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Liberalization, Prudential Supervision, and Capital Requirements: The Policy Trade-Offs

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**Liberalization, Prudential Supervision, and Capital Requirements:
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Abstract

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While deregulated financial markets and strong competition are commonly viewed as prerequisites for successful economic development, recent empirical evidence suggests that financial liberalization, if not well phased, can lead to costly financial crises. This paper focuses on the roles of minimum capital requirements and prudential supervision in promoting financial stability during financial liberalization. The paper extends the Hellmann, Murdock, and Stiglitz model to analyze the effects of prudential supervision and demonstrates the trade-off between the quality of supervision and the level of minimum capital requirements. Where prudential supervision is poor, higher capital requirements are optimal.

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I. INTRODUCTION

This paper investigates the importance of the quality of prudential supervision during financial liberalization and its implications for the level of minimum capital requirements. The analysis is based on an extension of the theoretical model proposed by Hellmann, Murdock, and Stiglitz (2000). By now there is a consensus that financial liberalization, while necessary for financial development, needs to be handled with care. Furthermore, empirical studies have found poor prudential supervision to be an important factor behind more "bumpy" liberalizations. However, few theoretical papers address explicitly the role of prudential supervision during liberalization or highlight the trade-off between the quality of supervision and the level of minimum capital requirements. This paper finds that the level of capital requirements should be increased to compensate for poor supervision.

While there is an extensive literature on the benefits of financial liberalization,[2] recent econometric studies have pointed out the importance of first strengthening prudential supervision: Lindgren, Garcia, and Saal (1996) have found that prudential regulation and supervision[3] are weak in most countries that experienced financial crises; Williamson and Mahar (1998) have observed that the countries with high-quality supervision have experienced less costly financial crises; Demirgüç-Kunt and Detragiache (1998) have pointed out that the dangers of liberalization are more pronounced in countries where the institutions to support financial markets were less developed. Finally, Rossi (1999) has found that postliberalization financial fragility is exacerbated by weak supervision.

In practice, prudential supervision was often inadequate at the time recent liberalizations took place. In a series of papers, Caprio and Honohan[4] have characterized the evolution of prudential supervision during financial liberalization. Prior to liberalization, there is often little need for prudential supervision: interest rates and credit allocation are under direct government control; the number of banks is small and competition is limited; public ownership of financial institutions is widespread. When liberalization occurs, bank competition and the sophistication of financial instruments both increase. Bank managers, often lacking experience in traditional banking, see the franchise value of their banks deteriorate, while the opportunities for risky investments increase. To keep up with these developments, supervisory agencies need to redirect their efforts toward more sophisticated, risk-based, supervision. But this takes time, in part because the number of

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[2] McKinnon (1973), Shaw (1973), King and Levine (1993), Levine (1997), Fry (1997), Beck, Levine, and Loayza (2000).

[3] Prudential regulation refers to the legal framework and supervision to the implementation of the prudential regulations.

[4] See, for example, Caprio and Honohan (1999).

supervisors, their skills, and the level of their remuneration may remain inadequate for a long period.[5]

Capital requirements are a readily available tool to combat excessive risk-taking during liberalization. However, these are frequently applied without taking into account country specifics, such as the quality of supervision. A substantial literature exists on the effects of capital requirements on risk-taking behavior.[6]

The innovation of this paper is to link explicitly the quality of prudential supervision and the level of capital requirements in a theoretical model. The paper finds that, if the supervisory authorities are ineffective during financial liberalization, competition reduces the franchise value of banks and may entail costs for governments and depositors, as banks are encouraged to take excessive risks with depositors' funds. If prudential supervision is weak, capital requirements should be set at higher levels than those designed for more developed supervisory capacities. A broad policy conclusion is that the minimum capital requirements should not be applied uniformly, but need to be adjusted to compensate for extra risks associated with poor quality supervision.

The rest of the paper is organized as follows. Section II extends Hellmann, Murdock, and Stiglitz's theoretical model of capital requirements and deposit controls in order to analyze the trade-off between the quality of prudential supervision and the level of minimum capital requirements, as well as the importance of sequencing liberalization to prevent financial crises. Section III presents the main conclusions and limitations of the analysis.

II. FINANCIAL LIBERALIZATION AND IMPERFECT SUPERVISION

To analyze the effects of liberalization with varying quality of prudential supervision, the paper extends a model developed by Hellmann, Murdock, and Stiglitz (hereafter known as the HMS model). The HMS model shows that as competition in the financial market increases, banks find it necessary to compete for deposits by offering higher deposit rates, thus narrowing profit margins. The limited liability of banks creates moral hazard as it makes highly risky investments more attractive, thereby passing on the cost of failed "gambles" to the general public. At a sufficiently high deposit rate, a bank will find gambling optimal. In the model, the only incentive for banks to invest prudently is their franchise value, which is put at risk when a bank starts gambling. One of the main results of the original model is that in highly competitive markets there is no equilibrium at which a bank will choose to invest prudently. The HMS model finds that two policy tools—capital requirements[7] and deposit rate ceilings[8]—can be used to increase the

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[5] Villanueva and Mirakhor (1990), Caprio and Summers (1993), Dekle and Kletzer (2001). Brownbridge and Kirkpatrick (2000) also provide a useful summary of the difficulties involved in strengthening prudential supervision in developing countries during financial liberalization.

[6] Santos (2000) presents a comprehensive overview of the literature on bank capital regulation.

[7] The authors also mention a case in which, for sufficiently farsighted banks, higher capital requirements can destroy franchise value. However, the model generally investigates the case in which the banks are

(continued…)

bank's franchise value sufficiently to render gambling unattractive. The HMS model assumes an ex post perfectly informed supervisor. Once a bank achieves negative equity, it is closed down.

This paper extends the HMS model to allow for imperfect monitoring by bank supervisors and analyzes how the quality of direct supervision affects the optimal level of minimum capital requirements. This is particularly relevant for episodes of financial liberalization where prudential supervision does not keep up with changes in the environment and therefore may sometimes leave gambling banks in business, even after a gamble has failed. Examples of imperfect monitoring include inadequate regulation, risk of litigation by bank owners, lack of qualified staff, low salaries leading to lax implementation of prudential regulations, political interference, or reluctance to acknowledge explicitly the fiscal costs of bank closure in hopes the gamble will later succeed.[9]

A. Model with Varying Quality of Prudential Supervision

In the model, there are many homogeneous banks. A bank sets the deposit rate (r_i) taking into account the minimum capital requirements. Holding capital is expensive: it has an opportunity cost of capital ρ such that $\rho > \alpha$. Therefore, in the absence of supervision, the bank will not hold own capital.[10] Having collected funds from depositors, a bank chooses to invest in one of two assets: a "prudent" asset, with a known return α, and a "gambling" or risky asset. The gambling asset offers high return γ when the gamble succeeds and low return β when the gamble fails ($\beta < \gamma$). The probability that the gamble succeeds is θ. After the banks have received the returns on their investments, the supervisor audits their balance sheets and decides which banks are allowed to operate in the next period.

Each bank is required to maintain an own capital ratio of k percent of deposits. Thus the profit margin from prudent investing is equal to $m_p(r_i, k) = \alpha(1+k) - \rho k - r_i$, and the profit margin from gambling is $m_g(r_i, k) = \theta[\gamma(1+k) - r_i] - \rho k$. Per period profits are equal to $\pi_p(r_i, r_{-i}, k) = m_p(r_i, k)D(r_i, r_{-i})$ and $\pi_g(r_i, r_{-i}, k) = m_g(r_i, k,)D(r_i, r_{-i})$, respectively. The expected social return from gambling is always less than that from the prudent asset

$\alpha > \gamma\theta + (1-\theta)\beta$. However, owing to the bank's limited liability, if the gamble fails the highly risky asset offers a higher private return to the bank and imposes a cost on the government insurance agency.

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sufficiently myopic, and, therefore, overall higher capital requirements create incentives to invest prudently.

[8] In view of empirical evidence (including Barth, Caprio, and Levine, 1999 and 2004) that deposit rate ceilings do not preserve the franchise values of banks and are therefore not effective for prudential regulation, this paper does not consider deposit rate ceilings.

[9] Caprio and Honohan (1999) and Brownbridge and Kirkpatrick (2000).

[10] A bank could hold higher capital as a signaling device; this motive is not explored in the model.

The innovation of the model is the fact that the supervisor does not always close a bank with insufficient equity. The parameter $q \in [0,1]$ reflects the quality of supervision, where q is equal to 1 when each gambling bank with negative end-of-period net equity is closed. With probability $(1-q)$, a gambling bank that made a losing bet stays in business due to the supervisory forbearance and, perhaps using government funds, can bring net equity back to zero.[11] The probability of survival of a gambling bank is higher in an environment of poor supervision.

Given the parameters, a bank maximizes its expected discounted profits $V=\Sigma_{t=0}^{T}\delta^{t}\pi_{t}$, where $\pi_{p,g}(r_i, r_{-i}, k) = m_{p,g}(r_i, k,) D(r_i, r_{-i})$. The main result of the model is the "No-Gambling-Condition" (NGC). The NGC states that, for a bank not to gamble, the expected profits from prudent investment must be higher than those from gambling:

$$V_p(r_i, r_{-i}, k) = (1-\delta)^{-1} \pi_p(r_i, r_{-i}, k) \geq V_g(r_i, r_{-i}, k, q)=[1-\delta (1-(1-\theta)q)]^{-1} \pi_g(r_i, r_{-i}, k,) \qquad (1)$$

Rearranging the expression emphasizes the underlying intuition:

$$(1-\theta)\delta V_p (r_i, r_{-i}, k) \geq \pi_g(r_i, r_{-i}, k) - \pi_p(r_i, r_{-i}, k) \qquad (2)$$

This means that for a bank to choose prudent investment, the one period rent from gambling, $\pi_g(r_i, r_{-i}, k) - \pi_p(r_i, r_{-i}, k)$, must be less than the lost franchise value, $\delta V_p (r_i, r_{-i}, k)$, if the gamble fails.

From the NGC the threshold deposit rate r* is derived, such that a bank offering a deposit rate of $r > r^*$ will find it optimal to gamble rather than to invest prudently:

$$r^* = \frac{1}{1-\delta(1-q)} \times \left[(1-\delta)\frac{(\alpha-\theta\gamma)}{1-\theta}(1+k)+q\delta\left(\alpha(1+k_L)-\rho k_L\right) \right] \qquad (3)$$

The derivatives of r* with respect to q and k are always positive. As r* is always increasing in the quality of supervision q, $\frac{\partial r*}{\partial q} > 0$, improving the quality of supervision will raise the NGC and make prudent investment optimal at higher levels of competition. Furthermore, the extreme values of q can be substituted into the NGC to solve for r*(q=1) and r*(q=0).

$$r^*_{(q=1)} = (1-\delta)\frac{(\alpha-\theta\gamma)}{1-\theta}(1+k)+\delta\left(\alpha(1+k_L)-\rho k_L\right) \qquad (4)$$

$$r^*_{(q=0)} = \frac{(\alpha-\theta\gamma)}{1-\theta}(1+k). \qquad (5)$$

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[11] This paper does not explicitly consider the fiscal cost to the government of bank recapitalization.

An important result is that, for the admissible values of k (0<k<1), the critical interest rate corresponding to the poorest quality of supervision always lies below the rate corresponding to the highest quality of supervision, r*(q=1) > r*(q=0). While the marginal return from gambling remains the same, the probability of a gambling bank surviving for another period is increased. As a result, gambling becomes more attractive when the quality of supervision is poor. If ex post monitoring is perfect (q=1), the NCG is identical to the expression in the original HMS model.

The rest of the first order conditions are as expected:

$$\frac{\partial r*}{\partial \alpha} > 0 \qquad \frac{\partial r*}{\partial \gamma} < 0 \qquad \frac{\partial r*}{\partial \theta} < 0 \qquad \frac{\partial r*}{\partial \rho} > 0$$

The critical interest rate increases as the prudent asset becomes more attractive. The interest rate decreases as the gambling asset becomes more attractive, either due to the higher return offered on the gambling asset (γ) or due to the increased probability of the "good" outcome from gambling (θ). The rate r* increases also when the opportunity cost of capital (ρ) raises the "tax" on gambling.

To complete our analysis, we derive from the first order condition for a bank's profit maximization problem, $\max_{r,k}\{V_{p,g}(r_i, r_{-i}, k, q)\}$, the optimal deposit rate that can be offered by a prudently investing bank (r_p) for each level of the required capital ratio (k). To model competition explicitly, the first order condition is combined with the measure (ε) for the elasticity of supply of deposits to the interest rates offered by banks:

$\varepsilon = \frac{\partial D(r_i, r_{-i})}{\partial r_i} \times \frac{r}{D}$. The elasticity ($\varepsilon$) increases as banking competition intensifies.

Thus we arrive at the expression for a deposit rate of a prudently investing bank:

$$r_p = \left(\alpha(1+k) - \rho k\right) \times \frac{\varepsilon}{\varepsilon + 1} \tag{6}$$

Figure 1. Effects of Poor Supervision on the NGC
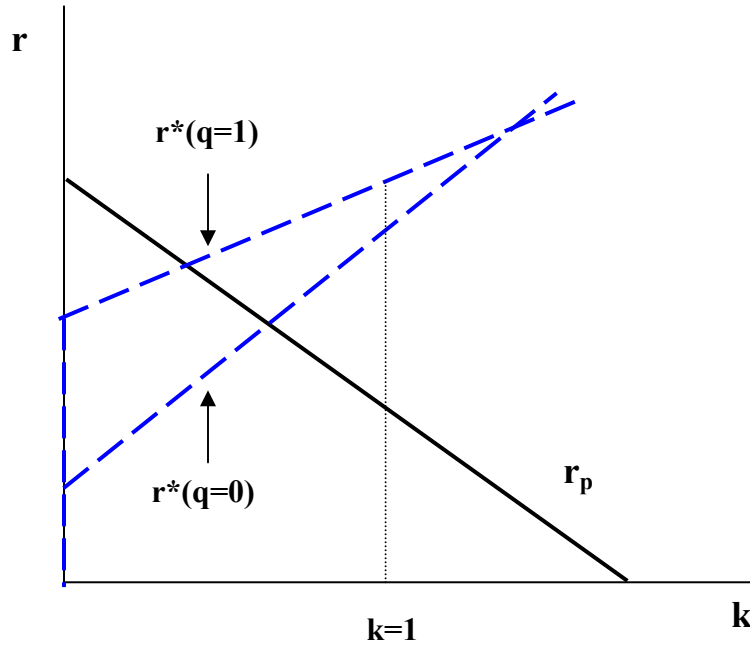
The upper limits of no-gambling regions are defined by the upward sloping dashed curves shown in Figure 1 for, respectively, high-quality, $r^*(q=1)$, and low-quality, $r^*(q=0)$, supervision. The downward sloping solid line is the optimal deposit rate (r_p) that shows the relationship between the capital requirement (k) and the deposit rate offered by a bank investing prudently. The crossing of the two lines, the critical deposit rate (r^*) and the optimal rate (r_p), allows us to find the optimal level of capital required to satisfy the NGC and prevent a bank from gambling.

Proposition 1. *As $r^*(q=1)$ is always above $r^*(q=0)$ for admissible values of k ($0<k<1$), the minimum capital requirement necessary to prevent gambling by financial institutions can always be lower in well-supervised than in poorly-supervised markets.*

## B. Model with Financial Liberalization

The model also has implications for the sequencing of financial liberalization. Financial liberalization can be broken down into three stages. In stage 1, prior to liberalization, banking supervision is weak and financial markets are repressed. In stage 2, markets are liberalized (deposit rate ceilings and restrictions on entry are removed), but prudential supervision, which takes a longer time to improve, remains poor. Liberalized financial markets place banks under competitive pressure, while supervision remains too weak to accurately assess their activities. In stage 3, in addition to financial liberalization, high-quality prudential supervision is established.

Prior to liberalization, a country can sustain the prudent equilibrium by either implementing a low capital ratio (k_1) supported by the deposit rate ceiling $r_p(k_1)$, or using capital requirements alone at level $k_2>k_1$. As markets are liberalized, both types of the capital requirements become ineffective. As soon as the deposit rate ceilings are removed, the lower capital requirement (k_1) does not prevent gambling. As competition intensifies due to liberalization, the elasticity of deposit supply increases,

$\varepsilon \to \infty$, and the function for optimal prudent rate, $r_p = \left(\alpha(1+k) - \rho k\right) \cdot \dfrac{\varepsilon}{\varepsilon+1}$, becomes

steeper, $r_p(\varepsilon_H)$ instead of $r_p(\varepsilon_L)$, rendering the higher capital ratio (k_2) also ineffective, as demonstrated in Figure 2. In a liberalized market, a bank also has greater freedom in choosing its credit portfolio. The variance of returns on the gambling asset might also increase (an increase in γ and/or θ). Therefore minimum capital requirements might need to increase further.

Figure 2. Effect of Removed Deposit Rate Ceilings and Increased Competition
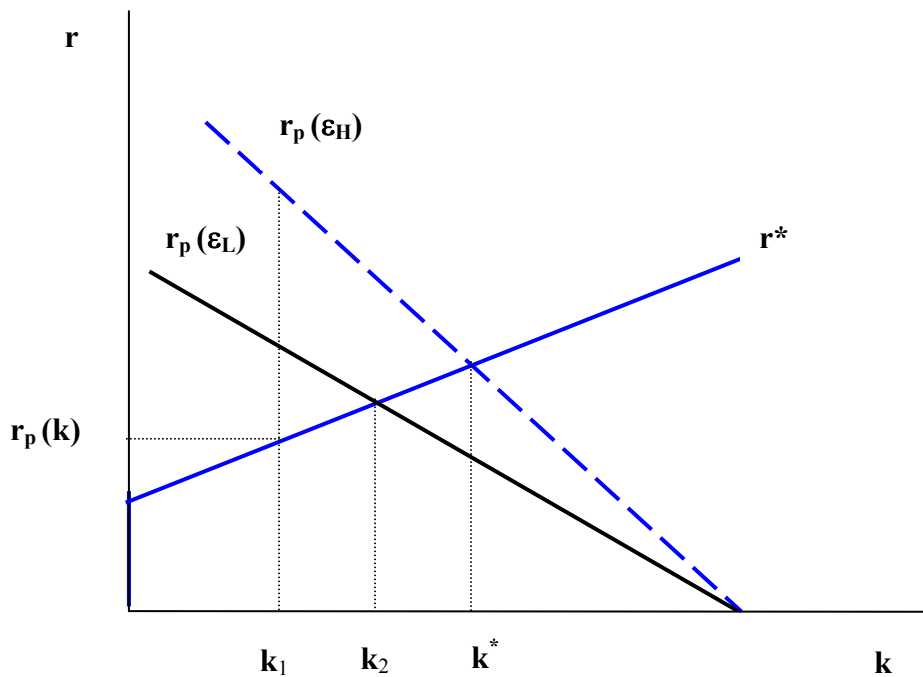
However, improvements in supervision to cope with the new challenges are time consuming. Hence, while market liberalization shifts the optimal deposit rate (r_p) outwards, $r_p(\varepsilon_L)$ to $r_p(\varepsilon_H)$, rather rapidly to the level of the developed economies, the quality of regulation stays at the same low level, $r^*(q<1)$, as before the liberalization. As shown in proposition 1, this means that the minimum capital requirement needs to be set higher. The effect is demonstrated in Figure 3 below. Here capital requirement prior to liberalization (stage 1) is set at k^*_{PL}, during liberalization (stage 2) at k^*_L, and after a

successful liberalization (stage 3) at k*$_D$. k*$_{PL}$ is set equal to k*$_D$ in order to simplify the figure. In general, of course, k*$_{PL}$ does not have to equal k*$_D$.

Figure 3. Minimum Capital Requirements in Economies with Repressed and
Developed Financial Markets
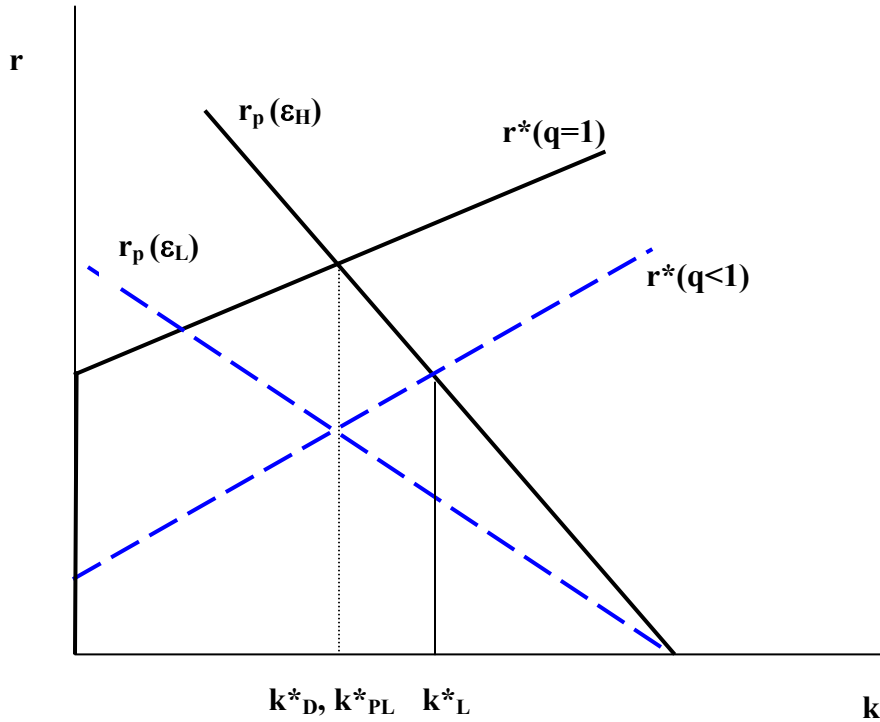
Proposition 2. *During financial liberalization capital requirement needs to be set higher than in repressed financial markets with low competition, k*$_L$ > k*$_{PL}$, and also higher than in developed financial markets with high-quality supervision, k*$_L$ > k*$_D$.*

This proposition provides a rationale for recent policy suggestions that the current Basel Accord minimum requirement is not sufficient for economies with low-quality supervision.[12] At times, the consequences can be severe: in some newly liberalized financial markets "gambling" resulted in an unsustainable amounts of bad loans leading to a collapse of the financial system.[13] One caveat exists: without numerical simulations, one cannot ascertain that for countries where the quality of supervision (q) is particularly low, the higher minimum capital requirements necessary to secure prudent equilibrium do not become prohibitively large and do not jeopardize the provision of banking services.

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[12] Among others, by Goldstein and Turner (1996), and Brownbridge and Kirkpatrick (2000).

[13] Krugman (1998). See also Dekle and Kletzer (2001) for empirical evidence.

The implication for policy of proposition 2 is that capital requirements need to be tailored to the stage of financial market reforms, and special attention needs to be paid to the sequencing of liberalization. To be sustainable, prudent competitive equilibrium needs high-quality domestic prudential supervision. Therefore, capital requirements may need to be assessed on a case-by-case basis when applied to countries with varying supervisory capacities.

III. CONCLUSION

The innovation of this paper is to link explicitly the quality of prudential supervision and the level of capital requirements in a theoretical model. The paper demonstrates how strengthening prudential supervision can help avoid financial crises during financial liberalization. First, higher minimum capital requirements should be used to compensate for poor quality prudential supervision. Second, the capital requirements used prior to the financial liberalization should be increased during the first years following the liberalization. This theoretical result supports the suggestion by Goldstein and others[14] that institutions and banks in the emerging countries are often not prepared for financial liberalization.

As a result, when implementing minimum capital requirements along the lines of the Basel Accord, economies with poor quality supervision need to be treated as special cases. Measures effective in repressed financial markets may not be sufficient once these economies have been opened to competition. Liberalization, including the removal of deposit rate ceilings and the promotion of competition, reduces the franchise value of banks and therefore can make excessive risk-taking more attractive. As a result, supervisors need to be particularly skillful and vigilant. However, sophisticated supervisory capacity often does not exist (and is not as much needed) in repressed financial markets. Also, the development of sufficient supervisory capacity is a lengthy process. Therefore, the Basel Accord capital ratios might need to be revised to compensate for the poor quality of domestic supervision.[15]

As the next step, the following extensions should be considered. A numerical analysis should be undertaken to assess whether the implied capital requirements are not be excessively high and thus inapplicable in practice for countries with particularly low-quality supervision. An attempt should be made to separate the areas of prudential regulation (including the rules on capital requirement levels) from those of prudential supervision (implementation of the existing prudential regulations). Finally, a link should be developed from the microeconomic analysis to the macroeconomic effects, for example, by explicitly modeling fiscal costs or welfare effects and monetary policy implications.

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[14] Goldstein (1997), Goldstein and Turner (1996), and Brownbridge and Kirkpatrick (2000).

[15] Caprio and Honohan (1999).

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