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# Macroprudential regulation and macroeconomic activity

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ABSTRACT

I develop a dynamic stochastic general equilibrium model to examine the impact of macroprudential regulation on banks' financial decisions and the implications for the real sector. I model an occasionally binding capital requirement constraint and analyze its costs and benefits. This friction means that the banks refrain from valuable lending. At the same time, capital requirements provide structural stability to the financial system. I show that higher capital requirements can dampen the business cycle fluctuations and raise welfare. I also show that switching to a countercyclical capital requirement regime can help reduce volatility and raise welfare. Finally, by means of the welfare analysis, I also obtain the optimal level of capital requirement.



"The reason I raise the capital issue so often, is that, in a sense, it solves every problem" – Alan Greenspan to the Financial Crisis Inquiry Commission

## 1. Introduction

The banking sector is highly regulated today. There are different forms of regulation, but capital regulation is of considerable importance because bank capital is an extremely good indicator of the financial soundness of the bank and also its risk taking abilities. Berger et al. (1995) and Kahn and Santos (2005) contain surveys on the motivations behind capital regulation. Bank equity is of great importance but has not really been given its due by traditional monetary macroeconomics although the trend seems to have been changing recently. In most bank related work, the focus is on reserve/liquidity requirements and how they affect the decision to accept demand deposits. In these studies, the bank capital regulation is discussed mostly as an afterthought. My work aims to fill this gap by focusing on bank capital requirements and studying the implications for the real economy.

This paper contributes to two strands of literature. The first is the literature that addresses the question of whether capital requirements are a boon or a bane for the economy. Giammarino et al. (1993) and Hellmann et al. (2000) talk about the benefits of capital requirements owing to the moral hazard problem arising from deposit insurance. Admati et al. (2013) propose implementing much stricter capital requirements. The authors say that the capital requirements should be as high as 20–25% which is much higher than the current FDIC regulations. More recently, Pessarossi and Weill (2015) use data on Chinese commercial banks and show that higher capital ratios improve the cost efficiency of banks. The question that immediately comes to mind is, are there no costs of these capital requirements? If there are indeed no costs, why not have 100% capital requirements and have all bank assets financed by equity. Van den Heuvel (2008) talks about the welfare implications of these requirements and shows that increasing capital requirements can lead to a non-negligible decline in welfare. Do the costs outweigh the benefits? Or is it the other way around? What is the net impact on welfare? There has been no consensus reached on this entire issue and it is the subject matter of a large body of ongoing work. I explore these questions in greater detail by incorporating both the costs and benefits of capital requirements in a single framework.

The second strand of literature that my work relates to is the one that explores how financial frictions might have adverse real consequences. Kiyotaki and Moore (1997), Bernanke et al. (1999), and Gertler and Kiyotaki (2010) are some of the major papers in this literature, but this is by no means an exhaustive list. Gertler and Kiyotaki (2010) study financial intermediation and its effect on the business cycle. However, they assume an always binding flow of funds constraint, which is necessary to derive some intuitive

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analytical results. Additionally, there is no capital requirement constraint in their model. In this paper I study macroprudential policy keeping the setup similar to the one of Aiyagari and Gertler (1999) and Gertler and Kiyotaki (2010). I not only allow for an explicit capital requirement constraint for the bank, but also acknowledge the fact that such a constraint is only occasionally binding. There is an emerging strand of literature that studies the interaction between monetary policy and macroprudential policy (Angelini et al., 2012) and Agenor and Pereira da Silva (2014)). In contrast, the model presented here is real, i.e. it only analyzes the implications, of implementing macroprudential policy, for the real sector. The aim of the paper is not to analyze questions such as coordination between monetary and macroprudential policies. It is for this reason that I abstract from nominal frictions like price and wage rigidities.

The difference between actual bank equity and the minimum requirements is defined as the capital buffer. The bank holds a capital buffer so that it remains compliant with the regulatory requirements should there be an economic downturn. There is one immediate benefit of this approach. De Wind (2008) and Den Haan and Ocaktan (2009) document that it might well be that the constraint is binding in the steady state but not off the steady state. Even in that case, the steady state results are greatly affected. However, it must be acknowledged that solving such models with occasionally binding constraints can be computationally intense. Standard perturbation methods cannot be applied. I use the penalty function method, originally proposed by Judd (1998). Other applications of this method can be found in Den Haan and Ocaktan (2009) and Preston and Roca (2007) among others.[2]

To elaborate a bit more, I develop a dynamic stochastic general equilibrium model with a representative household, a representative bank, and a non-financial firm sector. The role of the bank is to intermediate funds between the household and the non-financial firms. The bank is also subject to an occasionally binding capital requirement constraint. In the absence of regulation, the bank has an incentive to increase leverage and thereby increase its lending. Given that the impact of an economic downturn is proportional to the leverage, the economy will shrink more if the bank's assets start defaulting. The mechanism will be the standard pecuniary externalities and the financial accelerator mechanism, to be explained in detail further below. I explore two alternative capital requirement regimes in this paper. In the first half of the paper I maintain a fixed capital requirement regime. Later I introduce countercyclical requirements and show that this moderates the business cycle and also raises net welfare. This paper is the first that studies an occasionally binding bank capital requirement constraint in a dynamic general equilibrium setting. Another contribution of this paper is methodological. Having always binding constraints does help us derive closed form solutions, but we should be looking to incorporate asymmetries to make the models suitable for policy analysis. The motivation for this lies in the fact that recessions tend to be sharper than booms, as has been observed in the data. To achieve this end, I use the penalty function methodology to solve the model and perform a third-order approximation.

The rest of the paper is organized as follows. Section 2 presents some stylized facts about the equity-asset ratio of commercial banks in the United States. Sections 3 and 4 introduce the model and discuss the numerical solution methodology. Section 5 puts forward the calibration. Section 6 studies the countercyclical capital requirement regime. Section 7 presents the numerical results. Section 8 discusses the welfare analysis. Finally, Section 9 concludes. The tables and figures are in the appendix.

[2] For details, see Section 5 on numerical solution.

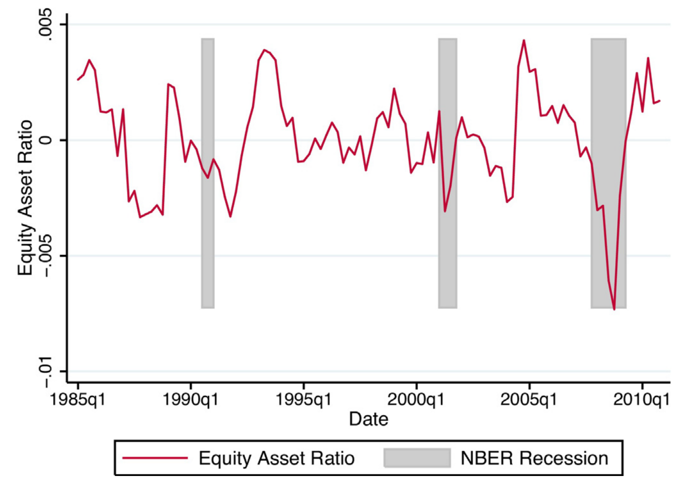


**Fig. 1.** Time plot of the equity-asset ratio.

## 2. Stylized facts about the equity-asset ratio

At the very outset, let us look at some stylized facts about the equity-asset ratios of the commercial banks in the United States. Fig. 1 shows the time plot of the equity asset ratio since 1985. The equity shown above is obtained by subtracting the total liabilities from the total assets. The data cover 104 quarters from 1985:Q1 to 2010:Q4. The source of the data is the consolidated report of condition and income, referred to as the call reports.[3] The equity asset ratio exhibits a procyclical pattern, as one would expect. The reason for that is that during the recessions the credit risk materialization is high and the amount of non-performing assets (NPA) on a bank's balance sheet rises, which in turn causes the equity to shrink, liabilities roughly remaining constant.

Fig. 2 shows the co-movement of the equity-asset ratio with two main real variables, namely the output gap and the gross private domestic investment in the economy.[4]

The series co-moves or rather the equity-asset ratio seems to lead the series for output and investment. Intuitively, as the equity-asset ratio falls, the regulatory constraints start to bind. The adjustment cannot come from the numerator as it is difficult to raise fresh equity when the economic scenario is adverse. As a result, the bank must adjust the assets. The deleveraging by banks in turn creates a credit crunch causing a decline in investment and output. The data show that this feedback takes roughly four quarters.

## 3. The model

The model builds on Aiyagari and Gertler (1999) and Gertler and Kiyotaki (2010). Owing to the presence of capital requirements, the model deviates from the Modigliani–Miller framework. I abstract from some of the other frictions such as nominal price and wage rigidities and habit formation in consumption.

### 3.1. The environment

There is a continuum of non-financial firms of mass unity, split into capital goods producers and final goods producers. The latter firms produce the final output of the economy by employing labor

[3] These data can be downloaded from the website of the Federal Reserve Bank of Chicago.

[4] The data are available in the FRED database of the Federal Reserve Bank of St. Louis. The output gap is the HP filtered real GDP series using the smoothing parameter $\lambda = 1600$.