Systemic risk and financial regulation

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CHAPTER 1

Introduction

1.1 Background and motivation

The outbreak of the 2008 Global Financial Crisis (GFC) increased interest in systemic risk from both researchers and policy makers due to its far-reaching and pronounced repercussions on financial and economic activities.[1] Systemic risk is the risk of collapse of an entire financial system triggered by a systemic event (De Bandt and Hartmann, 2000). Alternatively, Rochet and Tirole (1996) refer to systemic risk as "the propagation of an agent's economic distress to other agents linked to that agent through financial transactions" (p. 733); Billio et al. (2012) define it as "any set of circumstances that threatens the stability of or public confidence in the financial system" (p. 537), while Acharya (2009) considers a financial crisis as systemic "if many banks fail together, or if one bank's failure propagates as a contagion causing the failure of many banks" (p. 224).[2] These papers define systemic risk in different ways, but they all highlight that it is about distress of the whole financial system or many institutions to-

[1] For instance, in the United States (US), 504 banks were closed by a federal or state banking regulatory agency between 2008 and 2014 (see Figure 3.2). New loans to borrowers fell by 79% during the peak of the GFC in the fourth quarter of 2008 relative to the peak of the US credit boom in the second quarter of 2007 (Ivashina and Scharfstein, 2010). The commercial paper market nearly dried up and ceased being perceived as a safe haven during the GFC (Kacperczyk and Schnabl, 2010). World-wide syndicated cross-border lending shrank by 58% in 2009 (De Haas and Van Horen, 2012) while world trade flows declined by about 12% (Chor and Manova, 2012).

[2] For extensive discussions of the concept of systemic risk and comprehensive literature surveys, see De Bandt and Hartmann (2000), Benoit et al. (2017) and Silva et al. (2017).

gether rather than individual institutions, and recognize the important role of interconnectedness of individual institutions.

In line with the emergence of many definitions of systemic risk, several systemic risk measures have been proposed which aim to capture systemic risk from different angles. To name a few, ΔCoVaR of Adrian and Brunnermeier (2016) measures systemic risk as the change in the value-at-risk (VaR) of the financial system conditional on an institution being under distress relative to its median state. Systemic expected shortfall (SES) of Acharya et al. (2017) measures a financial institution's systemic risk contribution as its propensity to be undercapitalized when the system as a whole is undercapitalized. Acharya et al. (2017) show that a bank's SES is positively associated with the bank's leverage and its marginal expected shortfall (MES). MES captures the bank's losses in the tail of the financial system's loss distribution. Given the predictive power of the MES for the SES, some research uses MES instead of SES as a systemic risk measure (e.g., see Weiß et al., 2014; Idier et al., 2014; and Huang, 2018). SRISK of Brownlees and Engle (2017) measures the systemic risk contribution of a financial firm as its capital shortfall conditional on a severe market decline. The distress insurance premium (DIP) of Huang et al. (2009) measures systemic risk as the insurance premium required to cover distressed losses in the banking system. Billio et al. (2012) argue that any measure of systemic risk must capture the degree of connectivity of market participants and propose to measure connectedness based on principal components analysis and Granger-causality networks. Patro et al. (2013) demonstrate that daily stock return correlation is a simple, robust, forward-looking, and timely systemic risk indicator. In addition to the above bank-specific systemic risk measures, Allen et al. (2012) derive an aggregate systemic risk measure, designated CATFIN. For each month, they calculate three VaR measures based on the cross-sectional returns of financial firms using the generalized Pareto distribution, skewed generalized error distribution and nonparametric methods and then take the arithmetic average of the three VaR measures as the CATFIN.

Some of the above measures have been widely used to study systemic risk of financial institutions in different countries. For instance, López-Espinosa et al. (2012) apply the ΔCoVaR approach to large international banks and find that short-term wholesale funding is a key determinant in triggering systemic risk episodes. Weiß et al. (2014) apply the MES approach to estimate international banks' contributions to global systemic risk during financial crises and find that characteristics of the regulatory regime in place are important drivers of global

systemic risk. Laeven et al. (2016) apply the CoVaR and SRISK approaches to examine bank-specific determinants of systemic risk during the GFC and unfold the key roles of bank size and capital. For an overview of the recent literature on systemic risk, we refer to Silva et al. (2017) who analyze different characteristics of 266 published articles related to systemic risk.

In this thesis, we are interested in the application of the above measures to the Chinese banking system. China has achieved remarkable progress in reforming its banking system, but the banking system still faces numerous challenges in the post-GFC era (e.g., see Li, 2014; and Aizenman, 2015). Due to China's increasing influence on the global economy (see Feldkircher and Korhonen, 2014; and Qiu and Zhan, 2016), a banking crisis in China would create enormous problems not only in China but also in other countries. It therefore seems valuable to analyze systemic risk in the Chinese banking system. However, only a few studies have investigated systemic risk in the Chinese banking system (e.g., see Chen et al., 2014; and Wang et al., 2015) and they do not compare the results of different systemic risk measures. Therefore, we apply multiple systemic risk measures to Chinese banks and compare their performance in Chapter 2.

The GFC also led to a wave of financial regulatory reforms to address systemic risk and promote financial stability. For example, the Basel Committee on Banking Supervision developed a new global regulatory framework for more resilient banks and banking systems (i.e., Basel III) in 2010 to help avoid the build-up of systemic vulnerabilities. The main changes of Basel III compared to Basel II are increased capital requirements and the introduction of a leverage ratio requirement and liquidity requirements (see Basel Committee on Banking Supervision, 2010; and Hannoun, 2010). These new requirements were scheduled to be phased in between 2013 and 2019.[3] The general manager of the Bank for International Settlements (BIS) stressed that the implementation of Basel III would considerably increase the quality of banks' capital and significantly increase the required level of their capital (see Caruana, 2010). As holding extra capital is costly, banks may maintain their capital at the required levels, but research suggests that US banks' capital ratios were well above the regulatory minimum during 1986–2001 (Flannery and Rangan, 2008) and there was substantial variation in banks' capital ratios (Gropp and Heider, 2010). With regard to this research and the gradually stricter capital requirements, we wonder

[3] See "Group of Governors and Heads of Supervision announces higher global minimum capital standards" released by the Basel Committee on Banking Supervision on 12 September 2010, which is available at `www.bis.org/press/p100912.pdf`.

how bank capitalization evolved since Basel I. In addition, are banks with more capital associated with lower insolvency risk and therefore with lower expected stock returns? We examine these questions in Chapter 3.

At the country-level, a prominent financial regulatory reform was the enactment of the Dodd-Frank Act (DFA) in July 2010 in the US, which led to a sweeping overhaul of the US financial regulatory system. The DFA consists of 16 chapters focusing on different elements of the US financial system. At the end of 2015, nearly 70% of the DFA's requirements have been met with finalized rules according to the Dodd-Frank Progress Report.[4] No doubt, the DFA has brought many changes to the US financial system, but its effectiveness in reducing systemic risk and promoting financial stability remains unclear. We examine whether the DFA has contributed to reduce systemic risk in the US banking system by means of a counterfactual analysis in Chapter 4.

As such, this thesis consists of three original studies to address crucial issues about systemic risk and financial regulation. These studies apply state-of-the-art methods and yield instructive findings. We elaborate our methods, findings and contributions in the following subsections.

1.2 Outline, methodologies and main findings

In this thesis, we center on systemic risk and financial regulation to provide three original studies. Below we briefly describe the research question, methodology and findings of each study.

In Chapter 2, we examine systemic risk in the Chinese banking system by estimating the change in conditional value at risk (ΔCoVaR) of Adrian and Brunnermeier (2016), the marginal expected shortfall (MES) of Acharya et al. (2017), and the systemic impact index (SII) and the vulnerability index (VI) of Zhou (2010). The ΔCoVaR and MES approaches are widely used to monitor financial institutions by central bankers and bank regulators and have a high impact in academia (Benoit et al., 2013). The SII and VI approaches are based on a different estimation method (i.e., Extreme Value Theory). These measures, calculated using daily equity returns, are used to capture individual banks' systemic risk contributions. We investigate a sample of publicly traded banks in China for the 2007–2014 period and find that the above measures show different patterns, capturing different aspects of Chinese banks' systemic risk contribu-

[4] See `www.davispolk.com/Dodd-Frank-Rulemaking-Progress-Report` for detailed reports.

tions. However, rankings of banks based on these measures, except for the MES measure, are significantly and highly correlated. The time series results for the CoVaR and MES measures suggest that systemic risk in the Chinese banking system decreased after the GFC but started rising in 2014.[5]

In Chapter 3, we investigate the evolution of US bank capitalization and examine whether bank capitalization matters for bank stock returns. For this purpose, we use three different proxies for bank capitalization, namely the book capital ratio (BCR), the market capital ratio (MCR), and the stressed capital ratio (SCR). We find that the MCR and the SCR have similar dynamics, while the BCR develops very differently. Our cross-section and time-series regressions suggest that the MCR and the SCR are negatively associated with bank stock returns *only* during the 1994–2007 period while the BCR is positively associated with bank stock returns *only* during the 2008–2014 period. These results suggest that the effect of bank capitalization on bank stock performance depends on the capital measure used and the period examined.

In Chapter 4, we introduce a two-step strategy — a synthetic control method (SCM) combined with a difference-in-differences method (DID) — to evaluate the effectiveness of the Dodd-Frank Act (DFA). We apply the SCM of Abadie and Gardeazabal (2003) and Abadie et al. (2010) to construct a synthetic control group (SCG) of European banks as a comparison for the treatment group of US banks. The SCG has a very similar trend in systemic risk compared to the treatment group in the pre-DFA period and therefore provides a counterfactual for systemic risk of the treatment group in the post-DFA period. To evaluate the significance of the difference between systemic risk of both groups, we perform the DID analyses accounting for several macroeconomic variables and for shocks from the GFC, the European sovereign debt crisis and European financial regulatory changes. We find consistent evidence that the DFA has had no statistically significant impact on systemic risk in the US banking system. Our results suggest that endogenous risk persistence is the main driver of the decrease of systemic risk in the US banking system in the post-DFA period.

In Chapter 5, we draw conclusions from the above studies and discuss the policy implications.

[5] We cannot provide time series results of the SII and the VI due to the restriction of sample length.

1.3 Contributions

This thesis provides three original studies on different topics related to systemic risk and financial regulation. The studies are built on an extensive literature. Below we highlight our main contributions to the literature.

Our first contribution is the analysis of systemic risk in the Chinese banking system by employing recently developed market-based measures of systemic risk. We show that the measures yield different rankings of banks' systemic importance, but the correlations among rankings based on different measures are significant. We also find that the similarities and differences are time-varying. These findings suggest that financial regulators should be aware of the differences among (changes in) different systemic risk measures and not rely on one single measure. This study contributes to the literature (e.g., Rodriguez-Moreno and Peña, 2013; Benoit et al., 2013; Pankoke, 2014; Sedunov, 2016; Benoit et al., 2017; and Kleinow et al., 2017) by comparing various systemic risk measures for a country for which these measures had not been analyzed extensively before. In view of the increasing importance of Chinese banks in the international financial system, we think this is a major step forward.

Our second contribution is to help understand the effects of bank capital on bank performance. The recent financial crisis and financial regulatory reforms have encouraged researchers to study bank capital from different perspectives. Several closely related papers examine the impact of bank capital on bank stock returns, but they primarily focus on the GFC period (Demirgüç-Kunt et al., 2013) or on regulatory capital measures (Pelster et al., 2018). An exception is Bouwman et al. (2018b) who examine the book- and market-based capital measures, as done in our research. The main difference between the study of Bouwman et al. (2018b) and ours is the way to distinguish between different economic times, which results in somewhat different findings. Bouwman et al. (2018b) define bad times as those months when value-weighted bank stock return volatility exceeds its 80th percentile during 1994–2015 and find that high-capital banks have higher risk-adjusted stock returns only in bad times. In contrast, we distinguish between tranquil and turbulent periods according to the frequency of bank failures where, on average, the tranquil period (1994–2007) and the turbulent period (2008–2014) contain 5 and 72 bank failures per year, respectively. We find that banks with higher book-valued capital ratios have higher risk-adjusted stock returns only during 1994–2007, while banks with higher market-valued capitals have higher risk-adjusted stock returns only during 2008–2014.

Two other papers examine how bank capital affects bank value (Mehran and Thakor, 2011), and bank survival and market share (Berger and Bouwman, 2013), but they do not explore the asset pricing implications of bank capital. Besides, they do not provide insights into the evolution of bank capitalization. We show that US bank capitalization in the past three decades steadily increased according to the book capital ratio, but experienced a period of build-up and one of erosion coupled with the changes of financial regulation and the outbreak of financial crises according to the market capital ratio. Our cross-section and time-series regression analyses show that the effect of bank capitalization on bank stock performance depends on the capital measure used and the period examined. At last, we establish that bank capital measures, to some extent, proxy for exposures to systematic risk factors.

Our third contribution is the empirical evaluation of the effectiveness of the DFA in reducing systemic risk. A few studies have examined the impact of the DFA on market discipline (Balasubramnian and Cyree, 2014), bank risk-taking and market risk (Akhigbe et al., 2016; and Andriosopoulos et al., 2017), credit risk of banks (Acharya et al., 2018), and market participants' reactions to its passage (Acharya et al., 2016; and Gao et al., 2018). Overall, these studies find mixed evidence for the effectiveness of the DFA, but they do not examine the DFA's impact on systemic risk. We contribute to this literature by examining the effectiveness of the DFA in reducing systemic risk. Based on our counterfactual analysis, we find no evidence in support of the DFA's effectiveness. Our empirical evidence calls for further improvement of the DFA. Our empirical approach, which is a new combination of the synthetic control method and the difference-in-differences method, can be used to evaluate other policies, such as the passage of the Financial CHOICE Act, which aims to repair the DFA.

An important characteristic of this thesis is that we examine diverse topics about systemic risk and financial regulation, and aim to provide cutting edge knowledge in different aspects. However, each topic in this thesis can be easily expanded for deeper understanding. In Chapter 5, we discuss possible ways to expand our studies.