



The impact of imposing capital requirements on systemic risk



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ABSTRACT

This paper examines the impact of imposing capital requirements on systemic risk. We use a static model on financial institutions' risk-taking behavior to quantify the systemic risk in the cross-sectional dimension in both regulated and unregulated systems. Although imposing a capital requirement can lower individual risk, it simultaneously enhances systemic linkage within the system. By using a proper systemic risk measure combining both individual risk and systemic linkage, we show that systemic risk in a regulated system can be higher than that in an unregulated system. In addition, we analyze a sufficient condition under which the systemic risk in a regulated system is always lower.

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1. Introduction

Regulations in the financial sector are designed to limit risk-taking of financial institutions and thus prevent potential financial crises. The failure of the investment bank Lehman Brothers in 2008 almost resulted in a complete meltdown of the US and EU financial system. This raised questions about existing regulatory standards, such as the Basel I and II Accords, with the main criticism being that these standards do not focus on the stability of the financial system as a whole. Policy debates point toward macro-prudential regulations as a means of overcoming the shortage in the existing regulations. The word “macro-prudential” is seen as the opposite of “micro-prudential”, with the latter referring to incumbent regulations that focus on limiting the risk-taking behavior of individual financial institutions only. Academic research has attempted to document what went wrong with micro-prudential regulations, and consequently provide recommendations for regulatory reform. This paper contributes to this literature by studying the impact of imposing capital requirements on systemic risk. We find that capital requirements may fail to limit systemic risk in the cross-sectional dimension and consequently create instability in the financial system.

Conceptually, there are two ways in which capital requirements may have an impact on systemic risk. On the one hand, effective

capital requirements may reduce banks' individual risk-taking and consequently help to reduce systemic risk, because individual risk is an important driver of systemic risk. On the other hand, however, banks' response to capital requirements may enhance linkage within the system and consequently increase systemic risk. Hence, reducing individual risk may not simultaneously reduce the overall systemic risk. In order to compare the tradeoff between the two impacts, this paper therefore conducts an overall systemic risk analysis, while seeking to identify the scenarios in which capital requirements may help to reduce systemic risk.

The term “systemic risk” is defined as the risk that a large proportion of the financial system will fall into crisis or distress, thus having an adverse impact on the macro economy.¹ We distinguish systemic risk in two dimensions: the time dimension (i.e. interaction between the financial system and the macro economy) and the cross-sectional dimension (interconnectedness across financial institutions). Micro-prudential regulation fails to limit systemic risk on both dimensions. On the time dimension, the evolution of banks' risk-taking behavior may result in a procyclicality problem. Time-invariant micro-prudential regulation may enhance such a problem and thus lead to high systemic risk.² Recent studies have drawn attention to the other dimension of systemic risk

¹ For an overview on the systemic risk, see de Bandt and Hartmann (2001) and Allen et al. (2009).

² See, for example, Borio et al. (2001), Borio and Zhu (2008), Brunnermeier et al. (2009), Shin (2009) and Zhu (2008).

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– the cross-sectional dimension. Interconnectedness within the financial system arises either directly through channels such as interbank lending³ or indirectly through financial institutions having common exposures. The latter is usually a consequence of diversification at an individual level.⁴ This study seeks to quantify the impact of capital requirements on the cross-sectional dimension of systemic risk.

We model banks' risk-taking behavior under two scenarios: a regulated system and an unregulated system. Banks choose their asset decomposition by optimizing their portfolio with respect to a return-downside risk utility. They are interconnected through their common risk exposures. Thus, the degree of the interconnectedness, or in other words, systemic linkage, is determined by the similarity between their respective banking activities. The key feature in the model is that financial institutions rebalancing their portfolio in order to comply with the capital requirements end up with more similar portfolios. In turn, this enhances systemic linkage within the system. Although the individual risk of each institution in the regulated system is lower, the systemic linkage within the system is higher. We employ a systemic risk measure combining individual risk with systemic linkage so as to compare the systemic risks in the two cases. We find that, under certain condition, systemic risk can be higher in a regulated system. From our model, we derive a sufficient condition under which the systemic risk in a regulated system is always lower.

This study is closely related to that of Acharya (2009), which shows in a multi-period general equilibrium model that micro-prudential regulation seeking to mitigate banks' individual risk can in fact accentuate systemic risk. The key feature of that model is that micro-prudential regulation imposes an implicit "too-many-to-fail" guarantee that motivates banks to take correlated risks *ex ante*. Although we draw a similar conclusion, our model differs from that of Acharya (2009) in three respects. Firstly, our model shows the higher dependence in the regulated system to be an endogenous consequence of banks' individual risk management rather than a strategic choice toward systemic risk-shifting. The higher dependence under regulation in Acharya (2009) stems from "systemic moral hazard": banks strategically choose higher correlated risks in a regulated system. In our model, by contrast, banks do not have such a strategic motivation. The higher dependence under regulation in our model is a consequence of individual risk management. We show that even if "systemic moral hazard" is absent, imposing a capital requirements may nevertheless increase systemic risk on the cross-sectional dimension. Secondly, our model is simpler in that it excludes the dynamic on the time dimension. Thirdly, the tractability of the model makes it possible to identify scenario in which capital requirements can help reduce systemic risk.

This study also compares with existing literature on the impact of capital requirements on individual risk-taking, based on a portfolio approach. Initiated by Kahane (1977) and Koehn and Santomero (1980), a stream of literature focuses on bank portfolio positions when capital requirements are imposed. Under a mean-variance utility, they concluded that banks that are sufficiently risk-seeking will choose a riskier portfolio when regulated. This raises the criticism that capital requirements may actually enhance risk-taking.⁵

³ See, for example, Allen and Gale (2000), Freixas et al. (2000), and Dasgupta (2004).

⁴ See, for example, Lagunoff and Schreft (2001), de Vries (2005) and Wagner (2010).

⁵ Other theoretical models also show the risk enhancing effect of capital requirements based on bank incentives. See, for example, Boot and Greenbaum (1993), Blum (1999), Flannery (1989) and Hellmann et al. (2000). For a survey of modeling the impact of capital requirements, see VanHoose (2007).

These early studies are based on a flat capital requirement, without taking asset risk into account. Alternatively, Kim and Santomero (1988) studied the risk-weighted capital requirement and found that if risk weights are optimized, capital requirements can help reduce individual risk. In all these studies, the banking system is represented by a single bank, with its *individual* risk automatically recognized as the risk in the *system*. Our model goes beyond this approach in two aspects. Firstly, we consider a mean-downside risk utility and rule out the potential risk-enhancing effect of capital requirements. Secondly, we base our model on a two-bank system with heterogeneous risk aversions.⁶ This allows a systemic risk feature on the cross-sectional dimension. In turn, our model is effective in showing that even if capital requirements reduce individual risk, they may increase systemic risk simultaneously.

Also of relevance to this study is the stream of literature on measuring systemic risk. Although this study employs only the systemic risk measure proposed by Segoviano and Goodhart (2009), our qualitative conclusion is not limited to this specific choice. This is due to the fact that most systemic risk measures in literature share the feature of combining systemic linkage and individual risk. For measures on systemic risk and systemic importance of financial institutions, see Adrian and Brunnermeier (2008), Tarashev et al. (2009, 2009b), Huang et al. (2009) and Zhou (2010a).

Our finding on the limitations posed by capital requirements has direct policy implications. The sufficient condition that guarantees the systemic risk reduction impact of capital requirements is based on a comparison of the assets and liabilities sides of the balance sheets of all institutions within the system. It can therefore be verified only if one has all relevant information and can form a helicopter view of the entire system. This supports the view that regulatory reform should focus on a macro-prudential approach. In addition, we find that capital requirements can be effective in reducing systemic risk in financial systems consisting of institutions that are sufficiently similar in terms of banking activities, capital requirement can be effective in reducing systemic risk. In contrast, macro-prudential regulation is particularly important when regulating a financial system of heterogeneous financial institutions with different banking activities. In such a system, it is vital to identify the systemically important financial institutions (SIFIs) and to impose proper prudential regulations on them so as to manage the systemic risk.

The paper is structured as follows. Section 2 presents the general setup of the model. Section 3 analyzes the impact on individual risk of imposing capital requirements. The main results on comparing systemic risks in regulated and unregulated systems are discussed in Section 4. Section 5 considers policy discussions and potential extensions of this study. Proofs of the results are postponed to Appendix A.

2. Model

We introduce the general setup of our model in Section 2.1 This is followed by the discussion of the heavy-tailed feature on asset returns in Section 2.2. Section 2.3 discusses various assumptions that are useful in simplifying the analysis.

2.1. General setup

Consider a financial system consisting of two banks. Each bank can invest in two risky projects and the risk-free rate. The returns of

⁶ For other literature examining the heterogeneous reactions of banks to the imposition of capital requirement, see Almazan (2002) and Kopecky and VanHoose (2006). These studies, however, do not further evaluate systemic risk.

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