Capital Regulation and Risk Sharing*

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Capital requirements are the principal tool of macroprudential regulation of banks. Bank capital serves both as a buffer and as a disincentive to excessive risk taking. When general equilibrium effects are taken into account, however, it is not clear that higher capital requirements will reduce the level of risk in the banking system. In addition, an increase in the required capital ratio can force banks to take on more risk in order to achieve target rates of return.

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1. Introduction

Minimum capital requirements are one of the three "pillars" of macroprudential regulation. As a result of the financial crisis of 2008–09, there have been proposals to increase the amount of capital banks are required to hold. A capital structure that contains a substantial amount of equity has a number of advantages. It reduces the bank's vulnerability to market freezes; it reduces the risk of contagion to other financial institutions; it reduces the subsidy provided by deposit insurance; and, as we have recently seen, shareholders are less likely to be bailed out by government than debt holders. But while it may be optimal to have a substantial amount of equity in the capital structure, the crucial question is, "How much?" Will

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banks choose the right capital structure, left to themselves, or does the government have to force them to raise more capital?

One of the main arguments for increasing capital requirements is that it will provide banks with incentives to take less risk. More precisely, it is argued that if shareholders have a larger equity stake in the bank (more "skin in the game"), the incentives to engage in risk shifting or asset substitution will be reduced. But while this may be true in some circumstances, the idea that it is universally true must be treated with some skepticism. There may be a case that higher capital requirements will reduce risk, but the case has not yet been made. The theoretical literature gives us grounds for doubting that increased capital requirements will necessarily reduce risk taking, whatever other benefits it might have.

In this note, I attempt to do three things. First, I review some general equilibrium studies of the impact of capital requirements. Analyses of the impact of capital requirements on risk taking are often presented in a partial equilibrium framework. In a general equilibrium context, there may be complex feedbacks that lead to unexpected comparative static results. Second, I revisit the classical risk-shifting argument that underlies the claim that capital reduces risk. This too is a partial equilibrium argument. In particular, it ignores the factors that determine the supply and cost of capital. When the cost of capital is high, forcing banks to raise more capital may have the result of increasing the probability of default. In the third part of this note, I present a sketch of a model in which managers have target rates of return which force them to "reach for yield." In this model, the effects of greater capital on risk taking are turned upside down. A short conclusion sums up my views on capital requirements and risk.

2. General Equilibrium Perspectives

2.1 Incomplete Markets

Broadly speaking, there are two functions of bank capital. First, capital provides a buffer that allows for the orderly disposal of assets and shields debt holders from losses. Without an adequate buffer, assets might be sold in a "fire sale" that would amplify the losses to depositors or the deposit insurance corporation. This is the *risk-sharing function* of capital. Second, the fact that shareholders suffer the first loss gives the shareholders, or the managers acting on their behalf, an incentive to avoid unnecessary risks. This is the *incentive function* of capital.

Financial institutions have an incentive to adopt an optimal capital structure, one that will, among other things, improve risk sharing and reduce agency costs. In the absence of some kind of market failure, there is no need to impose regulation to force banks to hold the right amount of capital. If markets are incomplete, however, there may be a divergence between privately and socially optimal capital structures. In fact, it is generically possible to find a welfare-improving intervention (Geanakoplos and Polemarchakis 1986). This is the approach followed in Gale (2004) and Gale and Özgür (2005). It turns out that it is possible to improve on the laissez-faire capital structure, but the optimal policy does not necessarily take the form of a minimum capital requirement.

Gale (2004) and Gale and Özgür (2005) use a variant of the model developed in Allen and Gale (1998). There are three dates: $t = 0, 1, 2$. Investments and contracting decisions are made at date 0; assets pay off and consumption occurs at dates 1 and 2.

There is a single good that can be used for consumption or investment. Financial intermediaries can invest in two assets, a *short* asset and a *long* asset. The short asset is represented by a storage technology: one unit invested at date t yields one unit at date $t+1$. The long asset is represented by a constant returns to scale technology that is only available at date 0: one unit invested in the long asset at date 0 produces $R > 1$ at date 2.

Depositors have Diamond-Dybvig preferences: with probability λ a depositor is an early consumer, who only values consumption at date 1, and with probability $1 - \lambda$ he is a late consumer, who only values consumption at date 2. So the expected utility of a depositor who is promised c_1 if he withdraws at date 1 and c_2 if he withdraws at date 2 is

$$\lambda U(c_1) + (1 - \lambda)U(c_2).$$

For each intermediary i, the proportion of early consumers is a random variable λ_i with mean λ. To keep things simple, one can assume that the risk is purely idiosyncratic, so that the economy-wide fraction of early consumers is constant and equal to λ:

$$\int_0^1 \lambda_i di = \lambda.$$

All uncertainty is resolved at the beginning of the second date, when depositors learn whether they are early or late consumers and each intermediary observes the fraction of early consumers.

The Allen-Gale model, in the tradition of Bryant (1980) and Diamond and Dybvig (1983), assumes that free entry and competition force intermediaries to offer contracts that maximize the welfare of their depositors. There is a perfectly elastic supply of capital at the exogenously determined opportunity cost of ρ. The advantage of this assumption is that it allows one to characterize the intermediary's optimal behavior as the solution to a contracting problem in which the intermediary maximizes the depositors' welfare subject to the intermediary's zero-profit constraint and the investors' participation constraint.

Capital is assumed to be "expensive" in the sense that the opportunity cost of capital ρ is greater than the return on the long and short assets:

$$\rho > R.$$

Intermediaries offer completely contingent, incentive-compatible risk-sharing contracts to consumers and equity contracts to investors, taking as given the opportunity cost of capital ρ. Since there is no aggregate uncertainty, the payments to depositors and investors are contingent only on intermediary i's idiosyncratic liquidity shock, that is, the fraction λ_i of early consumers at intermediary i.

An intermediary has one unit of deposits and k units of capital at date 0 and invests these in a portfolio consisting of y units of the short asset and $1 + k - y$ units of the long asset. At date $t = 1, 2$ in state λ_i, intermediary i promises $c_t(\lambda_i)$ units of consumption to depositors who withdraw at date t and promises investors dividends of $e_t(\lambda_i)$. If the liquidity shock is λ_i, the intermediary has to supply $\lambda_i c_1(\lambda_i)$ to early consumers who withdraw at date 1 and pay a dividend $e_1(\lambda_i)$. The return from the short asset is y, so in the event that $\lambda_i c_1(\lambda_i) + e_1(\lambda_i) > y$, it will be necessary to sell some of the long asset. Since there is no aggregate uncertainty, the price of the long asset at date 1 will be known with certainty at date 0.

Even though intermediaries maximize their depositors' welfare, equilibrium is *constrained inefficient* when markets are incomplete. Whereas individual intermediaries take the price of the long asset as given, a central planner, by contrast, would take into account the impact of their choices on the price of the long asset. When markets are complete, a small change in the asset price will help some intermediaries and hurt others but have no impact on general welfare. When markets are incomplete, by contrast, these pecuniary externalities will generically have an effect on (ex ante) welfare.

Allen and Gale (2004) show that if the depositors' coefficient of risk aversion is high enough, an increase in the price of the long asset will increase welfare. This could be accomplished by requiring all intermediaries to hold more liquidity (more of the short asset). An increase in the minimum capital requirement has the opposite effect. In order to minimize the burden of raising more capital, the intermediary invests most of the additional capital in the long asset, which raises the ratio of the long asset to the short asset and lowers the price of the long asset at date 1. Thus, imposing a minimum capital requirement that raises capital above the laissez-faire level may reduce welfare.

2.2 Charter Values

A bank's charter value is the difference between its value as a going concern and its liquidation value. Since the charter value will be lost if the bank fails, its existence gives managers an incentive to avoid excessive risk taking that might lead to bankruptcy. This may offset the effect of deposit insurance (Marcus 1984; Keeley 1990). Charter value is reflected in the value of equity, and the conventional wisdom is that charter value and bank capital have similar effects on risk taking.

Competition may reduce charter value and increase financial instability. Allen and Gale (2001), henceforth AG, provide a theoretical analysis of the relationship between competition and financial stability. AG assume that banks engage in Cournot competition in the deposit market. Individual banks choose the quantity of deposits they want, and the upward-sloping aggregate supply curve for deposits determines the market-clearing deposit rate. Banks take into account the effect of an increase in their own demand for deposits on the interest they must pay. The larger the number of banks, the smaller the impact of a single bank on the equilibrium deposit rate. Thus, as the number of banks increases, the quantity of deposits increases and the deposit rate rises to clear the market. An increase in the deposit rate reduces profits and, hence, the charter value. As the charter value falls, the incentive for risk shifting increases and so does the risk of bank failures.

Boyd and De Nicolò (2005), henceforth BDN, criticize AG for ignoring the impact of competition on risk taking by *firms*. They extend the AG model by introducing a market for loans. Instead of investing directly in safe and risky assets, banks lend money to firms. Each firm wants to undertake a risky project that requires an investment of one unit. Firms have heterogeneous opportunity costs but are otherwise identical. This assumption gives rise to a downward-sloping demand curve for loans. Banks compete in Cournot fashion. In the loan market, each bank chooses the amount it wishes to lend, and the downward-sloping demand curve determines the equilibrium loan rate. In the deposit market, as in AG, each bank chooses the amount of deposits it wants to obtain, and the upward-sloping supply curve determines the equilibrium deposit rate.

Firms are subject to moral hazard as in Stiglitz and Weiss (1981), henceforth SW. Each firm is assumed to choose from a continuum of projects that vary in the probability of success. A project yields a payoff R if successful and 0 otherwise; the probability of success, $p(R)$, depends on the payoff R. If the loan rate is r, the entrepreneur chooses R to maximize his expected return $p(R)(R - r)$. A higher loan rate encourages greater risk taking, as SW showed.[1]

[1]The first- and second-order conditions for a local optimum are

$$p'(R)(R - r) + p(R) = 0$$

and

$$p''(R) + 2p'(R) < 0.$$

The implicit function theorem tells us that

$$\frac{dR}{dr} = \frac{p'(R)}{p''(R) + 2p'(R)} > 0$$

because $p'(R) < 0$ and the denominator is negative by the second-order condition.

An increase in the number of banks leads to greater competition in the loan and deposit markets, raising the deposit rate and lowering the loan rate. Both changes will have the effect of lowering the charter value of the banks. But the level of risk in the economy is determined solely by the loan rate and, as we have noted, a fall in the loan rate will cause firm owners to choose less risky projects.

The essential difference between the AG and BDN models is that AG assigns the choice of risk (i.e., the choice between safe and risky assets) to banks, whereas BDN assigns the choice of risk (i.e., the risk of the project) to firms. In general, both effects are present, and a reduction in charter value may be associated with both greater risk shifting by banks and less risk taking by firms. The net effect of greater competition will depend on the balance of these two forces.

Hakenes and Schnabel (2007) combine the two effects to investigate the effect of capital requirements on risk taking. Like BDN, they assume that banks lend to firms and that firms choose the riskiness of the projects in which they invest. Like AG, they allow banks to have a direct hand in setting the level of risk by choosing the correlation of the risks in their loan portfolio. The treatment of capital is similar to Gale (2004) and Gale and Özgür (2005), but there is no risk-sharing function. So, in equilibrium, banks hold the minimum amount of capital required by regulation.

Increasing the capital requirement has four different effects. It has a direct effect, reducing charter value and increasing the incentive for banks to engage in risk shifting. Capital requirements also increase the bank's costs and reduce the level of activity. This will have indirect effects on the loan and deposit markets. It will lower the demand for deposits and hence lower the deposit rate, which increases the charter value and reduces the incentive to take on risk. It will lower the supply of loans and hence increase the loan rate. A higher loan rate increases the charter value, causing the bank to take less risk, but it also causes borrowers to take on more risk.

While these effects do not all go in the same direction, it can be shown that, under plausible conditions, the net effect of higher capital requirements will be to raise the riskiness of the bank's portfolio.

2.3 Imperfectly Correlated Risks

As we saw with the Hakenes-Schnabel model, the interaction of competition, charter values, and risk taking is affected by the correlation of risks. Many of the models in the banking literature assume that asset returns are perfectly correlated. Martinez and Repullo (2008) develop a single-factor model of risk and show that it can reverse the results obtained from models with perfectly correlated risks. In a single-factor model, an increase in the loan rate has two effects. It has the usual Stiglitz-Weiss effect of encouraging greater risk taking by borrowers, but it also has the effect of increasing the income from solvent borrowers. When risks are perfectly correlated, all borrowers survive or fail together. In a single-factor model, some fail and some survive, and the interest paid by the survivors can offset the losses of the failures. Thus, it is possible that, although greater competition reduces loan rates and, hence, reduces the incentives for borrowers to take risks, it also makes banks more vulnerable to failure because it reduces the buffer provided by the interest payments made by the surviving firms.

Martinez (2009) has used this model to study the impact of capital regulation on bank failures. As noted above, higher loan rates have two effects: they increase risk shifting by borrowers and raise buffers that offset potential losses. In Martinez's model, higher capital requirements reduce banks' leverage and, for a given asset risk, reduce the probability of bank failure. But higher capital requirements increase the cost of funding, which leads to higher loan rates and, possibly, riskier loans. Numerical simulations show that the relationship between capital requirements and the risk of bank failure is non-monotonic.

2.4 The Cost of Capital

The assumption that capital is in perfectly elastic supply at an exogenous opportunity cost ρ is obviously a simplification. A more satisfactory approach would recognize the endogeneity of the supply and cost of capital. This is one of several innovations found in a recent paper by De Nicolò and Lucchetta (2009), henceforth DNL. In their model, agents decide whether to become entrepreneurs, who set up banks to provide intermediation services, or to become investors, who purchase debt from the banks. This occupational choice determines the equilibrium capital asset ratio, and this ratio in turn has an important impact on the level of risk taking in the economy.

DNL assume there is a continuum of agents, $q \in [0,1]$, where an agent of type q has an initial endowment qW. An agent can use his endowment to create $k \in (0, W)$ units of capital or he can keep his entire endowment qW and use it to buy bank debt. Since the amount of capital an agent can create is independent of the size of his endowment, an agent with a high (low) value of q has a comparative advantage in becoming an investor (entrepreneur). In equilibrium, there will be a cutoff q^* that determines who becomes an entrepreneur. Agents with $q < q^*$ choose to be entrepreneurs and those with $q > q^*$ choose to be investors.

An entrepreneur who has set up a bank can invest in projects that yield X per unit if successful and 0 otherwise. The probability of success p is a choice variable. Success requires costly effort. The cost of achieving success with probability p is assumed to be $\frac{1}{2}p^2$.

The division of returns is determined by the banks' ability to extract rents. This is measured by the return $\hat{R}$ per unit invested that is promised to investors. If L is the amount of debt issued by the representative bank, the entrepreneur's return is

$$p((1 - \hat{R})L + k)X - \frac{1}{2}p^2.$$

Maximizing this expression with respect to p gives us the first-order condition and decision rule:

$$p = ((1 - \hat{R})L + k)X.$$

Thus, the entrepreneur's equilibrium payoff is $\frac{1}{2}((1 - \hat{R})L + k)^2X^2$. Since the marginal type q^* must be indifferent between the two occupations, we have

$$\frac{1}{2}((1 - \hat{R})L + k)^2X^2 = pX\hat{R}q^*W.$$

Now, in order for the debt market to clear, the total debt issued by bank entrepreneurs must equal the investors' endowment, that is,

$$q^* L = \int_{q^*}^{1} qW = \frac{1}{2}(1 - q^{*2})W.$$

These two equations can be solved for the equilibrium value of q^*, which then determines L and the payoff of each agent.

DNL interpret the parameter $\hat{R}$ as a measure of the degree of competition in the banking sector. They argue that greater competition will raise the investors' share $\hat{R}$ toward the constrained optimum R^* that maximizes total surplus. By definition, as $\hat{R}$ increases, the entrepreneur's share of output falls. It can also be shown that q^* falls. But this does not mean that the entrepreneur's payoff falls. Fewer agents choose to be entrepreneurs and more choose to be investors, so L increases. In fact, L increases so much that the entrepreneur's payoff increases in spite of the increase in $\hat{R}$. DNL show that *both* the capital asset ratio and the level of risk *fall* as $\hat{R}$ rises to R^*. Risk can only fall if p increases and p is equal to the banker's return conditional on success. Thus, the banker's return conditional on success must be rising even though the investor's share $\hat{R}$ is also rising. The explanation of this counter-intuitive result is that, as the ratio of bankers to investors falls, the *scale* of each bank increases. The increase in scale for each bank leads to greater efficiency by both reducing the average fixed cost of setting up a bank and increasing the banker's incentive to take effort.

To sum up, whereas greater competition in AG and BDN is identified with an increase in the number of banks, in DNL it is identified with a fall in banks' ability to extract rents from investors. Since the marginal type q^* must be indifferent between becoming a bank entrepreneur and an investor, there is an increase in the returns to *both* investing and entrepreneurship. To achieve this, the number of banks decreases and the scale of each bank increases. The result of greater competition is an *increase* in charter value, and it is this increase in charter value that motivates the reduction in risk shifting, in spite of the fall in the capital asset ratio.

3. Risk Shifting Revisited

In reviewing these contributions to the literature on capital regulation, I have focused on the general equilibrium impact of capital on risk, without questioning the basic moral hazard model that underlies the view that more capital reduces the incentive for risk shifting. Now it is time to review the risk-shifting argument itself. There is a long literature on the role of capital structure on risk taking. In his classic paper on the option value of deposit insurance, Merton (1977) pointed out the rationale for capital requirements. He concluded that banks should be required to have more "skin in the game" as a counterweight to the incentive for excessive risk taking provided by (mispriced) deposit insurance. There followed a debate about the effects of capital on risk taking. A series of papers argued that in a mean-variance framework, higher capital ratios (lower leverage) do not necessarily lead a utility-maximizing manager to choose a portfolio with a smaller probability of default (Kahane 1977; Blair and Heggestad 1978; Koehn and Santomero 1980; and Kim and Santomero 1988). Furlong and Keeley (1989) and Keeley and Furlong (1990) argued that these authors had neglected the option value of deposit insurance and that in a model that included the option value of deposit insurance, it could be shown that increased levels of capital always lead to lower risk taking (as measured by the probability of default). Merton's analysis seems to be generally accepted these days and is certainly valid on its own terms, but that does not mean that there is no value in reconsidering the logic of the risk-shifting argument.

Consider the example in SW. A risk-neutral entrepreneur wants to undertake a risky venture that requires an investment of one unit. The entrepreneur has an initial endowment $0 < w < 1$ and raises the rest of the required investment by issuing debt with a face value of d. We assume that the debt is issued to risk-neutral investors whose opportunity cost of funds is one. Projects have two possible outcomes, success and failure, with returns R and 0, respectively. The probability of success, $p(R)$, is a decreasing function of the return R. The investors will be willing to purchase the firm's debt if it satisfies their participation constraint

$$p(R)d = 1 - w.$$

The entrepreneur chooses the project's target return $\hat{R}$ to maximize $p(R)(R - d)$. A revealed preference argument shows that $R^* \leq \hat{R}$ and $p(\hat{R}) \leq p(R^*)$, where R^* is the efficient project that maximizes

$p(R)R$.[2] Typically these inequalities are strict and the difference depends in a non-trivial way on the face value of the debt. Then, increasing w, the amount of "skin in the game," reduces the face value of the debt d and this in turn reduces the target return $\hat{R}$ and increases the probability of success $p(\hat{R})$.

The example is very simple, but it captures the essential logic of the argument that higher capital requirements reduce risk-shifting behavior. As the face value of the debt falls, the entrepreneur captures more of the total return and therefore internalizes more of the costs and benefits of his decision. How well does this correspond to reality? We have already seen that taking the supply of capital as exogenous can be misleading. From this point of view there are several aspects of the model that are special. First, the supply of capital is exogenous. The entrepreneur has a fixed amount of capital and invests it all in the risky project. Second, the entrepreneur has no alternative use for this capital and hence no opportunity cost. Third, it is assumed that, over the relevant range, risk and expected returns are negatively related. In other words, risk is mispriced. Finally, there is no room in this example for the common view that it is "expensive" to raise capital or that banks must "reach for yield" in order to satisfy shareholders.

Admati and Pfleiderer (2010) have argued that it is meaningless to say that capital is "expensive." Their argument is based on the Modigliani-Miller theorem (MMT), according to which the value of the firm is independent of the capital structure. The MMT is a useful counter-example to the idea that capital is universally "expensive," but the MMT itself is not universally valid. In particular, in a world of incomplete participation, where the purchasers of debt and equity are disjoint, the cost of equity finance may well be higher

[2] The efficient project R^* maximizes the expected return $p(R)R$, so

$$p(R^*)R^* \geq p(\hat{R})\hat{R}$$

and, since $\hat{R}$ maximizes the entrepreneur's expected return,

$$p(R^*)(R^* - d) \leq p(\hat{R})(\hat{R} - d).$$

These two inequalities imply that

$$-p(R^*)d \leq -p(\hat{R})d.$$

than the cost of debt finance, either because the purchasers of equity have better alternative investment opportunities or because equity holders are more risk averse at the margin.

3.1 A Model of "Return-Driven" Risk Taking

Suppose that equity and debt are held, at the margin, by different economic agents. Equity is held by a large number of risk-neutral investors, and debt is held by a large number of risk-averse consumers. Investors are assumed to have access to alternative investment opportunities that yield a return of ρ, so the opportunity cost of providing capital to the banking sector is ρ.

Banks invest in a constant returns to scale investment technology. The return to a unit investment is given by the usual SW technology: the return is R with probability $p(R)$ and 0 otherwise. We assume that capital is "expensive" in the sense that the returns on the banks' investments are lower than the investors' opportunity cost:

$$\rho > \sup_R p(R)R.$$

Since the scale of operation is immaterial, we assume that the representative bank raises one unit of deposits and k units of capital and invests the sum $1 + k$ in the investment technology with target return R.

To simplify the analysis, it is assumed that deposits are fully insured at no cost to the bank. Depositors are assumed to have an opportunity cost equal to one and supply funds elastically at this rate.

The interests of bank managers are not aligned with those of the shareholders. The bank's managers receive private benefits B if the bank survives and nothing otherwise. This ensures that managers have an incentive to avoid risk subject to the constraint that they must satisfy the shareholders.[3] The managers choose the amount of capital k, the face value of deposits d, and the portfolio return R

[3]Alternatively, instead of treating the cost of capital as a constraint on the manager's choice, we could assume that the shareholders provide high-powered incentives to the manager (e.g., stock options or shares) to achieve the desired return on equity.

to maximize $p(R)B$ subject to the participation constraints of the shareholders

$$p(R)(R-d)(1+k) \geq \rho k \tag{1}$$

and the debt holders $d \geq 1$. In equilibrium, these participation constraints will hold with equality, so we might as well set $d = 1$ from the outset.

Since capital is expensive and does not improve risk sharing (thanks to free deposit insurance), it is optimal to set $k = k_0$, where k_0 is the minimum amount of capital allowed under the Basel Accords. Then the manager will minimize R subject to the investors' participation constraint (1). Suppose that $f(R, k_0) = p(R)(R-1)(1+k_0) - \rho k_0$ is a concave function of k_0. For any feasible level of k_0, the participation constraint (1) will be satisfied for values of R that lie in an interval $[R_{\min}(k_0), R_{\max}(k_0)]$, where $R_{\min}(k_0)$ and $R_{\max}(k_0)$ are the values of R at which the graph of $f(R, k_0)$ intersects the horizontal axis. The manager chooses the lowest value of R that yields a non-negative value of $f(R, k_0)$; that is, he will set $R = R_{\min}(k_0)$. An increase in k_0 shifts the curve down, and the left intersection point $R_{\min}(k_0)$ with the horizontal axis shifts right. Thus, an increase in the minimum capital requirement forces the manager to take on more risk. See figure 1.

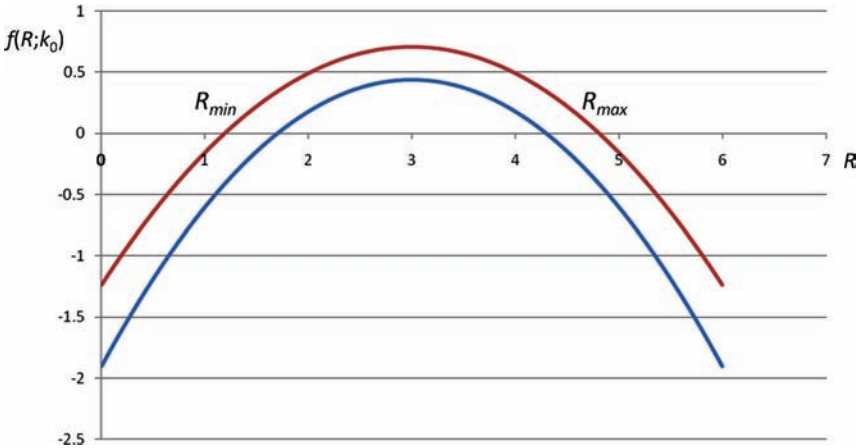
3.2 Risk-Weighted Capital

It might be argued that a more sophisticated system of capital requirements would take care of this problem. For example, if riskier investments require more capital, the manager will be forced to internalize the cost of increasing risk. But even if the risk of individual assets is held constant, the risk of the entire portfolio may be increased by choosing assets with more highly correlated returns.

Suppose there are two risky assets with returns R_i, for $i = 1, 2$. The returns are assumed to be independently and identically distributed, with distribution

$$R_i = \begin{cases} R & \text{w. prob. } p, \\ 0 & \text{w. prob. } 1-p. \end{cases}$$

Figure 1. Values of *R* Satisfying the Investors' Participation Constraint for Different Minimum Capital Requirements



The bank invests a fraction $0 \leq \alpha \leq \frac{1}{2}$ in asset 1 and the complementary fraction $1-\alpha$ in asset 2. Then the distribution of the bank's returns is given by

$$(\alpha R_1 + (1-\alpha)R_2)(1+k) = \begin{cases} R(1+k) & \text{w. prob. } p^2, \\ \alpha R(1+k) & \text{w. prob. } (1-p)p, \\ (1-\alpha)R(1+k) & \text{w. prob. } (1-p)p, \\ 0 & \text{w. prob. } (1-p)^2. \end{cases}$$

The banker's decision problem is to minimize the probability of default, subject to the investors' participation constraint. The minimum possible probability of default is achieved with $\alpha = \frac{1}{2}$. Suppose that $\frac{1}{2}R > 1$. Then it will be optimal under laissez-faire to set $k = 0$, and the probability of default will be $(1-p)^2$. If $k_0 > 0$, the banker will set $k = k_0$. For sufficiently small values of k_0, say $k_0 \leq k_0^*$, the probability of default will be $(1-p)^2$ as before but, for $k_0 > k_0^*$, we will have $\alpha R(1+k) < 1$ and the probability of default will be $(1-p)^2 + (1-p)p = 1-p$. In the first case, the participation constraint will require

$$p^2(R-1) + (1-p)p((1-\alpha)R-1) + (1-p)p(\alpha R-1) \geq \rho\frac{k_0}{1+k_0}$$

or

$$p^2(R-1) + (1-p)p(R-2) \geq \rho\frac{k_0}{1+k_0},$$

which is independent of α. Thus, the critical value of α is determined by the condition $\alpha^*R - 1 = 0$. For values of $k_0 > k_0^*$, we must have $\alpha < \alpha^*$, and the probability of default is $1-p$. Then the participation constraint is

$$p^2(R-1) + (1-p)p((1-\alpha)R-1) \geq \rho\frac{k_0}{1+k_0}.$$

This shows that increasing capital requirements can increase the risk of the bank's portfolio, even when all assets come from the same risk bucket.

3.3 A "Condominium" Theory of Banking

The preceding example is very stark, but it suggests a general perspective that may be worth pursuing further. Banking, as it has developed historically, requires people with very different risk tolerances to share the same institution. The problem is exacerbated by the transition from utility banking to casino banking, driven by high target returns on equity. Equity funding has benefits as well—e.g., improved risk sharing—but even then general equilibrium effects may imply a positive relation between capital and risk.

4. Conclusion

Tougher capital requirements may have positive benefits—they may reduce the consequences of market freezes, they may encourage banks to become smaller to avoid "systemic" capital requirements, and they may reduce contagion—but can they be relied on to reduce the risk of bank failure? Theory gives us a lot of contradictory results, and there is no overarching framework that holds out the promise of a clear, simple answer. Other tools may be needed and, possibly, structural changes in the banking industry, to avoid financial crises in the future.

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