



Contents lists available at ScienceDirect

## Journal of Banking &amp; Finance

journal homepage: [www.elsevier.com/locate/jbf](http://www.elsevier.com/locate/jbf)

# What factors drive systemic risk during international financial crises? <sup>☆</sup>



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## ARTICLE INFO

### Article history:

Received 23 May 2013

Accepted 5 January 2014

Available online 11 January 2014

### JEL classification:

G01

G21

F30

### Keywords:

Financial crises

Systemic risk

Determinants

## ABSTRACT

We analyze the determinants of the contribution of international banks to both global and local systemic risk during prominent financial crises. We find no empirical evidence supporting conjectures that bank size, leverage, non-interest income or the quality of the bank's credit portfolio are persistent determinants of systemic risk across financial crises. In contrast, our results show that global systemic risk in particular is predominantly driven by characteristics of the regulatory regime. We also confirm for the subprime crisis that the banks' contribution to moderately bad tail events in the past predicts the financial sector's crash risk.

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## 1. Introduction

In this paper, we investigate the factors that determine the contribution of international banks to both local and global systemic risks and whether the influence of these factors has been persistent across several historical financial crises. The topic of our paper is of considerable interest to both economists and regulators. Because the simultaneous failure of several banks in a financial system could adversely affect other industries and could have severe macroeconomic implications (see [Chava and Purnanandam, 2011](#)), the limitation of systemic risks and contagion effects in banking are often cited as the primary tasks of bank regulation, as the direct costs of bank failures are much greater than the costs of failures

of non-financial companies (see [James, 1991](#)).<sup>3,4</sup> However, preventing the next financial crisis requires regulators to dependably assess the determinants of systemic risk and to identify systemically important financial institutions (SIFIs).

This paper addresses the need for a better understanding of the determinants of systemic risk by taking a global perspective on prominent historical financial crises. To the best of the authors' knowledge, this is the first study that seeks to identify which factors can explain the cross-sectional variation in the contribution of individual banks to both global and local systemic risks by analyzing several international financial crises. Although the causes and effects of both bank contagion and financial market contagion have been addressed in several studies (see, e.g., [Allen and Gale, 2000](#); [Allen and Gale, 2004](#)), we know relatively little

<sup>☆</sup> We received very useful comments from Carol Alexander (the editor), Nadya Jahn, an anonymous associate editor, an anonymous referee and participants of the WHU Campus for Finance Research Conference 2013 in Koblenz and the Marie Curie ITN Conference on Financial Risk Management & Risk Reporting at the University of Konstanz. We are grateful to Janet Gabrysch, Sandra Gabrysch and Janina Mühlhnickel for their outstanding research assistance. Support by the Collaborative Research Center "Statistical Modeling of Non-linear Dynamic Processes" (SFB 823, project A7) of the German Research Foundation (DFG) is gratefully acknowledged.

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<sup>3</sup> Bank contagion is commonly defined as the transmission of a shock affecting one bank spilling over to other banks or banking sectors (see [Gropp et al., 2009](#)). Similarly, the [Group of Ten \(2001\)](#) defines systemic financial risk as the risk that an exogenous shock will trigger a loss of economic value in a substantial portion of a financial system, causing significant adverse effects on the real economy (for further discussions of systemic risk [DeBandt and Hartmann, 2000](#); [Dow, 2000](#) see also). More recent studies such as the one by [Adrian and Brunnermeier \(2010\)](#) and [Acharya et al. \(2010\)](#) quantify systemic risk by measuring how much a bank adds to the overall risk of the financial system. We adopt these latter definitions of systemic risk and try to measure the potential of systemic financial risk by estimating merging banks' propensity to experience joint extreme adverse effects with the financial sector.

<sup>4</sup> Closely related to bank contagion is the concept of financial market contagion, which encompasses the transmission of shocks between international equity markets, foreign exchange markets and bond markets. See [Forbes and Rigobon \(2002\)](#).

about the fundamental determinants of global financial systemic risk. Recently, the U.S. subprime mortgage crisis triggered several phases of turmoil in international stock, CDS and bond markets (see Brunnermeier, 2009; International Monetary Fund, 2010; Gorton and Metrick, 2012), spurring a surge in theoretical and empirical studies on the extent and magnitude of systemic risk in banking (see, e.g., Acharya et al., 2010). However, the determinants of the contribution of international banks to both local and global systemic risks have not been analyzed to date. Another important question to ask in this context is whether the determinants of banks' contribution to systemic risk are persistent over time and over different financial crises. If systemic risk is indeed driven by the same set of determinants during different times of financial crises, regulators and policy makers could design strategies based on these findings to identify SIFIs and limit the build-up of systemic risks. In contrast, some or all drivers of systemic risk could be unique to each crisis, thus rendering useless any attempt by regulators to limit systemic risk in the next crisis.

We investigate the relationship between several idiosyncratic factors and characteristics of regulatory systems on the one hand and the contribution of banks to both local and global systemic risk around several prominent historical crises on the other hand by using a comprehensive data sample of international banks. We begin our analysis by estimating two measures of moderate and extreme systemic risk. First, we employ the Marginal Expected Shortfall (MES) methodology by Acharya et al. (2010).<sup>5</sup> Second, we make use of the lower tail dependence (LTD) between the stock returns of individual banks and a market index. Closely related to the Marginal Expected Shortfall, the lower tail dependence of a bank with respect to a market index measures the propensity of a bank's stock to jointly crash with the market. While the MES measure is able to capture a bank's contribution to moderately bad tail events, the LTD measures the bank's and the market's joint probability of experiencing an extreme systemic event.

In our analysis, we argue that both measures of systemic risk could be correlated across financial crises. Acharya et al. (2010) argue that regulators could use the information contained in the moderate tail events (MES) to predict the contribution of banks to more extreme tail events. In a similar fashion, Fahlenbrach et al. (2012) show that a bank's stock return during the LTCM crisis predicts its stock performance during the subprime crisis, supporting the view that banks adhere to their risk cultures rather than learning from past mistakes. Persistence in the risk cultures of banks could also result in a positive relationship between moderate tail events in one crisis and extreme systemic risk in a subsequent crisis. If bank managers do not adjust a firm's risk culture as a result of a negative stock performance, they are even less likely to adjust the bank's risk-taking due to an elevated level of systemic risk, which affects the bank only indirectly. Moreover, the costs of the bank contributing more to systemic risk can be socialized among the remaining market participants. On the contrary, banks that are not disciplined in posing a threat to the financial system could even be encouraged to engage in more excessive risk-taking. In accordance with the risk culture hypothesis of Fahlenbrach et al. (2012), banks whose contribution to systemic risk rose in one crisis could thus be the banks that contributed significantly to extreme systemic risk in a following crisis. In contrast, regulators could systematically identify relevant banks during a crisis and force these banks to limit their risk exposure and, in turn, decrease their contribution to future financial instability. Conversely, banks that did not pose a systemic threat in a previous crisis could have benefited from lax regulations in the build-up to the next crisis. Following

what we refer to as the regulation hypothesis, a bank's MES around a crisis event and its LTD with the bank sector during a subsequent crisis could be negatively correlated.

We empirically analyze our main research questions and find no evidence in support of conjectures from the previous literature (see, e.g., Beltratti and Stulz, 2012) that bank size, leverage, non-interest income or the quality of banks' credit portfolios are persistent determinants of systemic risk across financial crises. For several crises, idiosyncratic variables and characteristics of regulatory systems as well as deposit insurance schemes help explain a significant portion of the cross-sectional variation in the changes in banks' contribution to systemic risk. The sets of determinants of systemic risk, however, are often unique to each crisis and thus negate any claims that certain factors persistently drive systemic risk over time.

Our analysis of moderate and extreme systemic risk shows that most financial crises are characterized by significant increases in moderate systemic risk. At the same time, the empirical evidence of the changes in the probability of an extreme crash of the financial system across financial crises is, at best, ambiguous. For example, banks in both North America and Europe suffered a significant increase in their contributions to extreme systemic risk at the beginning of the subprime crisis. Consistent with the notion of a flight to safety, however, this increase was reversed for European banks around the time of the default of Lehman Brothers. For the LTCM crisis and the burst of the Dotcom bubble, the contribution to extreme systemic risk decreased on average for international banks, confirming the results of Bartram et al. (2007) that financial crises in the past do not generally lead to increases in systemic risk and contagion effects in the future.

The distinction between a bank's contribution to local and global systemic risk provides us with further insights into the factors that drive systemic risk during financial crises. Several of the bank characteristics that we use to explain both moderate and systemic risk lose their statistical and economic significance when shifting focus from local to global systemic risk. Most dramatically, for several crises, a bank's contribution to the probability of an extreme crash of the global banking sector can only be explained by the country-specific characteristics of the regulatory system and the deposit insurance schemes.

We also find that a bank's contribution to the moderately bad tail events of the banking sector before the subprime crisis can indeed be used to predict the probability of an extreme crash of the banking sector at the beginning of the subprime crisis and at the time of the Lehman Brothers default. Our results support the regulation hypothesis, as the banks that contributed most strongly to moderate systemic risk in the past contribute less to extreme systemic risk in the future, and vice versa. The results we find on the determinants of local and global systemic risk hold up in a variety of robustness checks. Most importantly, our analyses on systemic risk are supported by an additional analysis of the changes in banks' default risk during financial crises.

Our paper is most closely related to the analysis of Bartram et al. (2007), where both wealth effects and default risk effects are estimated for a global sample of banks. In contrast to their study, however, we differentiate default risk from systemic risk, concentrating on an empirical analysis of the effects of systemic risk during periods of financial market turmoil. Additionally, Bartram et al. (2007) do not analyze the cross-section of the various risk effects, nor do they analyze the financial crisis of 2007–2009. Our paper is also related to the work of Brunnermeier et al. (2012) on U.S. banks; we extend their work by examining the influence of the regulatory environment on global systemic risk. We also extend the recent work of Bekaert et al. (2012), who study contagion during the subprime crisis. They find evidence for a strong contagion effect from domestic equity markets to domestic equity portfolios. Although their work is concerned with equity

<sup>5</sup> Because the MES methodology is closely related to the  $\Delta$ CoVaR measure of Adrian and Brunnermeier (2010), we opted for a probabilistic measure of systemic risk as a complement to the MES measure, rather than using both MES and  $\Delta$ CoVaR.

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