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Capital and liquidity in a dynamic model of banking

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ABSTRACT

This paper analyzes capital requirements in combination with a particular kind of cash reserves, that are invested in the risk-free asset, from now on, compensated reserves. We consider a dynamic framework of banking where competition may induce banks to gamble. In this set up, we can capture the two effects that capital regulation has on risk, the capital-at-risk effect and the franchise value effect (Hellman et al., 2000). We show that while capital alone is an inferior policy, compensated reserves, will complement capital requirements, by creating franchise value, and are therefore efficient in solving moral hazard problems.

1. Introduction

The recent financial crisis has re-opened a debate concerning the stability of the banking system and the use of safety nets. Deposit insurance systems and safety nets, in general, create a conflict for governments: although they prevent banking panics and their spill over effects, they may also reduce market discipline and consequently increase the probability of occurrence of such crises.There is therefore no doubt on the need to adopt measures that limit the risk that banks take in order to have a stable system. Establishing capital requirements is one of those measures adopted by regulators since the mid 1980s. The common justification for bank capital is the reduction in moral hazard generated by deposit insurance. It is argued that if shareholders have a larger stake in the bank, the incentives to engage in risk are lower because shareholders are less likely to be bailed out than depositors. The positive effects of capital requirements on risk have been widely analyzed from a theoretical point of view (see Buser et al. (1981), Repullo (2004) or Morrison and White (2005)). Nevertheless, other studies have reached the opposite result (Besanko and Kanatas, 1996; Blum, 1999; Koehn and Santomero, 1980 or Gennotte and Pyle (1991)). Overall, the theoretical literature has raised doubts about the effects of capital requirements on risk (Hellman et al., 2000; Gale, 2010) and Plantin (2015).

In particular, Hellman et al. (2000) analyze moral hazard in a dynamic model, and show that capital requirements are not an efficient tool. On one side, increased capital requirements induce banks to take lower risk projects since they are more exposed to losses on these projects, and so they will decide to undertake safer ones, thus reducing their probability of failure. This is the capital-at-risk-effect, usually contemplated in the literature. However, there is another effect at place. As the amount of capital is increased, the per-period future profits of the bank decrease, and hence, the franchise value decreases. This dynamic effect of capital, the negative franchise-value effect, is ignored in static models. Hence, the total effect of capital on risk is ambiguous, depending on which effect prevails. The authors show that Pareto efficient outcomes can be achieved by adding interest rate controls as a regulatory instrument. This result is in line with Keeley's well-known paper (Keeley, 1990). Keeley argues that banking competition erodes the value of banks' franchise values. He finds a significant relationship between competition, reduction in franchise values and increase in the number of bank failures in the US during the 1980s. In Hellman et al. (2000) an interest rate cap creates charter value.

We extend Hellman et al. (2000) in order to analyze capital and compensated liquidity requirements. We show how a combination of capital and compensated reserves turns out to be efficient in order to solve the moral hazard problem. The advantage of compensated reserves is that they always increase the franchise value, while the effect of capital alone is ambiguous. We also demonstrate that both policies complement each other. Finally, our proposal improves over the one described in Hellman et al. (2000), a policy of capital and interest rate controls. We do not need to limit competition in order to create charter value. A cap on interest rates, would increase competition from the non-banking sector. "Shadow banks" or non-banks institutions would have higher incentives to move into financial

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intermediation, creating time-inconsistency problems for the regulator. Our proposal avoids this issue.

We build on the model by Hellman et al. (2000). We consider a bank operating for T periods. There is deposit insurance and so the bank faces moral hazard problems. In particular, it can choose between two projects, a safe asset or a risky one, that yields a lower expected return. However, the gambling asset has greater return in case of success. Banks are subject to prudential regulation by the government, and are required an amount of capital. We show that in the competitive equilibrium, banks would voluntarily hold no capital, and under certain conditions, would invest in the gambling asset. In this context capital requirements alone are an inferior policy (Hellman et al., 2000). We extend this setup and analyze jointly capital and compensated reserves requirements. We show how for a given level of capital, implementing a policy of compensated reserves requirements can be Pareto efficient, and avoids the problems generated by a policy of interest rate caps.

Recently, a growing strand of literature has looked at the interaction between liquidity and capital instruments. The underlying argument in these papers is that these tools are not independent.[1] Along these lines Repullo (2005) examines the role of a lender of last resort. He demonstrates that contrary to capital, liquidity requirements do not influence banks' moral hazard. de Nicolo et al. (2014) examine the role of capital, liquidity and Prompt Corrective Actions (PCA) in a dynamic model of banking. Overall, their results support the argument that capital and liquidity requirements can be seen as substitutes. There exists an inverted U-shaped relationship between bank lending, welfare, and capital requirements but liquidity requirements unambiguously reduce lending, efficiency and welfare. Similarly, Vives (2014) shows, in a model of financial crisis, that solvency and liquidity requirements are partial substitutes. Calomiris et al. (2015) also develop a theory of liquidity requirements. They look at the interaction between capital and liquidity, in a context where both policies can influence liquidity and insolvency risk. They show that cash holdings improve bank incentives to manage risk in the remaining, non-cash portfolio of risky assets. In our case, contrary to these papers we find that capital and compensated reserves are complementary policies.

The rest of the paper is organized as follows. Section 2 presents the basic features of the model. Section 3 examines the decentralized economy with banks and no regulation. Section 4 analyzes both capital and compensated liquidity requirements, as complementary instruments to solve the moral hazard problem, introduced by deposit insurance. Capital regulation with interest rates caps is discussed in Section 5. Finally, Section 5 contains a policy debate and Section 6 summarizes the concluding remarks.

2. The model

The model is based on Hellman et al. (2000). We consider a bank operating for T periods. In each period, the bank offers an interest rate r_i on its deposits. There is deposit insurance in this economy and consequently, the volume of deposits depends only on the interest rate offered. The bank competes with other banks that offer an interest rate r_{-i} on their deposits. The total volume of the bank' deposits are $D(r_i, r_{-i})$, where the volume of deposits increases in the bank's own interest rate and decreases in the competitors' one ($D_1 > 0$, $D_2 < 0$). The bank is subject to a capital requirement that is a proportion of the deposits it mobilizes $kD(r_i, r_{-i})$. Therefore, total assets invested are equal to $(1 + k)D(r_i, r_{-i})$.

The bank faces moral hazard problems since its asset allocation decision is done after funds have been raised. In particular, this bank can choose between two projects: project I is the safe asset, that yields a return R with probability one. Project II, or the gambling asset, yields a return R^H with probability p and R^L with probability $(1 - p)$. The prudent asset has higher expected return ($R > pR^H + (1 - p)R^L$), but the gambling asset has greater return in case of success ($R^H > R$). We also assume that $R^L = 0$, which guarantees that in case of failure the bank is closed.

Banks are subject to prudential regulation by the government. Therefore, if a bank were to gamble and it fails, the bank would lose its charter value and it would be closed. In this economy, the regulator can observe the return of the bank at the end of the period but it is not able to detect good investments by monitoring.

Finally, it is assumed that bank capital is costly. The opportunity cost of capital (ρ) is exogenous and $\rho > R$.[2]

In this paper, our idea is to analyze capital requirements in combination with a particular kind of cash reserves, that are invested in the risk-free asset. We will refer to them, from now on, as compensated reserves. By assumption, these reserves are lost, whenever the bank fails.

3. Competitive equilibria and capital

This benchmark section, that characterizes the equilibrium in the economy without regulation, is based on Hellman et al. (2000).

We will derive the expected discounted profits of the bank with the two alternative investment choices. First, the per period profit of a bank that chooses the safe investment is: $\pi_P(r_i, r_{-i}) = b_P(r_i)D(r_i, r_{-i})$, where $b_P(r_i) = R(1 + k) - r_i - \rho k$, that is, the benefit per unit of deposit net of costs.

On the other side, the profit from investing in the gambling asset is $\pi_G(r_i, r_{-i}) = b_G(r_i)D(r_i, r_{-i})$, where $b_G(r_i) = p[R^H(1 + k) - r_i] - \rho k$. In this case, with probability p, the project is successful, depositors are paid and the bank receives the difference. With probability $1 - p$, the bank is closed and the banker looses the charter.

Banks maximize the expected discounted profits, $V = \sum_{t=0}^{T} \delta^t \pi^t$. As in Diamond (1989), we will look at the limit as $T \longrightarrow \infty$. Banks will choose strategies corresponding to an infinitely repeated static Nash equilibrium.

The sequence of events is as follows: For a given level of capital, banks offer a deposit rate. Depositors then choose the bank in which to deposit their money. Finally, banks select the project, the returns are realized and the regulator supervises the balance sheet of banks. It can be seen that the investment process takes place in two steps, the deposit funding and the project selection step.

We focus first on the project selection step, assuming that banks have $D(r_i, r_{-i})(1 + k)$ units to invest.

The expected discounted profits from investing in the safe asset are: $V_P(r_i, r_{-i}) = \sum_{t=0}^{\infty} \delta^t \pi_P^t = \pi_P(r_i, r_{-i})/(1 - \delta)$, while the expected discounted profits from investing in the gambling asset are: $V_G(r_i, r_{-i}) = \sum_{t=0}^{\infty} \delta^t \pi_G^t = \pi_G(r_i, r_{-i})/(1 - p\delta)$.

Banks will choose to invest in the safe asset if $V_P(r_i, r_{-i}, k) \geq V_G(r_i, r_{-i}, k)$ and will invest in the gambling asset otherwise. From the previous inequality, the following no gambling condition can be derived:

$$\pi_G(r_i, r_{-i}) - \pi_P(r_i, r_{-i}) \leq (1 - p)\delta V_P(r_i, r_{-i}, k) \tag{1}$$

where $(\pi_G - \pi_P)$ is the one period rent from gambling and should be less than the lost in the charter value (δV_P) that the bank gives up if the gamble fails, that happens with probability $(1 - p)$. From this condition, we can derive the threshold rate for the bank to choose to invest in the safe asset (assuming a symmetric equilibrium in deposit rates):

$$\hat{r}(k) = \frac{(1 - \delta)}{1 - p}[R - pR^H](1 + k) + \delta[R(1 + k) - \rho k] \tag{2}$$

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[1] The Basel Committee has proposed a new global set of liquidity requirements, the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR), to complement capital requirements.

[2] This is a standard assumption in the banking literature, see Brusco and Castiglionesi (2007) or Allen et al. (2011), among others.

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