$ the aggregate assets of the financial system. Thus, the SES of a bank describes the amount a bank's capital drops below the critical threshold in case of a systemic crisis. Next, Acharya et al. define a bank's *Marginal Expected Shortfall* (MES) as the mean net equity return of the bank during times of a market crash. More precisely, the MES is defined as

$$MES_i^{5\%} := -\mathbb{E}\left[\frac{w_1^i}{w_0^i} | I_{5\%}\right] \tag{12}$$

where $\frac{w_1^i}{w_0^i}$ is the net equity return and $I_{5\%}$ is defined as the set of days where the market experienced its worst 5% outcomes. The MES of a given bank i is then estimated by using the log returns on the bank's stocks on those days the market crashed. Finally, Acharya et al. conjecture and empirically confirm that MES together with the bank's leverage are predictors of the bank's SES (and thus the bank's contribution to systemic risk).

In our empirical study, we then test whether the differences

$$\Delta MES_i^{5\%} := MES_{i;[+11;+180]}^{5\%} - MES_{i;[-11;-180]}^{5\%} \tag{13}$$

between the banks' post- and pre-merger Marginal Expected Shortfalls are different from zero on average.

Note that MES and our measure of systemic tail dependence are conceptionally quite similar as MES (SCP) measures the conditional mean (conditional probability) of a bank's stock returns (a crash of the bank's stocks) when a relevant market crashes. SCP, however, possess two significant advantages over MES. First, SCP consider extreme returns when both the market as well as the individual bank crashes and thus measure the left tail of the respective *joint* distribution while MES is based on the left tail of the market's *marginal* distribution. Second, Systemic Crash Probabilities are independent of the respective used market index thus allowing easy averaging over different (international) financial sectors and market regimes.

3.2 MERGER SAMPLE AND DATA VARIABLES

We obtained our sample of merging banks from the Thomson One Banker Database and analyze a global sample of merger transactions with merging parties' SIC-Codes ranging from 6000 to 6162 or equaling 6712 and 6719. We thus include all mergers where the bidding firms are depository, non-depository credit institutions or bank holding companies but explicitly exclude mergers involving insurance companies, loan or security bankers. All mergers were announced and completed between 1991 and 2009. Moreover, all acquiring banks in our sample are listed with share price data available from Thomson Reuters Financial Datastream and financial accounting data available from Thomson Worldscope, respectively. Furthermore, for reasons of relevance and in contrast to the related study by Vallascas and Hagendorff (2011), we exclude deals with an underlying deal value of less than 10 million US-dollars or an acquired stake of the bidding bank below 50%. From an initial sample of 655 banks we omit deals in case of lacks or inconsistencies in accounting or share price data, by which we lose 130 deals. Additionally, in order to avoid distorting effects from confounding events, we require an interval of 360 trading days between the completion of a deal and the

announcement of another transaction by the same bank. Consequently, we exclude 85 bank mergers resulting in a final sample of 440 bank mergers. Our final sample consists of mergers with bidding banks predominantly located in the United States and Canada as well as in the European Union plus Norway, Switzerland and Turkey. Moreover we analyze merger effects of transactions in Asia (Japan, China, Malaysia Philippines, Singapore, Taiwan, Thailand) and Latin America (Argentina, Brazil, Mexico, Peru). The regional distribution of mergers is summarized in Table 1.

— insert Table 1 here —

316 mergers occurred in North America, 87 took place in Europe. 30 transactions were completed in Asia/Pacific while the remaining deals were completed in other regions (Latin America, Africa and Middle East). The temporal distribution of the sample is presented in Table 2.

— insert Table 2 here —

Descriptive statistics of the data on our sample of mergers together with corresponding statistics on the control variables used in our cross-sectional analyses are given in Table 3 (details on our choice of control variables are discussed later in section 4.2.1 on the cross-sectional analyses).

— insert Table 3 here —

Hence, in 389 of 440 cases (88.4%) the acquiring bank and the target domicile in the same country. For 414 transactions (94.1%) both bidding bank and target originate in the same region. Analyzing the full-sample, on average acquiring banks report total assets around 130 billion US-dollars and the deal value is about 2 billion US-dollars. On average for mergers with bidding banks operating in North America, acquiring banks exhibit total assets around 60 billion US-dollars and the deal value is close to 1.5 billion US-dollars. By

contrast, for mergers in Europe, acquiring banks are characterized by explicitly larger total assets approaching 400 billion US-dollars and more than three times higher deal value being close to 4.6 billion US-dollars.

4 Empirical results

4.1 RISK EFFECTS OF BANK CONSOLIDATION

Our first analysis involves the different risk effects of bank consolidation and aims at answering the question whether mergers influence the systematic, default and systemic risk of bidders in the same direction.

4.1.1 *Systematic risk changes*

First, we measure changes in the systematic risk of the bidding bank by the use of its beta coefficient relative to its region-specific bank sector index.[iii] Using a standard t-test, we test the hypothesis that the mean of the changes in the acquirer's beta factors is different from zero. The results of our computations are reported in Table 4.

— insert Table 4 here —

Table 4 reports the pre- and post-merger levels as well as the changes in the average beta factor of bidding banks both in our full sample as well as our regional sub-samples. The results for the full-sample analysis show that on average the change in the acquiring bank's beta factor relative to its region-specific bank sector index (0.030) is statistically significant at the 10% level. Primarily driven by the results for US banks, the systematic risk of bidders seems to increase slightly as a result of a bank merger. From a regulatory point of view, this

[iii] We additionally estimated cumulative average abnormal returns (CAARs). Analyzing our full sample, we find that acquiring banks, on average, earn statistically significant negative CAARs between −1% and −2.1% for a variety of event windows. As this decrease in the shareholders' value of the acquiring firm is in line with the vast M&A literature (see e.g. Eckbo, 1983; or Hannan and Wolken, 1989), we dropped the analysis of wealth effects from the final version of the paper and concentrated on merger-induced risk effects. Results on corresponding wealth effects are available from the authors upon request.

result shows that a policy implemented by regulators aiming at limiting the consolidation of the banking sector in order to decrease its systematic risk exposure can be supported by the empirical results from our sample. The results are, however, in contrast to the results of Amihud et al. (2002) who find no significant change in the systematic risk of bidding banks in cross-border mergers. Also, the overall level of the average systematic risk is considerably lower in their sample than in ours ($\beta_{pre} = 0.756$ and $\beta_{post} = 0.785$). This significant increase in systematic risk as well as the high overall level of bidders' beta factors could be due to the extended time frame our sample covers and the inclusion of the recent financial crisis. We explore this idea further below in our sub-sample analyses.

4.1.2 *Default risk changes*

Furthermore, we proxy the merger-related changes in the default risk of the acquiring bank by computing its industry-adjusted distance to default (IADD). We analyze whether bank mergers are effective in reducing the default risk of bidding banks and contribute to a more stable banking sector. Table 5 reports the pre- and post-merger values as well as the changes in the industry-adjusted distance to default (IADD) for market-value-weighted banks based on our full sample of 440 bank mergers and our regional sub-samples.

— insert Table 5 here —

The results given in Table 5 show for our full sample that the mean (median) IADD in the pre-merger period is -1.729 (-1.469) and mean (median) IADD in the post-merger period is -1.936 (-2.017). These results are statistically significant at the 1% level. To analyze whether consolidation has an impact on the bidders' default risk, we test the hypothesis that the mean merger-related change in IADD is equal to zero. The results show that the change in IADD (-0.207) for the full sample is statistically significant at the 10% level. We thus detect a significant increase in the default risk of bidding banks after the merger completion. Again we find only weak evidence of increases in default risk for our regional sub-samples and a weakly significant increase in default risk of our full sample of bidders. Two

findings, however, are interesting to comment on. First, though not statistically significant, the increase in default risk seems to be strongest for European mergers. Also, while the default risk of European and US banks seems to increase in the post-merger period, banks from the remaining regions seem to be able to weakly decrease their idiosyncratic default risk. Second, though our results on European bank mergers underline the finding by Vallascas and Hagendorff (2011), the evidence from our international sample hints at an increasing effect of bank consolidation on the idiosyncratic default risk of bidders.

4.1.3 *Systemic risk changes*

The results on systematic and default risk provide weak evidence for a destabilizing effect of bank consolidation on the financial system. In contrast to previous studies on the nexus of consolidation and financial stability, we directly quantify the changes in systemic risk due to bank mergers by estimating the changes of the bidding banks' SCP and MES relative to a region-specific bank sector index. The results of our analysis of merger-induced changes in the bidders' SCP are reported in Table 6. As before, we report the results both for our full sample as well as the regional sub-samples.

— insert Table 6 here —

From Table 6 we can see that on average bank mergers lead to a highly significant (1% level) increase in the bidder's SCP (0.036) and thus to an increase in systemic risk. When looking at our regional sub-samples, it becomes clear that this increase in systemic risk is again primarily driven by mergers in North America. Concerning the overall pre-merger levels of systemic risk we can see that the average SCP is smaller for North American (0.723) and Asian/Pacific banks (0.623) while banks from Europe (0.767) and the remaining countries (0.781) possess a considerably higher level of systemic pre-merger risk.

To complement our new measure of systemic risk, we also compute the bidding banks' MES given that the market return experienced its worst 5% outcomes and compare the results of our two analyses. The results of our computations are presented in Table 7.

— insert Table 7 here —

The findings of our full-sample analysis show that the mean (median) change in bidding banks' MES is 0.4% (0.3%).[iv] These results are statistically significant at the 1% level and confirm our result from the analysis of SCP that bank consolidation coincides with a significant increase of the bidding bank's contribution to the financial sector's systemic risk. At the regional level, we can see that the increase in bidding banks' MES is strongest for mergers in North America and Europe (ΔMES=0.5%; significant at the 10% level). Furthermore, we can see that the pre-merger level of MES is higher for banks in Europe than for banks in North America and Asia/Pacific.

4.1.4 *Sub-sample analysis*

For a more precise analysis of the found risk effects, we split our entire data sample into several sub-samples and analyze the bidding banks' change in default, systematic and systemic risk. Table 8 reports the investigation of our sub-samples based on (A) deal characteristics, (B) acquirer characteristics and (C) merger environment.

— insert Table 8 here —

Panel A of Table 8 focuses on deal characteristics, differentiating first between high, medium and low deal values. The results of our computations show increases in default risk for all deal value levels which are not statistically significant. In contrast, a statistically significant increase in SCP and MES for bidding banks for all sub-samples based on the deal size can be detected. The destabilizing effect of bank consolidation is therefore common to all deals regardless of their size. We further explore this finding by using the product of bidding banks' total assets and the relative deal value as a proxy for the acquiring banks' relevance. Differentiating between levels of high, medium and low relevance, the results show

[iv] As it is common with risk measures like Value-at-Risk and Expected Shortfall, losses are given with a positive sign. An increase in the systemic risk contribution of a bank is thus given by a positive change in the respective bank's MES.

that high and medium relevant banks show a statistically significant increase in default risk and an increase in systematic risk. Additionally, an increase in SCP and MES and therefore an increase in systemic risk can be detected for medium and low relevant banks. In our third specification, we differentiate between cross-border mergers and domestic mergers. The results offer evidence that for both cross-border and domestic bank mergers default risk increases slightly. These results are in contrast to the results in Vallascas and Hagendorff (2011) who find an increase in default risk only for cross-border bank mergers. Furthermore, domestic bank mergers lead to significant increases in the bidding banks' systemic risk (this result is independent of the measure of systemic risk). Diversifying mergers thus seem to shield bidders from the adverse effects of consolidation on financial stability. The last sub-sample of Panel A differentiates between mergers in emerging markets and those in developed markets. The results of our estimations indicate that (as expected) bidding banks in developed markets show a significant increase both in default, systematic and systemic risk.

Panel B of Table 8 presents the results of our second investigation based on acquirer characteristics. In our first specification based on the bidding banks' profitability, we can observe a statistically significant increase in default risk only for medium profitable bidders. For the remaining sub-samples, default risk seems to decrease as well though the changes are not significant. On the other hand, we find significant increases in systemic risk for all profitability levels. When looking at the absolute magnitude of these increases in systemic risk, we can see that the increase in the bidders' SCP is largest for the least profitable banks. The argument of Boot and Thakor (2000) can thus be confirmed as a higher profitability limits the (still) adverse effects on financial stability. Additionally, we use the bidding banks' total assets as a proxy for bank size. As we can see from Table 8, especially small banks experience a significant increase in default risk as well as a significant increase in systematic and systemic risk due to a merger. Interestingly, our results show that regulators can suffer from the too-many-to-fail problem, which gives small banks incentives to herd in order to

increase their risk. In this case small and failed banks could be acquired by healthy banks (see Acharya and Yorulmazer, 2007). Moreover, our results for large banks do not support the perception that banks could be inclined to merge in order to become too big to fail (see Mishkin, 1999).

The third part of our sub-sample analysis deals with the merger environment. Using the HHI as a proxy for concentration in the banking sector, we can see that bidding banks that are located in less concentrated countries show a significant increase in default risk in contrast to banks located in high and medium concentrated countries. Moreover, both the SCP and MES of bidders increase after the merger with the increases in SCP being significant at the 1% level for all concentration levels. Additionally, the results on MES confirm the results of our analysis on SCP for mergers in less concentrated markets. In summary, the results indicate that the higher the market concentration the lower (and less significant) the increase of the bidder's default risk will be. At the same time, this positive effect of market concentration on default risk is accompanied by a more pronounced increase in systemic risk as measured by the bidder's SCP. While the increase in systemic risk in highly concentrated markets again confirms the "concentration-fragility" hypothesis, bidders in these markets seem to be able to limit the merger-related effects on their default risk. Again we find a reverse direction of default and systemic risk effects thus negating any claims that idiosyncratic default risk equals the respective bank's contribution to systemic risk.

Finally, we consider bank mergers, that were completed in the pre-crisis period before 2007 and mergers that were completed during the financial crisis from 2007 until 2009. The results show that during the financial crisis significant increases in both the bidding banks' default and systemic risk can be detected. Both default and systemic risk increase following mergers in the pre-crisis period as well, though the risk effects of mergers seem to be considerably stronger in the crisis period. This result supports the notion that bank consolidation in times of financial crises could, among other factors, be motivated by regulatory incentives therefore inducing an increase in bidding banks' idiosyncratic risk (see Vallascas and Hagen-

dorff, 2011). Our main finding in this respect, however, is that increases in systemic risk seem to be a common by-product of bank consolidation regardless of the financial sector's market environment. Financial crises, on the other hand, only seem to amplify the general increase in the systemic relevance of a bidder.

4.1.5 *Comparison of the different risk effects*

In order to compare the different risk effects, we split our entire data sample in sub-samples according to the bidding banks' pre-merger default and systemic risk levels. The presentation of changes in default and systemic risk is given in Tables 9 and 10.

— insert Tables 9 and 10 here —

As one can see, particularly banks assigned to a high risk class for both systemic and default risk show a lower default risk and a lower systemic risk in the post-merger period. In contrast, banks with a low systemic and a low default risk become systemically more relevant and imply a higher risk of default in relation to the pre-merger period.

Hence, one consequence of consolidation in the banking industry is a harmonization of risky and less risky banks. Moreover, the sub-sample characterized by a high systemic risk reports a significant drop in default risk at the 10% level, whereas the sub-sample of less risky banks is marked by a drop in the distance to default, i.e. an increase in default risk. Concerning the systemic importance, one can see that the change does not depend on the classification in default risk classes, but the classification in systemic risk classes. Thus, systemically less important banks become more important while high systemically important banks are characterized by a decline in the SCP and therewith a decrease in systemic importance.

From an economic point of view, one could argue that for banks with a high pre-merger systemic relevance diversification benefits surprisingly seem to outweigh adverse moral hazard effects. Conversely, the opposite can be observed for banks with low pre-merger systemic

relevance, for which systemic importance increases. Hence, banks with a lower systemic importance seem to merge not for diversification purposes, but to become bigger and systemically more relevant.

4.2 CROSS-SECTIONAL ANALYSIS OF MERGER-RELATED RISK EFFECTS

4.2.1 *Model specifications and choice of variables*

We now turn to the question how the merger-induced changes in the systematic, default and systemic risk of the acquirers can be explained in the cross-section by a set of deal and idiosyncratic bank characteristics, macroeconomic control variables and the acquirer's regulatory environment. The definitions and summary statistics for the variables used in the cross-sectional analyses are given in Tables 3 and 11 respectively.

— insert Table 11 here —

The first group of variables we use in our cross-sectional analyses comprises deal characteristics with which we control for the (relative) deal size and the geographic nature of the merger. First, we include the natural logarithm of the deal value in US dollars (LDVL) in our cross-sectional regressions. Furthermore, we employ the ratio of the deal value to the market value of the acquirer's equity at the end of one year before the deal announcement (RELSIZE) in our analyses in order to control for the relative size of the transaction. Absolute and relative deal size are hypothesized to have both a positive and a negative influence on our different measures of merged-induced risk effects. On the one hand, the size of the deal could have a risk-reducing effect on all three types of risk (systematic, default and systemic) as larger banks could be able to better diversify their asset and credit portfolio. Also, larger deals might facilitate collusion among the remaining competitors thus increasing profits and ultimately reducing the acquirers' risk. On the other hand, larger deals possess a higher

probability of failure due to an increased complexity of the integration of the target. As a result, larger deals could lead to more pronounced risk effects of mergers.

Second, we include a dummy variable capturing the geographic nature of the deal (CROSS) in our regressions which takes on the value 1 for cross-border and 0 for domestic deals. Here, we expect cross-border deals in contrast to domestic deals to have a risk reducing effect as geographic diversification should decrease both the acquirer's default probability as well as its systemic risk.

The second group of variables includes a set of idiosyncratic balance sheet characteristics of the acquiring bank. We employ the bank's return on assets (ROA) as well as its operating income margin (OPM) to control for a bank's profitability, the bank's total assets as well its log value (TOTAL and LTOTAL) to proxy for the bank's size, the market-to-book ratio (MTBV) to control for the hubris of the bank's directors (see Vallascas and Hagendorff, 2011) as well as the bank's investment opportunity set (see Baker and Wurgler, 2002) and the pre-merger equity-to-assets ratio (EQUITY) to proxy for a bank's leverage.

We expect the profitability proxies (ROA and OPM) to have a risk reducing effect while the influence of the bank's size on our different risk measures is unrestricted. The expected sign of the coefficient of the market-to-book ratio is unrestricted as well. While Vallascas and Hagendorff (2011) argue that the directors' hubris will lead them to engage in too risky mergers, Keeley (1990) expects a positive influence on the bank's idiosyncratic risk as more valuable banks possess less incentives to act too riskily. Further, we expect the acquirer's size to have a negative influence on the merger induced changes in default risk as larger banks are more likely to become too-big-to-fail as a result of the merger. For the same reason, however, we expect a positive influence on the change in systematic/systemic risk at the same time (see e.g. Benston et al., 1995). Concerning the leverage of the acquirer, we expect banks with low leverage to experience higher risk effects around mergers as leverage forces the bank's management to increase profitability. Next, extending the approach by Vallascas and Hagendorff (2011), we include a dummy variable that identifies bidding banks

with a high pre-merger level of default risk (HIGHRISK). The variable takes on the value 1 if the bidding bank is in the upper most default risk quartile and 0 otherwise. Finally, we further include the merger-induced change in the bidder's idiosyncratic default risk as given by our variable $\Delta IADD$ and the change in the non-adjusted distance to default (ΔDD) as an instrumental variable for $\Delta IADD$ in our cross-sectional regressions of the bidder's change in systemic risk.

Our third group of control variables includes both macroeconomic variables as well as dummy variables for the geographic origin and the regulatory environment of the bidder. To be precise, we include the annual real GDP growth rate (GDPGR) in per cent, the annual unemployment rate (UNEMPL) in per cent, the one-period lagged annual change of GDP deflator (INFL) as our macroeconomic controls. Regarding the regulatory environment, we employ an indicator of political stability (POLSTAB), an indicator variable for the rule of law (ROL) and the Herfindahl-Hirschman index (HHI) of the bidding bank's home country as further control variables. All macroeconomic control variables are retrieved from the World Bank's World Development Indicator (WDI) database. Finally, we include three dummy variables for North American, European and Asian/Pacific mergers in our cross-sectional regressions.

We then perform four sets of cross-sectional OLS regressions in order to answer the question which idiosyncratic, macroeconomic or regulatory variables significantly influence the merger-related changes in systematic, default and systemic risks as measured by a bidding bank's beta factor, distance to default, SCP and MES. As we observe considerable heteroscedasticity in our data, we resort to estimating and reporting heteroscedasticity consistent Huber-White standard errors.

Using each measure of idiosyncratic or systemic risk as the dependent variable, we then estimate a set of different regression model specifications and add the regional dummy variables as well as the variables concerning the regulatory environment to our baseline regressions one by one in order to analyze our main regression's sensitivity to the inclusion of these

control variables. Correlations between our regressors are presented in Table 12.

— insert Table 12 here —

As Table 12 shows, there seems to be no sign of multicollinearity between our regressors thus eliminating the need for further transformations or regressions of our set of variables.

Finally, the causality running from a bank's idiosyncratic default risk to its systemic risk contribution is not clear as the bank's default probability might itself depend on the overall risk of the financial system. Consequently, our baseline regressions might suffer from possible endogeneity as a result of reverse causality between default and systemic risk. Thus, to address likely reverse causality between our variables $\Delta IADD$ on the one hand and ΔSCP and ΔMES on the other hand, we apply 2SLS instrumental variable techniques as a robustness check for our main regressions. As instrumental variable, we employ the change in the distance to default without industry-adjustment (ΔDD). Our instrument is highly correlated (0.9039) with the possibly endogeneous covariate $\Delta IADD$ and shows no significant correlation (-0.0507) with the estimated model's residuals.

4.2.2 *Results*

Focusing first on the determinants of the mergers' systematic risk effects, corresponding results for the regression on the changes in the bidding banks' beta factors are presented in Table 13.

— insert Table 13 —

Beginning with deal characteristics, we cannot observe any significant effect on the acquiring banks' systematic risk. Among bidding banks' idiosyncratic characteristics, the results in Table 13 show that the profitability proxies (ROA) and the operating profit margin (OPM) have a statistically significant positive effect on changes in bidding banks' systematic risk in several of our regression model specifications. Banks with a high pre-merger profitability are

less likely to suffer from post-merger integration problems and are thus more likely to keep or even increase their level of profitability after the merger. This increase in profitability and consequently in the bank's expected rate of return is then reflected in increases in its beta factor. Moreover, banks whose default risk increases also experience an increase in their systematic risk in the post-merger period. Controlling for the macroeconomic and regulatory environment, we can observe that a higher unemployment rate and greater political stability in a country positively effect bidding banks' systematic risk. Finally, we consider the dummy variable CRISIS in order to detect effects on the bidding banks' systematic risk in the pre-crisis and crisis period. The results show that bank mergers that were announced and completed during the financial crisis surprisingly had a reducing effect on the bidding banks' change in systematic risk.

Table 14 reports the results of the regressions on merger-related changes in the bidders' industry-adjusted distance to default.

— insert Table 14 —

The results show that the changes in industry-adjusted distance to default can neither be explained by the bidding bank's balance sheet characteristics as well as deal characteristics nor by the acquirers' regulatory environment.

The cross-sectional analysis outlines that high-risk banks have a statistically significant positive effect on the distance to default. This result is in line with the cross-sectional result in Vallascas and Hagendorff (2011) that high-risk banks benefit disproportionately from diversification in terms of a reduced probability of default. Furthermore, we control for concentration in the banking sector (HHI). The results indicate that a decrease in market competition has a positive effect on the default risk reduction of bidding banks (though the variable HHI enters only two regression models at a significant level). This can be seen as an argument in favor of the hypothesis by Boyd et al. (2004) that consolidation could coincide with collusion among the remaing banks. Additionally, the results show that bank mergers

that were announced and completed during the financial crisis, have an increasing effect on the bidding banks' default risk.

Additionally, we are interested if changes in the bidding banks' SCP can be explained in a cross-sectional analysis. The results of our cross-sectional regressions are presented in Table 15.

— insert Table 15 —

The results show that the changes in the bidders' systemic risk as measured by their SCP are solely driven by our proxies for the bidding bank's size and the merger-induced change in idiosyncratic default risk. More precisely, we can see that bank size has a weakly significant negative effect on the bidding banks' systemic risk while the change in default risk enters all of our regression models negatively (significant at the 1% level). These cross-sectional results underline our finding that especially bidders of smaller pre-merger size increase their systemic risk significantly through means of merging. As part of this harmonization of systemic risk, larger banks on the other hand do not experience significant increases in systemic risk. Furthermore, the results show that the bidding banks' systemic risk as proxied by the banks' SCP is primarily driven by the change in idiosyncratic default risk. Thus, the intuitive notion that idiosyncratic default and systemic risk are interlinked can also be observed in our empirical analysis. In regression model specification (10), we estimate a 2SLS regression with ΔDD as our instrumental variable for $\Delta IADD$ in order to rule out endogeneity problems between default and systemic risk. Model diagnostics for the 2SLS regression (F-statistic 162.3, Hausman specification test p-value 1.000) and the results from the first stage regression confirm the validity of our estimation results. Again, the change in idiosyncratic default risk enters our regression highly significantly with a negative sign giving strong evidence for our result that the merger-induced change in systemic risk is indeed primarily due to a change in idiosyncratic default risk. Idiosyncratic default risk, however, is only one of several drivers of systemic risk.

Finally, we are interested if changes in the bidding banks' Marginal Expected Shortfall (MES) can be explained in a cross-sectional analysis. The results of our cross-sectional regressions are reported in Table 16.

— insert Table 16 —

The results presented in Table 16 show that, among deal characteristics, high deal values have a positive effect on MES. This result indicates that larger deals exert an increasing impact on bidding banks' systemic risk. The reason for this can be explained by an increased complexity of the integration of the target, whereby larger deals could lead to more pronounced risk effects of mergers. Also, larger deals might be indicative of banks which are about to become too-big-to-fail thus leading to an increase in systemic risk. Further, our dummy variable CROSS for cross-border deals enters several of our regressions significantly with a positive sign. Again, the increased complexity and the increased costs due to post-merger integration problems of a cross-border deal in contrast to a domestic deal outweigh the benefit of a better portfolio diversification. Similar to the results on SCP, bank size enters all of our regressions with a negative sign showing again that small- and medium-sized bidders increase their systemic risk disproportionately due to a merger. In contrast, larger banks and banks with a high pre-merger level of idiosyncratic default risk (HIGHRISK) do not seem to experience such rises in systemic risk. Moreover, the results show that an increase in default risk has a increasing effect on the acquiring banks' MES. This effect is statistically significant at the 1% level and confirms our main result from Table 15 that idiosyncratic default risk is a major driver of systemic risk. The 2SLS instrument variable regression in model specification (10) in Table 16 (Hausman specification test p-value 0.9565) confirms that we can rule our concerns of possible endogeneity due to reverse causality between default and systemic risk. The analysis of MES, however, reveals that idiosyncratic risk is only one of several factors determining the merger-induced change in a bank's systemic risk. Finally, the crisis dummy variable enters all our regressions signifi-

cantly with a positive sign giving evidence for the notion that increases in systemic risk are amplified in but not entirely caused by times of financial market turmoil.

4.3 ROBUSTNESS CHECKS

In order to verify the robustness of the results obtained in the empirical analysis, we conduct several robustness checks. First, we test whether our findings hold when different relative size requirements are incorporated. We evaluate the robustness of changes in systemic, systematic and default risk for mergers with RELSIZE exceeding 5% (10%), leading to the exclusion of 150 (213) deals. In particular bank mergers in the Asian Pacific and European region are omitted due to this requirement. However, our estimated changes in risks for North-American banks are qualitatively robust for several relative size thresholds. By contrast, for European as well as Asian/Pacific bidding banks deviations from our initial results can be observed. Nevertheless, the validity of these results is diminished by a small sample size with 39 (33) examined mergers in Europe and 7 (5) mergers in Asia/Pacific, respectively.

Second, since the high market values of very few banks are able to distort our results for changes in default risk when applying a market-value weighted approach in the computation of the industry-related changes in the distance to default, we use an equally-weighted approach instead. In this approach, the changes in default risk are adjusted by the average of changes in default risk of other listed banks in the same region. As a result, we find qualitatively identical changes in default risk compared to the results following a market-value weighted approach for both our full sample as well as all regional sub-samples.

Third, we control for possible heteroscedasticity in our sample by estimating and reporting Huber-White standard errors in our main regressions.

5 Conclusion

This paper is the first to analyze the systemic risk effects of global bank mergers. As a unique feature, we propose the Systemic Crash Probability as a novel measure of systemic risk which is closely related to the Marginal Expected Shortfall by Acharya et al. (2010) but is based on the *joint* distribution of an individual bank's stock returns and the market returns. This study also provides the first comparative study of merger-induced idiosyncratic default, systematic and systemic risk effects at acquiring banks.

For our full-sample of 440 international bank mergers, we first document significant increases in the bidders' systematic risk. In contrast to previous results by Vallascas and Hagendorff (2011) on the default risk of European bank mergers, we also find a significant increase in the default risk of international bidders as measured by their industry adjusted distance to default (and confirm their results for European mergers). Thus, by including US banks in our analysis, we document new evidence for a destabilizing effect of bank consolidation on the merging institutions idiosyncratic default risk.

Focusing on our main research question, we find a statistically significant average increase in the acquirers' SCP and MES (and consequently in their systemic risk). Thus, we find clear empirical evidence for the hypothesis that following bank mergers, systemic risk increases due to the merger announcement while the bidder's ability to profit from favorable developments of the bank sector is significantly reduced. Based on our results for both measures of systemic risk, we thus confirm the "concentration-fragility" hypothesis.

Additionally, this paper is the first to jointly analyze the cross-sectional determinants of the risk effects of bank mergers. The results of the regression of the bidding bank's beta factors show that changes in the systematic risk are primarily driven by the merger-induced change in default risk, bidder profitability and by our macroeconomic control variables. Also, the results of our cross-sectional analysis for industry-adjusted distance to default are in line with Vallascas and Hagendorff (2011) and show that high-risk banks benefit disproportionately from diversification in terms of a reduced probability of default while

mergers during the recent financial crisis were characterized by an additionally destabilizing effect on idiosyncratic default risk.

Controlling for possible reverse causality, we show that idiosyncratic default risk is (among several other variables) a major driver of the increases in systemic risk caused by bank mergers. Overall, cross-sectional regressions on systematic, default and systemic risk show clearly that results on the driving factors of systematic and default risk cannot be generalized to the case of systemic risk. Finally, in our sub-sample analysis, we show that a higher bidder profitability, cross-border diversification and mergers in less concentrated financial sectors shield bidders from increases in systemic risk.

Future research should concentrate on answering the question how the results found in this study can be used for identifying systemically relevant banks as well as systemically critical bank mergers. Methodically, the link between our measure of systemic risk (SCP) and the competing measure of a bank's Marginal Expected Shortfall should be analyzed in more detail.

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Tables

	Africa	Central Asia	Eastern Europe	Latin America	North America	Pacific	South East Asia	Western Europe	Sum
Eastern Europe			1						1
Latin America				7					7
North America					313	1	1	1	316
Pacific					2	11			13
South East Asia							17		17
Western Europe	1	1	6	2	8	2	1	65	86
Sum	1	1	7	9	323	14	19	66	440

Table 1: Regional distribution of bank merger. The table shows the distribution of acquiring banks (first column) and target banks (first line). The sample consists of 440 global bank mergers that were announced and completed between 1991 and 2009. The majority of mergers took place in North America 316, 87 occurred in Europe and 30 transactions were completed in Asia/Pacific. The remaining mergers were completed in other regions (Latin America, Africa and Middle East).

Year	Announcement	Completion	Year	Announcement	Completion
1991	5	3	2001	31	40
1992	4	3	2002	20	22
1993	5	6	2003	35	23
1994	12	6	2004	34	38
1995	13	14	2005	30	31
1996	21	16	2006	49	44
1997	27	27	2007	34	42
1998	30	31	2008	13	19
1999	34	31	2009	3	8
2000	40	36	Sum	440	440

Table 2: Distribution of bank mergers by year. The table outlines the merger announcements and completions categorized by year. The majority of bank mergers (182) were announced between 2003 and 2007. In addition to the merger announcements, the majority of the sample deals were completed during the period 2004-2007.

		Total N = 440				North America N = 316				Europe N = 87				Asia/Pacific N = 30				Others N = 7			
		Mean	Std.dev.	$Perc_{25}$	$Perc_{75}$	Mean	Std.dev.	$Perc_{25}$	$Perc_{75}$	Mean	Std.dev.	$Perc_{25}$	$Perc_{75}$	Mean	Std.dev.	$Perc_{25}$	$Perc_{75}$	Mean	Std.dev.	$Perc_{25}$	$Perc_{75}$
	DEAL	2.082	6.498	58	744	1.440	6.304	44	344	4.634	7.569	266	7.159	1.600	3.334	202	1.601	1.391	3.124	113	423
Deal characte-	LDVL	5,52	1,93	4,06	6,61	5,04	1,70	3,79	5,84	7,03	1,96	5,58	8,88	6,21	1,69	5,31	7,38	5,51	1,89	4,69	6,01
ristics	CROSS	0,12	0,32	0,00	0,00	0,03	0,16	0,00	0,00	0,44	0,50	0,00	1,00	0,17	0,38	0,00	0,00	0,00	0,00	0,00	0,00
	RELSIZE	0,19	0,29	0,03	0,26	0,22	0,26	0,06	0,30	0,15	0,37	0,01	0,20	0,08	0,23	0,00	0,04	0,03	0,04	0,01	0,05
	ROA	1,49	0,86	1,14	1,75	1,49	0,52	1,23	1,74	1,34	0,96	0,86	1,70	1,30	1,63	0,71	1,87	3,82	2,61	2,63	3,84
	MTBV	1,88	0,84	1,31	2,26	1,85	0,74	1,33	2,26	1,85	0,95	1,22	2,19	2,13	1,30	1,29	2,72	2,21	1,17	1,52	2,73
Acquirer	TOTAL	131.447	298.269	3.116	91.148	58.600	188.312	2.130	36.687	391.201	429.973	59.753	558.198	153.601	387.356	17.236	118.715	96.667	103.453	29.005	153.535
characteristics	LTOTAL	9,83	2,12	8,04	11,42	9,11	1,85	7,66	10,51	12,06	1,51	11,00	13,23	10,75	1,42	9,75	11,68	10,75	1,54	10,21	11,84
	OPM	20,34	9,70	15,23	25,46	23,38	7,92	18,76	27,82	12,47	7,19	7,59	16,69	13,31	14,42	8,22	19,52	11,13	11,11	2,95	18,47
	EQUITY	8,08	3,36	6,25	9,60	8,90	2,41	7,38	9,99	4,97	3,66	3,09	5,63	8,27	5,45	5,12	9,15	8,86	2,66	7,54	9,15
	HIGHRISK	0,25	0,43	0,00	0,25	0,28	0,45	0,00	1,00	0,17	0,38	0,00	0,00	0,17	0,38	0,00	0,00	0,00	0,00	0,00	0,00
	GDPGR	3,13	1,86	2,17	4,17	3,08	1,21	2,50	4,17	2,71	2,12	1,86	3,68	4,75	4,24	3,15	7,08	3,75	3,00	1,75	5,16
	UNEMPL	5,45	1,86	4,40	5,83	5,06	0,81	4,50	5,63	6,94	2,98	3,90	8,90	4,16	1,00	3,73	4,21	10,06	3,42	9,00	12,10
	INFL	2,63	1,51	1,99	3,23	2,73	1,06	2,27	3,23	2,20	1,33	1,63	2,48	1,98	3,23	-0,25	3,54	6,16	3,54	3,64	6,72
Country	POLSTAB	0,66	0,41	0,35	0,92	0,63	0,37	0,35	0,92	0,86	0,37	0,59	1,13	0,59	0,57	0,39	1,03	-0,29	0,30	-0,33	-0,11
controls	ROL	1,44	0,39	1,49	1,57	1,54	0,12	1,53	1,57	1,38	0,47	1,14	1,74	1,05	0,59	0,58	1,72	-0,46	0,19	-0,55	-0,34
	HHI	0,09	0,09	0,07	0,09	0,10	0,10	0,08	0,09	0,07	0,02	0,05	0,08	0,07	0,02	0,06	0,09	0,06	0,02	0,05	0,07

Table 3: Summary statistics. This table reports summary statistics for the deal characteristics, the acquirer statistics and the country control variables. The sample consists of 440 mergers announced and completed over the period from 1991 to 2009. Moreover we categorize the summary statistics for the full-sample and at four regional levels (North America, Europe, Asia/Pacific and Others).

		Mean			Median		
	N	$\beta_{\text{Pre-Merger}}$	$\beta_{\text{Post-Merger}}$	$\Delta\beta$	$\beta_{\text{Pre-Merger}}$	$\beta_{\text{Post-Merger}}$	$\Delta\beta$
North America	316	0.751	0.791	0.040 **	0.772	0.833	0.026 **
				(0.033)			(0.033)
Europe	87	0.824	0.841	0.017	0.858	0.887	-0.005
				(0.548)			(0.649)
Asia/Pacific	30	0.528	0.473	-0.055	0.450	0.361	-0.102
				(0.505)			(0.622)
Others	7	1.095	1.166	0.071	1.514	1.317	0.048
				(0.560)			(0.578)
Total	440	0.756	0.785	0.030 *	0.773	0.833	0.016 *
				(0.059)			(0.053)

Table 4: Merger-induced changes in systematic risk/beta factors. This table outlines the results for the systematic risk changes of bidding banks by the use of its beta coefficient relative to its region-specific bank sector index. The pre- and post-merger levels for the average beta factor of bidding banks are determined both for the full-sample analysis as well as for the regional sub-samples. Following Amihud et al. (2002), the acquiring bank's beta factors are measured relative to our region-specific bank sector indices. The estimated regression model is $R_{i,t} = \alpha_i + \alpha_{1,i} D_t + \beta_j R_{m,t} + \gamma_j R_{m,t} D_t + \varepsilon_{i,t}$ where D_t is a dummy variable taking on the values $D_t = 0$ for days $t \in [-180; -11]$ relative to the merger announcement (pre-merger period) and $D_t = 1$ for days $t \in [+11; +180]$ relative to the deal completion (post-merger period). Changes in the beta factor are then computed via $\Delta\beta_j := \beta_{j,post} - \beta_{j,pre} = \gamma_j$. The statistical significance of the changes in systematic risk are then tested by the use of a standard t-test.
***,**,* denote changes in beta factors, which are significant at the 1%, 5% and 10% level.

		Mean			Median		
	N	**IADD$_{\text{Pre-Merger}}$**	**IADD$_{\text{Post-Merger}}$**	**Δ IADD**	**IADD$_{\text{Pre-Merger}}$**	**IADD$_{\text{Post-Merger}}$**	**Δ IADD**
North America	316	-2.270 ***	-2.455 ***	-0.185	-2.209 ***	-2.396 ***	-0.415 ***
		(0.000)	(0.000)	(0.129)	(0.000)	(0.000)	(0.008)
Europe	87	0.207	-0.284	-0.491	0.389	-0.330	-0.425
		(0.376)	(0.407)	(0.148)	(0.153)	(0.169)	(0.169)
Asia/Pacific	30	-2.008 ***	-1.684 ***	0.324	-2.648 ***	-1.670 ***	0.260
		(0.000)	(0.004)	(0.306)	(0.001)	(0.008)	(0.217)
Others	7	0.029	0.470	0.441	-0.376	-0.945	0.149
		(0.939)	(0.458)	(0.241)	(0.938)	(0.469)	(0.469)
Total	440	-1.729 ***	-1.936 ***	-0.207 *	-1.469 ***	-2.017 ***	-0.320 ***
		(0.000)	(0.000)	(0.063)	(0.000)	(0.000)	(0.010)

Table 5: Merger-induced changes in default risk/industry-adjusted distance to default. This table shows the pre- and post-merger values for industry-adjusted distance to default (IADD) for market-value-weighted banks based on a full sample of 440 bank mergers and regional sub-samples. The pre- and post-merger distance to default of the acquiring bank are estimated by using the two estimation windows $[-180; -11]$ (relative to the merger announcement) and $[+11; +180]$ (relative to the deal completion) respectively. The merger-related changes in the bidding banks' default risk are then proxied by computing the changes in their pre- and post-merger distances-to-default via $\Delta DD_{bidder} := DD_{bidder;[+11;+180]} - DD_{bidder;[-180;-11]}$. We then construct a value-weighted distance to default index in which we include all banks from the bidding bank's home region (i.e. in the same manner as for the estimation of the changes in systematic risk). The changes in the market's distance to default are then subtracted from those of the bidding banks yielding the changes in industry-adjusted distances-to-default $\Delta IADD$ given by $\Delta IADD = DD_{bidder;[+11;+180]} - DD_{bidder;[-180;-11]} - \left(DD_{index;[+11;+180]} - DD_{index;[-180;-11]}\right)$. The statistical significance of the changes in default risk are then tested by the use of a standard t-test.
***,**,* denote changes in IADD, which are significant at the 1%, 5% and 10% level.

		Mean			Median		
	N	**$SCP_{\text{Pre-Merger}}$**	**$SCP_{\text{Post-Merger}}$**	**Δ SCP**	**$SCP_{\text{Pre-Merger}}$**	**$SCP_{\text{Post-Merger}}$**	**Δ SCP**
North America	316	0.723	0.768	0.046 ***	0.783	0.812	0.035 ***
				(0.000)			(0.000)
Europe	87	0.767	0.782	0.015	0.798	0.837	0.017 *
				(0.210)			(0.095)
Asia/Pacific	30	0.623	0.628	0.005	0.666	0.662	0.004
				(0.873)			(0.805)
Others	7	0.781	0.804	0.022	0.889	0.931	-0.009
				(0.450)			(0.813)
Total	440	0.726	0.762	0.036 ***	0.781	0.810	0.031 ***
				(0.000)			(0.000)

Table 6: Merger-induced changes in Systemic Crash Probability (SCP). This table shows the pre- and post-merger values as well as the changes in the bidding banks' Systemic Crash Probability (SCP) both for our full sample of 440 bank mergers and our regional sub-samples. The Systemic Crash Probability equals the coefficient of lower tail dependence between the returns on an individual bank's stocks and a region-specific bank sector index. The SCP is estimated by the use of the nonparametric estimator for the lower tail copula as proposed by Schmidt and Stadtmüller (2006) and which is given by $\hat{\Lambda}_{L;m}(x,y) \approx \frac{1}{k}\sum_{j=1}^{m} \mathbf{1}_{\left\{R_{m1}^{(j)} \leq kx \text{ and } R_{m2}^{(j)} \leq ky\right\}}$ with the parameter $k \in \{1,\ldots,m\}$ being chosen by the use of a plateau-finding algorithm. The SCP are then computed nonparametrically via $\hat{\Lambda}_{L;m}(1,1)$. The changes in the Systemic Crash Probability are then computed via $\Delta SCP_i := SCP_{i;[+11;+180]} - SCP_{i;[-180;-11]}$ where $SCP_{i;[+11;+180]}$ and $SCP_{i;[-180;-11]}$ describe the LTD between bank i and the relevant region-specific bank sector index in the post- and pre-merger period respectively. The original data is filtered with the help of GARCH(1,1) models with t-distributed innovations and the the Systemic Crash Probability are then estimated from the standardized residuals from the fitted GARCH(1,1) models. The statistical significance of the changes in the Systemic Crash Probability are then tested by the use of a standard t-test.
***,**,* denote changes in SCP, which are significant at the 1%, 5% and 10% level.

		Mean			Median		
	N	**MES$_{\text{Pre-Merger}}$**	**MES$_{\text{Post-Merger}}$**	**ΔMES**	**MES$_{\text{Pre-Merger}}$**	**MES$_{\text{Post-Merger}}$**	**ΔMES**
North America	316	0.015	0.019	0.004 ***	0.014	0.016	0.003 ***
				(0.000)			(0.000)
Europe	87	0.023	0.027	0.005 *	0.020	0.021	0.003 **
				(0.055)			(0.042)
Asia/Pacific	30	0.014	0.016	0.002	0.011	0.015	0.002
				(0.561)			(0.510)
Others	7	0.033	0.031	0.002	0.032	0.033	0.006
				(0.881)			(0.813)
Total	440	0.017	0.021	0.004 ***	0.015	0.018	0.003 ***
				(0.000)			(0.000)

Table 7: Merger-induced changes in Marginal Expected Shortfall. This table shows the pre- and post-merger values as well as the changes in the bidding banks' Marginal Expected Shortfall (MES) as proposed by Acharya et al. (2010) both for our full sample of 440 bank mergers and our regional sub-samples. The MES of an individual bank is defined as $MES_i^{5\%} := -\mathbb{E}\left[\frac{w_1^i}{w_0^i}|I_{5\%}\right]$ where $\frac{w_1^i}{w_0^i}$ is the net equity return and $I_{5\%}$ is defined as the set of days where the market experienced its worst 5% outcomes. The MES of a given bank i is then estimated by using the log returns on the bank's stocks in order to proxy for $\frac{w_1^i}{w_0^i}$ and the 5% worst outcomes of the respective region-specific bank sector index during the time windows $[-180; -11]$ (relative to the merger announcement) and $[+11; +180]$ (relative to the deal completion). The statistical significance of the changes in MES are then tested by the use of a standard t-test.
***,**,* denote changes in Marginal Expected Shortfalls, which are significant at the 1%, 5% and 10% level.

Panel A: Deal Characteristics

Deal Value	N	$\Delta IADD$	$\Delta\beta$	ΔSCP	ΔMES
High Deal Value	147	-0.295	0.017	0.014 *	0.005 ***
		(0.198)	(0.496)	(0.059)	(0.004)
Medium Deal Value	189	-0.185	0.027	0.036 ***	0.004 ***
		(0.220)	(0.262)	(0.000)	(0.000)
Low Deal Value	104	-0.122	0.052	0.069 ***	0.002 *
		(0.557)	(0.144)	(0.000)	(0.094)

Relevance	N	$\Delta IADD$	$\Delta\beta$	ΔSCP	ΔMES
High Relevance	90	-0.384*	0.042	0.016	0.004 **
		(0.074)	(0.254)	(0.250)	(0.038)
Medium Relevance	187	-0.308 *	0.054 **	0.056 ***	0.004 ***
		(0.069)	(0.025)	(0.000)	(0.000)
Low Relevance	163	0.006	-0.005	0.025 ***	0.004 ***
		(0.977)	(0.843)	(0.004)	(0.010)

Geographic diversification	N	$\Delta IADD$	$\Delta\beta$	ΔSCP	ΔMES
Cross-border Merger	51	-0.430	0.058	0.019	0.007 **
		(0.269)	(0.129)	(0.208)	(0.249)
Domestic Merger	389	-0.178	0.026	0.039 ***	0.003 ***
		(0.123)	(0.129)	(0.000)	(0.000)

Markets	N	$\Delta IADD$	$\Delta\beta$	ΔSCP	ΔMES
Emerging Markets	24	0.126	-0.032	0.026	-0.002
		(0.608)	(0.691)	(0.462)	(0.669)
Developed Markets	416	-0.226*	0.033 **	0.037***	0.004 ***
		(0.053)	(0.038)	(0.000)	(0.000)

Panel B: Acquirer Characteristics

Profitability	N	$\Delta IADD$	$\Delta\beta$	ΔSCP	ΔMES
High Profitability	196	-0.175	0.037	0.019 **	0.004 ***
		(0.295)	(0.106)	(0.013)	(0.002)
Medium Profitability	119	-0.396 **	0.021	0.035 ***	0.005 ***
		(0.050)	(0.528)	(0.005)	(0.002)
Low Profitability	125	-0.078	0.026	0.064 ***	0.003 **
		(0.723)	(0.349)	(0.000)	(0.026)

Total Assets	N	$\Delta IADD$	$\Delta\beta$	ΔSCP	ΔMES
High Total Assets	105	-0.306	-0.008	0.009	0.003
		(0.237)	(0.778)	(0.187)	(0.183)
Medium Total Assets	144	-0.021	0.029	0.023 ***	0.003 **
		(0.924)	(0.261)	(0.009)	(0.017)
Low Total Assets	191	-0.293 **	0.051 *	0.061 ***	0.005 ***
		(0.028)	(0.058)	(0.000)	(0.000)

Panel C: Merger Environment

Concentration	N	$\Delta IADD$	$\Delta\beta$	ΔSCP	ΔMES
High Concentration	110	-0.118	0.183 ***	0.050 ***	0.002
		(0.577)	(0.000)	(0.001)	(0.124)
Medium Concentration	155	0.157	-0.038 *	0.034 ***	0.002 *
		(0.332)	(0.758)	(0.513)	(0.064)
Low Concentration	175	-0.586***	-0.006	0.031 ***	0.007 ***
		(0.003)	(0.796)	(0.002)	(0.000)

Crisis	N	$\Delta IADD$	$\Delta\beta$	ΔSCP	ΔMES
Pre-crisis	390	-0.095	0.042 **	0.036 ***	0.002 ***
		(0.400)	(0.011)	(0.000)	(0.003)
Crisis	50	-1.081**	-0.063	0.043***	0.018 ***
		(0.010)	(0.241)	(0.000)	(0.000)

Table 8: Sub-sample analysis. The table presents the changes in the systematic risk ($\Delta\beta$), default risk ($\Delta IADD$) and systemic risk (ΔSCP and ΔMES) for different sub-samples of acquirers. The sub-samples are built by using the dummy variables for cross-border mergers, mergers during the financial crisis and mergers in emerging markets and by assigning the mergers to tertiles of the respective idiosyncratic or macroeconomic characteristic.
***,**,* denote changes which are significant at the 1%, 5% and 10% level.

	Risk-Class 1_{DD}		Risk-Class 2_{DD}		Risk-Class 3_{DD}		Risk-Class 4_{DD}		Risk-Class 5_{DD}		Total	
	N	**Δ IADD**	**N**	**Δ IADD**	**N**	**Δ IADD**	**N**	**Δ IADD**	**N**	**Δ IADD**	**N**	**Δ IADD**
Risk-Class 1_{SCP}	23	1.535 **	14	0.672	20	0.488	20	0.186	22	-0.701	88	-0.294
		(0.017)		(0.125)		(0.349)		(0.642)		(0.371)		(0.272)
Risk-Class 2_{SCP}	12	0.727 *	28	0.636 **	17	0.480	12	-0.634	19	-2.171 ***	88	-0.161
		(0.070)		(0.050)		(0.390)		(0.236)		(0.004)		(0.517)
Risk-Class 3_{SCP}	20	-0.139	24	-0.455 **	14	0.139	14	-0.531	16	-3.087 ***	88	-0.779 ***
		(0.426)		(0.038)		(0.822)		(0.158)		(0.000)		(0.000)
Risk-Class 4_{SCP}	26	0.436	12	-0.206	17	-0.092	20	-1.264 **	13	-1.788 **	88	-0.468 **
		(0.115)		(0.702)		(0.846)		(0.025)		(0.029)		(0.040)
Risk-Class 5_{SCP}	18	0.788 *	10	0.430	20	0.350	22	-0.118	18	-0.888	88	0.078
		(0.057)		(0.272)		(0.583)		(0.833)		(0.303)		(0.779)
Total	88	0.567 ***	88	0.206	88	0.287	88	-0.445 **	88	-1.651 ***	440	-0.207 *
		(0.000)		(0.202)		(0.243)		(0.049)		(0.000)		(0.063)

Table 9: Comparison of changes in default risk for different systemic and default risk-classes. The table presents changes in default risk for the merging banks classified in 5 risk-classes. As we are interested in comparing a bank's overall default risk to systemic risk, we use the pre-merger level of the bidders' distance to default rather than industry-adjusted values of default risk to identify risky and less risky banks. Risk-Class 1_{SCP} (Risk-Class 5_{SCP}) indicates the class with the highest (lowest) Systemic Crash Probability (SCP), e.g. the highest (lowest) systemic risk, whereas Risk-Class 1_{DD} (Risk-Class 5_{DD}) marks the class with the lowest (highest) DD, eg. the highest (lowest) default risk.
***,**,* denote Δ IADD, which are significant at the 1%, 5% and 10% level.

	Risk-Class 1_{DD}		Risk-Class 2_{DD}		Risk-Class 3_{DD}		Risk-Class 4_{DD}		Risk-Class 5_{DD}		Total	
	N	**Δ SCP**	**N**	**Δ SCP**	**N**	**Δ SCP**	**N**	**Δ SCP**	**N**	**Δ SCP**	**N**	**Δ SCP**
Risk-Class 1_{SCP}	12	-0.032	14	-0.003	20	-0.025 *	20	-0.024 **	22	0.000	88	-0.016 ***
		(0.110)		(0.763)		(0.050)		(0.046)		(0.990)		(0.005)
Risk-Class 2_{SCP}	12	0.005	28	-0.001	17	0.018 *	12	0.000	19	0.031 **	88	0.011 *
		(0.720)		(0.960)		(0.059)		(0.989)		(0.014)		(0.089)
Risk-Class 3_{SCP}	20	0.043 ***	24	0.028 **	14	0.055 ***	14	-0.002	16	0.064 ***	88	0.037 ***
		(0.002)		(0.044		(0.005)		(0.926)		(0.000)		(0.000)
Risk-Class 4_{SCP}	26	-0.062 *	12	0.009	17	-0.012	20	0.010	13	0.044	88	-0.010
		(0.063)		(0.808)		(0.626)		(0.770)		(0.246)		(0.487)
Risk-Class 5_{SCP}	18	0.186 ***	10	0.150 ***	20	0.149 ***	22	0.179 ***	18	0.132 ***	88	0.161 ***
		(0.000)		(0.003)		(0.005)		(0.002)		(0.005)		(0.000)
Total	88	0.026	88	0.025 **	88	0.038 ***	88	0.041 **	88	0.052 ***	440	0.036 ***
		(0.109)		(0.010)		(0.008		(0.022)		(0.000)		(0.000)

Table 10: Comparison of changes in systemic risk for different systemic and default risk-classes. The table presents changes in systemic risk for the merging banks classified in 5 risk-classes. As we are interested in comparing a bank's overall default risk to systemic risk, we use the pre-merger level of the bidders' distance to default rather than industry-adjusted values of default risk to identify risky and less risky banks. Risk-Class 1_{SCP} (Risk-Class 5_{SCP}) indicates the class with the highest (lowest) Systemic Crash Probability (SCP), e.g. the highest (lowest) systemic risk, whereas Risk-Class 1_{DD} (Risk-Class 5_{DD}) marks the class with the lowest (highest) DD, eg. the highest (lowest) default risk.

***,**,* denote Δ SCP, which are significant at the 1%, 5% and 10% level.

	Variable	Definition
Deal characteristics	Deal	Deal Value (in millions of USD)
	LDVL	Log of the deal value (in millions of USD)
	CROSS	Equals one for cross boarder mergers (zero otherwise)
	RELSIZE	Ratio of the deal value to the acquirer's market value one year before announcement (%)
Acquirer Characteristics	ROA	Pre-tax profits over total assets (%)
	MTBV	Market Value of the acquiring bank divided by the Total Asset Value
	TOTAL	Total Assets (in millions of USD)
	LTOTAL	Log of Total Assets (in millions of of USD)
	OPM	Operating Income over Net Sales or Revenues (%)
	EQUITY	Ratio of Common Equity over Total Assets (%)
	HIGHRISK	This indicator equals one if the bank's per-merger default risk (Distance to Default) is below the 0.25-quartile and zero otherwise.
	$\Delta IADD$	Industry-adjusted distance to default of the acquiring bank.
	ΔDD	Non-adjusted distance to default of the acquiring bank (instrument variable).
Country controls	GDPGR	Annual real GDP growth rate (%)
	UNEMPL	Annual Unemployment rate (%)
	INFL	Lag (1) of annual change of GDP deflator
	POLSTAB	This indicator measures the perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent. Indicator ranges from (-2.5) to (2.5). A higher indicator values indicates greater political stability.
	ROL	The Rule of Law indicator measures the individuals degree of confidence in rules of society and the likelihood of crime and violence. The scores range between 2.5 and 2.5. Higher scores correspond with better outcomes.
	HHI	The Herfindahl-Hirschman Index is computed as the sum of the squared market shares of a countrys domestic and foreign banks.
	NAMERIC	Dummy variable, which equals one if the acquiring bank's home is in North America and zero otherwise.
	EUROPE	Dummy variable, which equals one if the acquiring bank's home is in Europe and zero otherwiseotherwise.
	ASIAPAC	Dummy variable, which equals one if the acquiring bank's home is in Asia/Pacific and zero otherwise.
	CRISIS	Dummy variable, which equals one if the bank merger was completed during the subprime crisis and zero otherwise.

Table 11: Variable definitions. This table reports the definitions of the various variables used in our cross-sectional regressions. Deal characteristics were retrieved from the Thomson One Banker database while acquirer characteristics are from Thomson Reuters Financial Datastream. Country and regulatory environment control variables are taken from the World Bank's World Development Indicator (WDI) database. The variable HIGHRISK is computed based on our estimated per-merger level of default risk and the variables $\Delta IADD$ and ΔDD are taken from our analysis of default risk.

	ROA	MTBV	LTOTAL	OPM	EQUITY	GDPGR	UNEMPL	INFL	POLSTAB	ROL	HHI	LDVL	HIGHRISK	$\Delta IADD$	$DD_{bidder;[-180;-11]}$	ΔDD	RELSIZE	CROSS	NAMERIC	EUROPE	ASIAPAC	CRISIS
ROA	1.00																					
MTBV	0.27	1.00																				
LTOTAL	0.07	0.13	1.00																			
OPM	0.32	0.27	-0.26	1.00																		
EQUITY	0.38	-0.10	-0.39	0.42	1.00																	
GDPGR	0.23	0.25	-0.03	0.16	0.03	1.00																
UNEMPL	0.06	-0.12	0.17	-0.26	-0.16	-0.10	1.00															
INFL	0.09	-0.07	-0.13	-0.09	0.23	-0.10	0.20	1.00														
POLSTAB	-0.13	-0.03	0.18	-0.25	-0.33	0.00	-0.23	-0.27	1.00													
ROL	-0.18	-0.02	-0.11	0.20	-0.05	-0.11	-0.41	-0.37	0.48	1.00												
HHI	-0.09	0.04	0.08	-0.05	-0.07	0.05	-0.13	0.14	0.09	0.04	1.00											
LDVL	0.05	0.05	0.73	-0.15	-0.30	0.02	0.14	-0.14	0.13	-0.11	0.08	1.00										
HIGHRISK	0.03	0.10	-0.32	0.10	0.26	-0.01	-0.11	0.06	-0.06	-0.06	-0.06	-0.23	1.00									
$\Delta IADD$	-0.01	0.07	-0.02	0.00	0.02	0.03	-0.04	0.00	-0.02	-0.02	0.08	-0.05	0.17	1.00								
$DD_{bidder;[-180;-11]}$	-0.09	-0.17	0.51	-0.24	-0.37	-0.03	0.17	-0.04	0.21	0.09	0.04	0.39	-0.56	-0.39	1.00							
ΔDD	0.01	0.11	-0.06	0.09	0.06	0.03	-0.02	-0.03	-0.10	-0.04	0.09	-0.07	0.22	0.90	-0.46	1.00						
RELSIZE	-0.03	0.02	-0.24	0.11	0.01	0.01	-0.08	0.00	0.04	0.12	-0.02	0.18	0.10	-0.07	-0.11	-0.05	1.00					
CROSS	-0.10	0.08	0.48	-0.24	-0.35	0.01	0.07	-0.09	0.17	0.07	0.19	0.25	-0.16	-0.03	0.34	-0.05	-0.18	1.00				
NAMERIC	0.01	-0.04	-0.54	0.50	0.39	-0.04	-0.34	0.11	-0.11	0.40	0.15	-0.40	0.16	0.02	-0.31	0.08	0.15	-0.45	1.00			
EUROPE	-0.09	-0.02	0.52	-0.40	-0.46	-0.11	0.40	-0.14	0.24	-0.08	-0.12	0.39	-0.23	-0.06	0.42	-0.11	-0.08	0.50	-0.79	1.00		
ASIAPAC	-0.06	0.08	0.12	-0.20	0.02	0.24	-0.19	-0.12	-0.05	-0.27	-0.05	0.10	0.07	0.05	-0.05	0.03	-0.10	0.04	-0.43	-0.13	1.00	
CRISIS	0.02	-0.11	0.09	-0.16	-0.04	-0.25	0.01	0.09	-0.17	-0.06	-0.09	0.01	-0.04	-0.13	0.06	-0.33	-0.06	0.07	-0.11	0.06	0.05	1.00

Table 12: Correlation matrix. The table presents the Bravais-Pearson correlation coefficients for our set of idiosyncratic and macroeconomic variables used in our cross-sectional analyses.

Model	1	2	3	4	5	6	7	8	9	10 (IV)
LDVL	-0.015	-0.017	-0.017	-0.017	-0.016	-0.018	-0.015	-0.016	-0.018	-0.017
	(0.305)	(0.273)	(0.252)	(0.268)	(0.277)	(0.238)	(0.312)	(0.305)	(0.230)	(0.272)
CROSS	0.067	0.069	0.058	0.077	0.094 *	0.057	0.066	0.066	0.056	0.059
	(0.189)	(0.176)	(0.271)	(0.177)	(0.097)	(0.274)	(0.194)	(0.191)	(0.290)	(0.267)
RELSIZE	0.034	0.042	0.039	0.041	0.045	0.042	0.032	0.038	0.045	0.041
	(0.573)	(0.490)	(0.511)	(0.498)	(0.451)	(0.481)	(0.582)	(0.534)	(0.454)	(0.519)
ROA	3.790 *	2.879	2.412	2.420	2.430	2.645	2.418	2.942	3.029	2.404
	(0.065)	(0.158)	(0.223)	(0.226)	(0.250)	(0.193)	(0.197)	(0.148)	(0.142)	(0.245)
MTBV	-0.012	-0.009	-0.006	-0.004	-0.005	-0.007	-0.005	-0.008	-0.009	-0.006
	(0.538)	(0.671)	(0.771)	(0.832)	(0.794)	(0.713)	(0.805)	(0.693)	(0.654)	(0.761)
LTOTAL	-0.007	-0.007	-0.008	-0.007	-0.006	-0.009	-0.009	-0.007	-0.006	-0.009
	(0.696)	(0.710)	(0.625)	(0.701)	(0.740)	(0.608)	(0.601)	(0.706)	(0.747)	(0.624)
OPM	0.240	0.304	0.414 *	0.358	0.375	0.449 **	0.381 *	0.290	0.307	0.419 *
	(0.273)	(0.191)	(0.067)	(0.127)	(0.105)	(0.047)	(0.096)	(0.204)	(0.182)	(0.069)
EQUITY	-0.876	-0.729	-0.452	-0.458	-0.553	-0.526	-0.490	-0.715	-0.703	-0.445
	(0.278)	(0.404)	(0.602)	(0.601)	(0.522)	(0.527)	(0.574)	(0.410)	(0.414)	(0.620)
HIGHRISK	-0.055	-0.053	-0.056	-0.058	-0.060	-0.057	-0.056	-0.051	-0.050	-0.059
	(0.173)	(0.180)	(0.161)	(0.149)	(0.132)	(0.155)	(0.157)	(0.193)	(0.204)	(0.148)
$\Delta IADD$	-0.053 ***	-0.053 ***	-0.053 ***	-0.053 ***	-0.053 ***	-0.053 ***	-0.052 ***	-0.053 ***	-0.054 ***	-0.050 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDPGR		0.342	0.330	0.367	0.183	0.195	0.441	0.410	0.311	0.332
		(0.723)	(0.741)	(0.713)	(0.857)	(0.851)	(0.647)	(0.680)	(0.750)	(0.735)
UNEMPL		1.555 **	2.196 **	2.289 ***	2.760 ***	2.413 ***	2.085 **	1.682 **	1.777 **	2.213 ***
		(0.040)	(0.011)	(0.008)	(0.002)	(0.008)	(0.011)	(0.040)	(0.025)	(0.010)
INFL		-0.050	-0.218	-0.455	-0.427	-0.061	0.242	0.087	-0.373	-0.210
		(0.968)	(0.873)	(0.735)	(0.756)	(0.963)	(0.844)	(0.947)	(0.770)	(0.881)
POLSTAB			0.079 *	0.087 *	0.095 *	0.080 *	0.070 *			0.081 *
			(0.099)	(0.069)	(0.054)	(0.099)	(0.077)			(0.095)
ROL			-0.026	-0.049	-0.033	-0.014		0.019		-0.026
			(0.627)	(0.388)	(0.541)	(0.784)		(0.677)		(0.621)
HHI			0.216 *	0.170	0.148	0.228 *			0.226 *	0.210 *
			(0.059)	(0.200)	(0.246)	(0.053)			(0.052)	(0.064)
NAMERIC				0.046						
				(0.367)						
EUROPE					-0.089 *					
					(0.073)					
ASIAPAC						0.047				
						(0.520)				
CRISIS	-0.156 ***	-0.145 ***	-0.115 **	-0.113 **	-0.116 **	-0.118 **	-0.123 **	-0.144 ***	-0.139 ***	-0.112 **
	(0.002)	(0.005)	(0.026)	(0.032)	(0.026)	(0.024)	(0.019)	(0.005)	(0.007)	(0.040)
R2	0.187	0.194	0.202	0.204	0.207	0.203	0.199	0.194	0.197	0.171
Adjusted R2	0.166	0.167	0.170	0.170	0.173	0.169	0.171	0.166	0.169	0.138

Table 13: Determinants of changes in merger related systematic risk. The dependent variable is the change in the bidding bank's beta coeffient. Regressions models (1) through (9) are estimated via OLS with heteroscedasticity consistent Huber-White standard errors, while regression model specification (10) is estimated via 2SLS with ΔDD as our instrumental variable for $\Delta IADD$ (Hausman specification test p-value 1.000). P-Values are denoted in parentheses. The deal characteristics include the log deal value (LDVL), a dummy variable which equals one for cross boarder mergers and zero otherwise (CROSS), and the ratio of the deal value to the acquirer's market value one year before announcement (RELSIZE). The acquirer statistics include the ratio between pre-tax profit and total assets (ROA), the market to book ratio (MTBV), the acquirer's log of total assets (LTOTAL), the operating income over Net Sales or Revenues (OPM), the ratio between common equity and total assets (EQUITY) and the bidding banks' industry adjusted distance to default ($\Delta IADD$). Country control variables include the real GDP growth rate (GDPGR), the annual unemployment rate (UNEMPL), the lag (1) of annual change of GDP deflator (INFL), the political stability (POLSTAB), the Rule of Law (ROL) and the HHI as an indicator market concentration. Moreover we include regional dummy variables in order to measure regional differences. The dummy variable (NAMERIC) equals one if the acquiring bank's home is North America and zero otherwise, the dummy variable EUROPE equals one if the acquiring bank's home is Europe and zero otherwise and we include ASIAPAC which equals one if the bidding bank's home is Asia/Pacific and zero otherwise. Further, we include the dummy variable CRISIS which equals one if the bank merger was completed during the subprime crisis and zero otherwise.
***,**,* denote coefficients, which are significant at the 1%, 5% and 10% level.

Model	1	2	3	4	5	6	7	8	9
LDVL	-0.045	-0.041	-0.060	-0.064	-0.060	-0.063	-0.051	-0.044	-0.054
	(0.661)	(0.693)	(0.566)	(0.542)	(0.566)	(0.549)	(0.620)	(0.674)	(0.599)
CROSS	-0.341	-0.348	-0.477	-0.631	-0.481	-0.481	-0.330	-0.335	-0.464
	(0.402)	(0.394)	(0.255)	(0.166)	(0.288)	(0.251)	(0.419)	(0.417)	(0.263)
RELSIZE	-0.627	-0.651	-0.578	-0.591	-0.579	-0.561	-0.588	-0.635	-0.617
	(0.186)	(0.172)	(0.230)	(0.220)	(0.231)	(0.245)	(0.219)	(0.188)	(0.195)
ROA	-5.771	-3.322	2.463	2.399	2.460	3.847	-0.353	-3.593	-1.922
	(0.705)	(0.835)	(0.880)	(0.883)	(0.880)	(0.816)	(0.983)	(0.823)	(0.904)
MTBV	0.136	0.122	0.095	0.082	0.094	0.086	0.098	0.120	0.118
	(0.369)	(0.431)	(0.545)	(0.603)	(0.546)	(0.585)	(0.530)	(0.444)	(0.449)
LTOTAL	0.067	0.067	0.092	0.079	0.092	0.091	0.082	0.067	0.075
	(0.531)	(0.536)	(0.393)	(0.473)	(0.399)	(0.403)	(0.449)	(0.533)	(0.487)
OPM	-0.781	-0.934	-1.654	-1.205	-1.649	-1.446	-1.420	-0.872	-0.900
	(0.572)	(0.515)	(0.289)	(0.463)	(0.295)	(0.369)	(0.336)	(0.551)	(0.530)
EQUITY	-0.355	-0.951	-2.442	-2.394	-2.428	-2.875	-2.480	-1.013	-0.706
	(0.935)	(0.834)	(0.602)	(0.609)	(0.606)	(0.546)	(0.596)	(0.824)	(0.876)
HIGHRISK	0.917 ***	0.912 ***	0.968 ***	0.981 ***	0.968 ***	0.961 ***	0.927 ***	0.905 ***	0.931 ***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GDPGR		-0.525	-0.875	-1.177	-0.855	-1.673	-1.153	-0.819	-0.813
		(0.936)	(0.895)	(0.859)	(0.898)	(0.806)	(0.859)	(0.902)	(0.900)
UNEMPL		-4.864	-5.579	-6.318	-5.655	-4.284	-8.241	-5.410	-2.792
		(0.456)	(0.438)	(0.383)	(0.462)	(0.574)	(0.237)	(0.437)	(0.674)
INFL		1.385	-2.536	-0.633	-2.508	-1.606	-0.492	0.792	-1.595
		(0.861)	(0.767)	(0.943)	(0.771)	(0.854)	(0.951)	(0.924)	(0.844)
POLSTAB			-0.555	-0.617	-0.557	-0.553	-0.448		
			(0.136)	(0.104)	(0.143)	(0.138)	(0.168)		
ROL			0.198	0.383	0.199	0.268		-0.080	
			(0.625)	(0.402)	(0.625)	(0.530)		(0.820)	
HHI			2.127	2.497 *	2.136	2.198 *			2.075
			(0.104)	(0.069)	(0.113)	(0.095)			(0.112)
NAMERIC				-0.366					
				(0.384)					
EUROPE					0.012				
					(0.977)				
ASIAPAC						0.282			
						(0.600)			
CRISIS	-0.974 ***	-1.001 ***	-1.092 ***	-1.114 ***	-1.092 ***	-1.104 ***	-1.141 ***	-1.007 ***	-0.935 **
	(0.006)	(0.007)	(0.004)	(0.004)	(0.005)	(0.004)	(0.003)	(0.006)	(0.011)
R2	0.057	0.058	0.069	0.070	0.069	0.069	0.062	0.058	0.064
Adjusted R2	0.035	0.029	0.034	0.033	0.031	0.032	0.031	0.027	0.033

Table 14: Determinants of changes in industry-adjusted distance to default. The dependent variable is the change in the industry-adjusted distance to default. The different models are estimated via OLS with heteroscedasticity consistent Huber-White standard errors. P-Values are denoted in parentheses. The deal characteristics include the log deal value (LDVL), a dummy variable which equals one for cross boarder mergers and zero otherwise (CROSS), and the ratio of the deal value to the acquirer's market value one year before announcement (RELSIZE). The acquirer statistics include the ratio between pre-tax profit and total assets (ROA), the market to book ratio (MTBV), the acquirer's log of total assets (LTOTAL), the operating income over Net Sales or Revenues (OPM) and the ratio between common equity and total assets (EQUITY). Further, we include the dummy variable HIGHRISK which equals one if the bank's pre-merger default risk is below the 0.25 quartile and zero otherwise. Country control variables include the real GDP growth rate (GDPGR), the annual unemployment rate (UNEMPL), the lag (1) of annual change of GDP deflator (INFL), the political stability (POLSTAB), the Rule of Law (ROL) and the HHI as an indicator market concentration. Moreover we include regional dummy variables in order to measure regional differences. The dummy variable (NAMERIC) equals one if the acquiring bank's home is North America and zero otherwise, the dummy variable EUROPE equals one if the acquiring bank's home is Europe and zero otherwise and we include ASIAPAC which equals one if the bidding bank's home is Asia/Pacific and zero otherwise. Further, we include the dummy variable CRISIS which equals one if the bank merger was completed during the subprime crisis and zero otherwise.
***,**,* denote coefficients, which are significant at the 1%, 5% and 10% level.

Model	1	2	3	4	5	6	7	8	9	10 (IV)
LDVL	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005
	(0.269)	(0.268)	(0.296)	(0.323)	(0.309)	(0.328)	(0.277)	(0.292)	(0.272)	(0.288)
CROSS	0.008	0.006	0.005	0.017	0.010	0.006	0.005	0.005	0.006	0.004
	(0.696)	(0.777)	(0.810)	(0.449)	(0.667)	(0.795)	(0.787)	(0.815)	(0.787)	(0.836)
RELSIZE	-0.020	-0.019	-0.021	-0.020	-0.020	-0.022	-0.020	-0.020	-0.019	-0.021
	(0.202)	(0.240)	(0.213)	(0.230)	(0.229)	(0.171)	(0.210)	(0.218)	(0.244)	(0.190)
ROA	0.104	-0.009	-0.040	-0.036	-0.038	-0.197	-0.056	0.009	-0.009	-0.037
	(0.908)	(0.991)	(0.962)	(0.967)	(0.964)	(0.815)	(0.946)	(0.991)	(0.992)	(0.965)
MTBV	-0.009	-0.012	-0.012	-0.011	-0.011	-0.011	-0.012	-0.012	-0.012	-0.011
	(0.238)	(0.136)	(0.143)	(0.189)	(0.146)	(0.182)	(0.144)	(0.134)	(0.137)	(0.140)
LTOTAL	-0.012 **	-0.011 **	-0.011 **	-0.010 *	-0.011 **	-0.011 **	-0.011 **	-0.011 **	-0.011 **	-0.011 **
	(0.019)	(0.035)	(0.031)	(0.055)	(0.037)	(0.036)	(0.030)	(0.035)	(0.037)	(0.033)
OPM	-0.047	-0.050	-0.045	-0.081	-0.051	-0.069	-0.042	-0.054	-0.050	-0.048
	(0.547)	(0.514)	(0.582)	(0.357)	(0.550)	(0.410)	(0.595)	(0.474)	(0.515)	(0.561)
EQUITY	-0.149	-0.187	-0.164	-0.168	-0.178	-0.115	-0.163	-0.182	-0.186	-0.168
	(0.582)	(0.489)	(0.546)	(0.544)	(0.510)	(0.673)	(0.544)	(0.495)	(0.490)	(0.536)
HIGHRISK	-0.024	-0.023	-0.023	-0.024	-0.023	-0.022	-0.023	-0.022	-0.023	-0.021
	(0.121)	(0.137)	(0.153)	(0.134)	(0.144)	(0.166)	(0.136)	(0.147)	(0.136)	(0.186)
$\Delta IADD$	-0.012 ***	-0.012 ***	-0.012 ***	-0.012 ***	-0.012 ***	-0.012 ***	-0.012 ***	-0.012 ***	-0.012 ***	-0.014 ***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GDPGR		0.443	0.460	0.485	0.441	0.551	0.453	0.464	0.443	0.459
		(0.214)	(0.211)	(0.188)	(0.240)	(0.150)	(0.207)	(0.208)	(0.214)	(0.212)
UNEMPL		-0.258	-0.197	-0.137	-0.120	-0.343	-0.205	-0.220	-0.257	-0.205
		(0.434)	(0.602)	(0.713)	(0.740)	(0.365)	(0.577)	(0.526)	(0.454)	(0.581)
INFL		0.238	0.280	0.128	0.251	0.175	0.267	0.279	0.236	0.276
		(0.541)	(0.510)	(0.768)	(0.553)	(0.696)	(0.498)	(0.485)	(0.570)	(0.512)
POLSTAB			0.006	0.011	0.008	0.006	0.007			0.005
			(0.761)	(0.578)	(0.682)	(0.770)	(0.668)			(0.795)
ROL			0.002	-0.012	0.001	-0.006		0.006		0.003
			(0.906)	(0.561)	(0.944)	(0.774)		(0.745)		(0.896)
HHI			0.000	-0.030	-0.009	-0.008			0.001	0.003
			(0.997)	(0.565)	(0.862)	(0.868)			(0.977)	(0.943)
NAMERIC				0.029						
				(0.126)						
EUROPE					-0.012					
					(0.528)					
ASIAPAC						-0.032				
						(0.297)				
CRISIS	-0.006	-0.001	0.001	0.003	0.001	0.002	0.001	-0.001	-0.001	-0.001
	(0.655)	(0.923)	(0.955)	(0.850)	(0.959)	(0.875)	(0.945)	(0.950)	(0.927)	(0.954)
R2	0.105	0.110	0.111	0.114	0.111	0.113	0.111	0.110	0.110	0.114
Adjusted R2	0.082	0.081	0.075	0.076	0.073	0.075	0.079	0.079	0.079	0.079

Table 15: Determinants of changes in merger related systematic crash probabilty. The dependent variable is the change in the bidding bank's systematic crash probabilty (SCP). Regressions models (1) through (9) are estimated via OLS with heteroscedasticity consistent Huber-White standard errors, while regression model specification (10) is estimated via 2SLS with ΔDD as our instrumental variable for $\Delta IADD$ (Hausman specification test p-value 1.000). P-Values are denoted in parentheses. The deal characteristics include the log deal value (LDVL), a dummy variable which equals one for cross boarder mergers and zero otherwise (CROSS), and the ratio of the deal value to the acquirer's market value one year before announcement (RELSIZE). The acquirer statistics include the ratio between pre-tax profit and total assets (ROA), the market to book ratio (MTBV), the acquirer's log of total assets (LTOTAL), the operating income over Net Sales or Revenues (OPM), the ratio between common equity and total assets (EQUITY) and the bidding banks' industry adjusted distance to default ($\Delta IADD$). Country control variables include the real GDP growth rate (GDPGR), the annual unemployment rate (UNEMPL), the lag (1) of annual change of GDP deflator (INFL), the political stability (POLSTAB), the Rule of Law (ROL) and the HHI as an indicator market concentration. Moreover we include regional dummy variables in order to measure regional differences. The dummy variable (NAMERIC) equals one if the acquiring bank's home is North America and zero otherwise, the dummy variable EUROPE equals one if the acquiring bank's home is Europe and zero otherwise and we include ASIAPAC which equals one if the bidding bank's home is Asia/Pacific and zero otherwise. Further, we include the dummy variable CRISIS which equals one if the bank merger was completed during the subprime crisis and zero otherwise.
***,**,* denote coefficients, which are significant at the 1%, 5% and 10% level.

Model	1	2	3	4	5	6	7	8	9	10 (IV)
LDVL	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(0.333)	(0.338)	(0.161)	(0.161)	(0.162)	(0.160)	(0.280)	(0.190)	(0.300)	(0.166)
CROSS	0.005 *	0.004	0.004	0.004	0.003	0.004	0.004	0.003	0.005 *	0.004
	(0.097)	(0.137)	(0.205)	(0.272)	(0.312)	(0.201)	(0.147)	(0.299)	(0.096)	(0.221)
RELSIZE	-0.003	-0.003	-0.005 *	-0.005 *	-0.005 *	-0.005 *	-0.004	-0.005 *	-0.004	-0.006 *
	(0.247)	(0.225)	(0.062)	(0.063)	(0.064)	(0.059)	(0.148)	(0.071)	(0.206)	(0.054)
ROA	0.122	0.141	0.159	0.159	0.159	0.151	0.114	0.170	0.132	0.160
	(0.379)	(0.350)	(0.364)	(0.365)	(0.371)	(0.398)	(0.498)	(0.295)	(0.394)	(0.333)
MTBV	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.001
	(0.430)	(0.760)	(0.559)	(0.560)	(0.562)	(0.535)	(0.629)	(0.581)	(0.745)	(0.532)
LTOTAL	-0.002 *	-0.002 *	-0.002 *	-0.002 *	-0.002 *	-0.002 *	-0.002 *	-0.002 *	-0.002 *	-0.002 *
	(0.056)	(0.087)	(0.057)	(0.057)	(0.056)	(0.060)	(0.057)	(0.068)	(0.081)	(0.061)
OPM	-0.007	-0.010	-0.017	-0.016	-0.016	-0.018	-0.006	-0.017 *	-0.010	-0.017
	(0.454)	(0.308)	(0.126)	(0.146)	(0.138)	(0.118)	(0.583)	(0.090)	(0.306)	(0.108)
EQUITY	0.000	-0.015	-0.009	-0.009	-0.007	-0.006	-0.001	-0.008	-0.016	-0.009
	(0.991)	(0.698)	(0.842)	(0.842)	(0.865)	(0.888)	(0.987)	(0.840)	(0.677)	(0.825)
HIGHRISK	-0.004 **	-0.004 **	-0.004 **	-0.004 **	-0.004 **	-0.004 **	-0.004 **	-0.004 **	-0.004 **	-0.003 *
	0.017	0.015	0.032	0.033	0.035	0.033	0.011	0.044	0.012	0.054
$\Delta IADD$	-0.002 ***	-0.002 ***	-0.002 ***	-0.002 ***	-0.002 ***	-0.002 ***	-0.002 ***	-0.002 ***	-0.002 ***	-0.002 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDPGR		0.063	0.097 **	0.097 **	0.099 **	0.102 **	0.069	0.095 **	0.065	0.097 **
		(0.207)	(0.048)	(0.049)	(0.046)	(0.046)	(0.165)	(0.049)	(0.198)	(0.043)
UNEMPL		-0.113 **	-0.066	-0.066	-0.072	-0.073	-0.082 *	-0.054	-0.126 **	-0.068
		(0.023)	(0.201)	(0.201)	(0.192)	(0.180)	(0.095)	(0.294)	(0.013)	(0.183)
INFL		0.054	0.139 **	0.141 **	0.142 **	0.134 **	0.071	0.118 **	0.073	0.138 **
		(0.336)	(0.022)	(0.024)	(0.023)	(0.029)	(0.198)	(0.048)	(0.181)	(0.022)
POLSTAB			0.000	0.000	0.000	0.000	0.004 *			0.000
			(0.895)	(0.909)	(0.957)	(0.899)	(0.050)			(0.966)
ROL			0.009 ***	0.009 **	0.009 **	0.008 **		0.009 ***		0.009 ***
			(0.010)	(0.024)	(0.011)	(0.022)		(0.004)		(0.009)
HHI			-0.014 ***	-0.014 **	-0.013 **	-0.015 ***			-0.013 **	-0.013 **
			(0.006)	(0.020)	(0.013)	(0.007)			(0.013)	(0.012)
NAMERIC				0.000						
				(0.930)						
EUROPE					0.001					
					(0.738)					
ASIAPAC						-0.002				
						(0.680)				
CRISIS	0.014 ***	0.014 ***	0.015 ***	0.015 ***	0.015 ***	0.015 ***	0.016 ***	0.015 ***	0.014 ***	0.014 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R2	0.234	0.254	0.287	0.287	0.288	0.288	0.261	0.282	0.258	0.303
Adjusted R2	0.214	0.229	0.259	0.257	0.257	0.257	0.235	0.256	0.232	0.256

Table 16: Determinants of changes in merger related Marginal Expected Shortfall. The dependent variable is the change in the bidding bank's MES. Regressions models (1) through (9) are estimated via OLS with heteroscedasticity consistent Huber-White standard errors, while regression model specification (10) is estimated via 2SLS with ΔDD as our instrumental variable for $\Delta IADD$ (Hausman specification test p-value 0.9565). P-Values are denoted in parentheses. The deal characteristics include the log deal value (LDVL), a dummy variable which equals one for cross boarder mergers and zero otherwise (CROSS), and the ratio of the deal value to the acquirer's market value one year before announcement (RELSIZE). The acquirer statistics include the ratio between pre-tax profit and total assets (ROA), the market to book ratio (MTBV), the acquirer's log of total assets (LTOTAL), the operating income over Net Sales or Revenues (OPM), the ratio between common equity and total assets (EQUITY) and the bidding banks' industry adjusted distance to default ($\Delta IADD$). Country control variables include the real GDP growth rate (GDPGR), the annual unemployment rate (UNEMPL), the lag (1) of annual change of GDP deflator (INFL), the political stability (POLSTAB), the Rule of Law (ROL) and the HHI as an indicator market concentration. Moreover we include regional dummy variables in order to measure regional differences. The dummy variable (NAMERIC) equals one if the acquiring bank's home is North America and zero otherwise, the dummy variable EUROPE equals one if the acquiring bank's home is Europe and zero otherwise and we include ASIAPAC which equals one if the bidding bank's home is Asia/Pacific and zero otherwise. Further, we include the dummy variable CRISIS which equals one if the bank merger was completed during the subprime crisis and zero otherwise.
***,**,* denote coefficients, which are significant at the 1%, 5% and 10% level.

A Appendix: Nonparametric estimation of the lower tail dependence coefficient

Suppose we are given an i.i.d. sample $\left(X^{(1)};Y^{(1)}\right),\ldots,\left(X^{(m)};Y^{(m)}\right)$ of the random vector $(X;Y)$ with distribution function F having marginal distribution functions G,H and a copula C (we assume that the regularity conditions of Sklar's theorem are fulfilled and that C is thus unique). Then let

$$C_m(u,v) = F_m\left(G_m^{-1}(u), H_m^{-1}(v)\right),\ (u,v)\in[0;1]^2 \tag{14}$$

be the empirical copula with F_m, G_m, H_m being the empirical distributions corresponding to F,G,H.

Further, let $R_{m1}^{(j)}$ and $R_{m2}^{(j)}$ $(j=1,\ldots,m)$ denote the rank of the observations $X^{(j)}$ and $Y^{(j)}$ in the sample. A nonparametric estimator for the lower tail copula is then given by (see Schmidt and Stadtmüller, 2006)

$$\hat{\Lambda}_{L;m}(x,y) \;=\; \frac{m}{k}C_m\left(\frac{kx}{m},\frac{ky}{m}\right) \approx \frac{1}{k}\sum_{j=1}^{m}\mathbf{1}_{\left\{R_{m1}^{(j)}\le kx \text{ and } R_{m2}^{(j)}\le ky\right\}} \tag{15}$$

with some parameter $k\in\{1,\ldots,m\}$ which is chosen by the use of a plateau-finding algorithm (see Schmidt and Stadtmüller, 2006, for some details concerning the optimal choice of the parameter k). By computing $\hat{\Lambda}_{L;m}(1,1)$ we can then estimate the LTD coefficients nonparametrically.