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The macroeconomic implications of capital adequacy requirements for banks

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Abstract

Capital adequacy regulation for banks may reinforce macroeconomic fluctuations: If negative shocks to aggregate demand reduce the ability of firms to service their debts to banks, this reduction in debt service lowers bank equity, and, because of capital adequacy requirements, this in turn reduces bank lending and industry investment.

Keywords: Banking regulation; Capital adequacy requirements; Macroeconomic fluctuations

JEL classification: E10, G21, G28

1. Introduction

The recent and in many countries still ongoing recession has led to increased concern about the role of the financial system in macroeconomic fluctuations. The term 'debt deflation' has reentered the economist's vocabulary (King, 1994). The 'credit crunch' in the United States has focused attention on (i) the determinants of bank lending and (ii) the macroeconomic impact of the decline in bank lending.

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Was the decline in bank lending an independent force in precipitating the recession and retarding the recovery? [1]

The present paper considers the role of banking regulation in this context. According to one hypothesis, the 'credit crunch' in the United States was at least partly a consequence of banks' scrambling to meet the 1992 deadline for capital adequacy requirements under the 1988 Basle agreement (Bernanke and Lown, 1991). We go beyond the discussion of difficulties of the transition after an increase in capital adequacy requirements and ask more generally, what are the macroeconomic implications of a regulatory system which links bank lending to bank equity. We are concerned that if there is anything like true accounting for bank equity, a rigid link between bank equity and bank lending may act as an automatic amplifier for macroeconomic fluctuations, inducing banks to lend more when times are good and to lend less when times are bad, thus reinforcing any underlying shocks.

As a tool of banking regulation, capital adequacy requirements are not new. However during the past few years, their role has become rather more prominent as they are the main focus of a movement towards a reregulation of banking following the deregulation of the late seventies and early eighties. [2] The 1988 Basle agreement on the 'international harmonization' of capital adequacy requirements for 'credit risks' marked a major step in this direction. A further step that has recently been proposed concerns the introduction of additional capital adequacy requirements for 'market risks', in particular interest rate and exchange risks (Basle Committee on Banking Supervision, 1993). The net effect of this proposal is likely to be a further increase in capital adequacy requirements as certain assets which have reduced or zero risk weights for 'credit risk' will be given positive risk weights for 'market risk'; [3] this is, e.g., the case for fixed-interest, domestic-currency government bonds, which are subject to interest rate risk, but not to default risk. Negotiations about the Basle Committee's proposal are still going on.

The economic implications of capital adequacy regulation are as yet poorly understood. There have been a few studies of their microeconomic implications – interestingly, most of them *following* the 1988 agreement and the Second EC Banking Directive, which endorsed it (see, e.g., Rochet (1992), Dewatripont and Tirole (1993) and the references cited there). To the best of our knowledge, there have been no studies of their *macroeconomic* implications.

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[1] For a detailed account of these issues, see Bernanke and Lown (1991).

[2] This shift of focus is reflected in the literature: whereas capital adequacy requirements play hardly any role in Baltensperger and Dermine (1987), they take center stage in Dewatripont and Tirole (1993), see also Tirole (1994).

[3] For a critique of the distinction between 'credit risk' and 'market risk', see Hellwig (1994).

2. Capital adequacy regulation: from micro- to macroeconomics

Capital adequacy requirements are intended to reduce bank insolvency risk. According to the simplest argument, equity is a buffer protecting depositors from asset return risk; by increasing the buffer, capital adequacy requirements improve depositor protection. If this argument is pursued to its logical conclusion, a capital adequacy requirement of 100% is found to be most desirable as it provides depositors with perfect protection; however, there are then no depositors left to be protected. A more subtle argument suggests that a capital adequacy requirement may reduce moral hazard that arises because depositors have no control of the bank's investment policy. By effectively limiting the debt–equity ratio, a capital adequacy requirement may reduce the tendency towards excessive risk taking that is known to be associated with debt finance (Rochet, 1992; Dewatripont and Tirole, 1993).

Important though these arguments are, they have two limitations:

- They involve a one-shot investment–return framework without paying attention to the ongoing nature of a bank's relations with its depositors, its borrowers – and its regulators. A capital adequacy requirement is not imposed just once, at the time of an 'initial' investment; *it is imposed throughout*, as outstanding loans are serviced, new loans are made, deposits are withdrawn and redeposited.
- The entire discussion is carried out without any consideration of whether the risks in question are diversifiable or not. To the extent that a bank's asset returns depend on macroeconomic developments and/or the market rate of interest, return risks are *not* diversifiable; moreover, different banks are likely to be hit by these risks at the same time.

These considerations are important because there is a natural correlation between the stringency of capital adequacy requirements tomorrow and the returns tomorrow on today's investment: the higher the return on today's investment, the higher is tomorrow's equity in the absence of any recapitalization. Given this correlation, in a moral-hazard model, it seems quite possible that even though today's capital adequacy requirement reduces excessive risk taking today, today's anticipation of tomorrow's capital adequacy requirement may enhance excessive risk taking today. The overall effect of a uniform requirement today and tomorrow is then unclear.

The correlation between asset returns and the stringency of capital adequacy requirements is particularly relevant when returns are correlated across banks. If many banks experience low return realizations at the same time, they may all run up against their capital adequacy requirements at the same time. Thus they may all have to cut back lending or to recapitalize at the same time. If they all cut back lending at the same time, this is likely to reduce investment demand. The reduction in investment demand in turn reduces aggregate demand and therefore the cash flow that firms obtain from current production. The reduction in cash flow affects the ability of firms to service their debts and hence the returns that banks receive on their outstanding loans. A given initial shock to asset returns may thus be amplified by a rigid application of a capital adequacy requirement. *From the ex ante point of view, the correlation between the stringency of tomorrow's capital adequacy requirement and the returns tomorrow on today's investment may therefore increase return risks in banking* even if there are no adverse incentive effects associated with today's anticipation of tomorrow's capital adequacy requirements. Then again the overall effect of a uniform requirement today and tomorrow is unclear.

The preceding argument implicitly assumes (i) that banks do not recapitalize by issuing new equity and (ii) that firms do not fully replace bank loans by other sources of finance. From the perspective of a Modigliani–Miller world with perfect capital markets, both assumptions are objectionable. In a Modigliani–Miller world with perfect markets though, there would not be any banks (Hellwig, 1991, 1994) nor would there be a role for banking regulation. In practice, banks, like ordinary firms, are averse to issuing new equity in bad times; they are afraid of the negative inferences that might be drawn (see, e.g., Greenwald and Stiglitz, 1990). For banks such signalling considerations are even more important than for ordinary firms: Whereas ordinary firms need to worry only about the cost of the new equity issue, banks must also worry about the effects of their behaviour on depositor confidence. As for firms' investment behaviour, empirically, bank loans are the most important source of external funds in most countries (see, e.g., Mayer, 1990). Reductions in bank lending are usually *not* compensated by other external funds; instead they tend to go along with an increased dependence of investment on earnings (Hoshi et al., 1990, 1991). For a first approach then neither assumption (i) nor assumption (ii) seems unreasonable.

Given these assumptions though, one must be careful as to what macroeconomic effects one actually attributes to capital adequacy requirements. Even without capital adequacy requirements, bank lending can be expected to be procyclical; after all, bank deposits as well as bank equity are likely to be correlated with economic activity. The question then is whether capital adequacy requirements enhance or reduce the procyclical character of bank lending.

3. A formal model

We use a simple macroeconomic model to analyze the problem. Consider the usual goods market equilibrium condition $y^d = y^s$, where aggregate supply y^s is a function of the output price p and the wage rate w, and aggregate demand y^d is the sum of household consumption demand x^d, firm investment demand i^d, government demand g^d and a disturbance term ϵ. We assume that the wage rate w has been set before the value of the demand disturbance was known, e.g., $w = \alpha \mathrm{E}_{-1} p$, where $\mathrm{E}_{-1} p$ is the expectation of p at the time w was set. The question is how ϵ affects prices and output; from the *ex ante* perspective, what variances of prices and output are induced by the uncertainty about ϵ? By standard calculations, equilibrium price and output satisfy

$$\frac{\mathrm{d}p}{\mathrm{d}\epsilon}=\frac{\partial y^{\mathrm{d}}}{\partial \epsilon}\bigg/\left[\frac{\partial y^{\mathrm{s}}}{\partial p}-\frac{\partial y^{\mathrm{d}}}{\partial p}\right], \tag{1a}$$

$$\frac{\mathrm{d}y}{\mathrm{d}\epsilon}=\frac{\partial y^{\mathrm{s}}}{\partial p}\frac{\partial y^{\mathrm{d}}}{\partial \epsilon}\bigg/\left[\frac{\partial y^{\mathrm{s}}}{\partial p}-\frac{\partial y^{\mathrm{d}}}{\partial p}\right]. \tag{1b}$$

Under the usual assumption that supply is increasing and demand is decreasing in price, we see that both, $\mathrm{d}p/\mathrm{d}\epsilon$ and $\mathrm{d}y/\mathrm{d}\epsilon$ are the larger – and therefore the variances of price and output are the larger – the larger is $\partial y^{\mathrm{d}}/\partial\epsilon$ and the smaller is $-(\partial y^{\mathrm{d}}/\partial p)/(\partial y^{\mathrm{d}}/\partial \epsilon)$. We are thus lead back to the investigation of the standard aggregate demand multipliers

$$\frac{\partial y^{\mathrm{d}}}{\partial \epsilon}=\left[1-\frac{\partial x^{\mathrm{d}}}{\partial y}-\frac{\partial i^{\mathrm{d}}}{\partial y}-\left(\frac{\partial x^{\mathrm{d}}}{\partial r}+\frac{\partial i^{\mathrm{d}}}{\partial r}\right)\frac{\mathrm{d}r}{\mathrm{d}y}\bigg|_{\mathrm{LM}}\right]^{-1} \tag{2a}$$

and

$$\frac{\partial y^{\mathrm{d}}}{\partial p}=\left[\frac{\partial x^{\mathrm{d}}}{\partial p}+\frac{\partial i^{\mathrm{d}}}{\partial p}+\left(\frac{\partial x^{\mathrm{d}}}{\partial r}+\frac{\partial i^{\mathrm{d}}}{\partial r}\right)\frac{\mathrm{d}r}{\mathrm{d}p}\bigg|_{\mathrm{LM}}\right]\frac{\partial y^{\mathrm{d}}}{\partial \epsilon} \tag{2b}$$

where, as usual, r is the rate of interest on government bonds. The question is how capital adequacy requirements affect these multipliers.

We concentrate on the interdependence of banking and investment. For consumption we assume the conventional form $x^{\mathrm{d}}(p,r,(1-t)py)$, *regardless of capital adequacy requirements.* [4] We also assume that money demand takes the conventional form $M^{\mathrm{d}}(p,r,y)$, with a constant currency–deposit ratio γ. Thus deposit demand is

$$D^{\mathrm{d}}=\frac{1}{1+\gamma}M^{\mathrm{d}}(p,r,y), \tag{3}$$

and, with a given quantity H of high-powered money and bank reserve demand R^{d}, the money market equilibrium condition (LM equation) is

$$H=R^{\mathrm{d}}+\frac{\gamma}{1+\gamma}M^{\mathrm{d}}(p,r,y). \tag{4}$$

[4] Arguments justifying this assumption in a rational-expectations framework are given in Hellwig (forthcoming).

We assume a non-Modigliani–Miller world in which investment demand depends on the ability of firms to retain earnings and/or to obtain bank loans. We write

$$i^{d} = f(p, r, py - wl(y) - \delta, L^{s}), \tag{5}$$

where $wl(y)$ is the labour cost associated with the output y, δ is aggregate debt service, and L^s is loan supply by banks. The third argument in (5) reflects the role of retentions, the fourth argument the role of bank lending. The specification is quite crude as it abstracts from distribution effects across firms, and it neglects any possible role of the interest rate on loans (for the latter, see Bernanke and Blinder, 1988).

Bank lending depends on deposit demand, bank equity – and banking regulation. A bank with deposit demand D^d and equity E can put its funds into loans to firms L^s, government bonds B^B, or reserves of high-powered money R^d. In order to keep stock-flow interactions as simple as possible, we assume that loans, bonds and real capital all have a maturity of one period; thus we neglect the problem of capital gains and losses on longer-lived assets. We assume that *ceteris paribus* rate of return considerations induce a strict preference for loans over bonds and for bonds over reserves. However, banks must satisfy a minimum-reserve requirement $R^d \geqslant \rho D^d$ and a capital adequacy requirement

$$cL^{s} \leqslant E; \tag{6}$$

here c is the 'Cooke ratio' on loans to firms. With these requirements, bank behaviour is given as

$$R^{d} = \rho D^{d}, \tag{7a}$$

$$L^{s} = \min\left[E/c, E + (1-\rho)D^{d}\right], \tag{7b}$$

$$\frac{1}{1+r} B^{B} = \max\left[0, E + (1-\rho)D^{d} - E/c\right]. \tag{7c}$$

Deposit demand is given by household behaviour. Again abstracting from distribution effects, for the banking system as a whole, D^d is given by (3). As for bank equity, we assume that there is no new equity issue and no dividend distribution. Neglecting operating costs, for the banking system as a whole, we get

$$E = R_{0} + B_{0}^{B} - D_{0} + \delta, \tag{8}$$

where R_0, B_0^B, D_0 are initial values of reserves, bonds coming due, and deposits, and δ is again aggregate debt service. The debt service δ depends on the amount L_0 of loans outstanding and on the ability of firms to repay these loans. The latter depends on market conditions; we write $\delta = \delta(p, y, w, L_0)$ without paying any attention to the differences between firms that repay their debts and firms that go bankrupt.

From (3)–(8), we obtain

$$\frac{\partial i^{\mathrm{d}}}{\partial y} = f_3\big(p - wl'(y) - \delta_y\big) + f_4\delta_y/c, \tag{9a}$$

$$\frac{\partial i^{\mathrm{d}}}{\partial r} = f_2, \tag{9b}$$

$$\frac{\partial i^{\mathrm{d}}}{\partial p} = f_1 + f_3\big(y - \delta_p\big) + f_4\delta_p/c, \tag{9c}$$

if $E/c < E + (1-\rho)D^{\mathrm{d}}$, i.e., if capital adequacy requirements are binding, and

$$\frac{\partial i^{\mathrm{d}}}{\partial y} = f_3\big(p - wl'(y) - \delta_y\big) + f_4\left(\delta_y + \frac{1-\rho}{1+\gamma}M_y^{\mathrm{d}}\right), \tag{10a}$$

$$\frac{\partial i^{\mathrm{d}}}{\partial r} = f_2 + f_4\frac{1-\rho}{1+\gamma}M_r^{\mathrm{d}}, \tag{10b}$$

$$\frac{\partial i^{\mathrm{d}}}{\partial p} = f_1 + f_3\big(y - \delta_p\big) + f_4\left(\delta_p + \frac{1-\rho}{1+\gamma}M_p^{\mathrm{d}}\right), \tag{10c}$$

if $E/c > E + (1-\rho)D^{\mathrm{d}}$, i.e., if capital adequacy requirements are not binding. (As usual, subscripts stand for partial derivatives.) From (3), (4), and (7a) we also obtain the conventional money market equation $M^{\mathrm{d}}(p, r, y) = H(1+\gamma)/(\rho+\gamma)$, hence $(\mathrm{d}r/\mathrm{d}y)|_{\mathrm{LM}} = -M_y^{\mathrm{d}}/M_r^{\mathrm{d}}$ and $(\mathrm{d}r/\mathrm{d}p)|_{\mathrm{LM}} = -M_p^{\mathrm{d}}/M_r^{\mathrm{d}}$. It follows that

$$\left.\frac{\partial i^{\mathrm{d}}}{\partial y} + \frac{\partial i^{\mathrm{d}}}{\partial r}\frac{\mathrm{d}r}{\mathrm{d}y}\right|_{\mathrm{LM}} = -f_2\frac{M_y^{\mathrm{d}}}{M_r^{\mathrm{d}}} + f_3\big(p - wl'(y) - \delta_y\big) + f_4\delta_y/c \tag{11a}$$

and

$$\left.\frac{\partial i^{\mathrm{d}}}{\partial p} + \frac{\partial i^{\mathrm{d}}}{\partial r}\frac{\mathrm{d}r}{\mathrm{d}p}\right|_{\mathrm{LM}} = f_1 - f_2\frac{M_p^{\mathrm{d}}}{M_r^{\mathrm{d}}} + f_3\big(y - \delta_p\big) + f_4\delta_p/c, \tag{11b}$$

if $E/c < E + (1-\rho)D^{\mathrm{d}}$; in contrast

$$\left.\frac{\partial i^{\mathrm{d}}}{\partial y} + \frac{\partial i^{\mathrm{d}}}{\partial r}\frac{\mathrm{d}r}{\mathrm{d}y}\right|_{\mathrm{LM}} = -f_2\frac{M_y^{\mathrm{d}}}{M_r^{\mathrm{d}}} + f_3\big(p - wl'(y) - \delta_y\big) + f_4\delta_y \tag{12a}$$

and

$$\left.\frac{\partial i^{\mathrm{d}}}{\partial p} + \frac{\partial i^{\mathrm{d}}}{\partial r}\frac{\mathrm{d}r}{\mathrm{d}p}\right|_{\mathrm{LM}} = = f_1 - f_2\frac{M_p^{\mathrm{d}}}{M_r^{\mathrm{d}}} + f_3\big(y - \delta_p\big) + f_4\delta_p, \tag{12b}$$

if $E/c > E + (1 - \rho)D^{\mathrm{d}}$. Capital adequacy requirements thus affect not only the levels of bank lending and investment; they also affect the sensitivity of investment demand to changes in output and prices. As one raises c from zero to a level where the capital adequacy requirement is binding, at first there is no effect, then from the point where (6) first becomes binding, any further increase in c lowers bank lending and investment. At the point where (6) first becomes binding, the derivatives (10a)–(10c) are replaced by (9a)–(9c). This switch entails a discontinuous increase in the aggregate demand multipliers $(\partial y^{\mathrm{d}}/\partial \epsilon)$ and the ratio $(\partial y^{\mathrm{d}}/\partial p)/(\partial y^{\mathrm{d}}/\partial \epsilon)$ in (2a) and (2b). *At the point where the capital adequacy requirement becomes binding there is thus a discontinuous increase in the sensitivity of equilibrium price and output with respect to the demand disturbance* ϵ. From the *ex ante* point of view, this raises the variances of output and prices and, by implication, the variance of the returns on bank lending.

The point is that with a binding capital adequacy requirement an additional écu of bank profits induces $1/c$ additional écus of bank lending; without a binding capital adequacy requirement, an additional écu of bank profits induces just one additional écu of bank lending. Since $1/c$ is greater than one, the multiplier effect of bank profits on investment demand is higher with a binding capital adequacy requirement than without one.

Once the switch to a regime of binding capital adequacy requirements has occurred, *any additional increase in c will lower* $(\partial y^{\mathrm{d}}/\partial \epsilon)$, $(\partial y^{\mathrm{d}}/\partial p)/(\partial y^{\mathrm{d}}/\partial \epsilon)$ *and hence the sensitivity of equilibrium price and output with respect to the demand disturbance*; however, this effect will never compensate for the initial discontinuous increase in sensitivity at the point where the capital adequacy requirement first becomes binding.

4. Discussion

How robust is our analysis? One question concerns the specification of deposit demand. We have assumed that the currency–deposit ratio and the reserve–deposit ratio are constant. With r adjusting to clear the market for high-powered money, this assumption ensures that equilibrium deposits are equal to $H/(\rho + \gamma)$, a constant. Deposits then play no role in the transmission of demand disturbances; in (12a) and (12b), the effects of changes in deposit demand on bank lending and thereby on investment have dropped out. Suppose instead that the currency–deposit ratio γ is decreasing in y and p, but independent of r. Then bank deposits as well as bank equity play a role in the transmission of aggregate demand disturbances. Indeed one easily checks that the mere dependence of bank lending on deposit demand through the balance sheet constraint of the bank enhances the demand disturbance multiplier (2a). However, the main conclusion of our analysis remains valid if the output and price elasticities of bank equity exceed the output and price elasticities of bank deposits. In this case, *a shift from a regime of* *non-binding capital adequacy requirements to a regime of binding capital adequacy requirements still induces a discontinuous increase in the sensitivity of equilibrium output and price with respect to a demand disturbance.*

In general, the macroeconomic implications of capital adequacy requirements depend on whether the procyclical effects that they induce are weaker or stronger than the procyclical effects that are induced by alternative regulations or merely the bank balance sheet connection alone. We should expect capital adequacy requirements to increase any aggregate uncertainty from shocks that concern bank returns and bank equity without concerning deposits and to decrease any aggregate uncertainty from shocks that concern bank deposits but not bank equity. In practice, this may depend on accounting rules. If banks have a lot of leeway to build up or to dissolve hidden reserves, a capital adequacy requirement may be a restriction on how much equity a bank chooses to disclose rather than a restriction on lending. In contrast, if banks are constrained to anything like true market value accounting, we should expect shocks concerning bank equity to be important both, in absolute terms and in relation to bank deposits.

If one allows for long-lived assets, one also has to worry about the relation between stocks and flows. Capital adequacy requirements concern stocks; so do asset revaluations induced, e.g., by changes in market rates of interest. How then is the system to respond to a decrease in equity caused by a fall in the market value of long-lived assets due to an increase in interest rates? Given the illiquidity of many assets financed by bank lending, the stock adjustment necessitated by capital adequacy requirements in this situation is likely to fall largely on new flows. Even small changes in market valuations of stocks may then induce dramatic changes in the flows of new lending, investment, aggregate demand, and income.

What happens if the set of securities subject to capital adequacy requirements is expanded? This question bears on the pending proposals to extend capital adequacy requirements to deal with interest rate risk as well as credit risk. To answer it, consider our simple model with (6) replaced by $cL^s + \hat{c}(1+r)^{-1}B^B \leqslant E$, with $\hat{c} \in (0, c]$. If $E/c < E + (1-\rho)D^d$, i.e. if the capital adequacy requirement on loans is binding, three possibilities can arise: (i) For $\hat{c}$ close to zero, banks set $R^d = \rho D^d$, $L^s = [(1-\hat{c})E - \hat{c}(1-\rho)D^d]/(c-\hat{c})$, and $(1+r)^{-1}B^B = E + (1-\rho)D^d - L^s$; (ii) for a possibly empty set of intermediate values of $\hat{c}$, banks set $L^s = 0$ as the return per unit of equity engaged is higher for bonds than for loans; (iii) for $\hat{c}$ close to c, $R^d = D^d - (1-c)E/c$, $L^s = E/c$, and $B^B = 0$ as the bank does not want to 'waste' any equity on bonds. In cases (i) and (iii), *the procyclical effects of capital adequacy requirements are reinforced*: In case (i) the coefficient $1/c$ in (11a) and (11b) is replaced by $(1-\hat{c})/(c-\hat{c}) > 1/c$; moving from loans to bonds now does less to satisfy Mr. Cooke's requirements than before, and therefore more of a move is needed. In case (iii) the spillover of funds induced by the capital adequacy requirement goes entirely into the demand for reserves and *induces a procyclical behaviour of the quantity of high-powered money that is* *available to the public for currency*; the LM-curve therefore is flatter, and the aggregate demand multiplier (2a) even larger than in the preceding analysis.

Our analysis suggests that perhaps one ought to have second thoughts about the current emphasis of banking regulation on fairly rigid capital adequacy requirements. We appreciate that this emphasis is at least partly based on the observation that the worst excesses of the savings and loans crisis in the United States would probably have been avoided if capital adequacy requirements had been more strictly enforced in the early eighties. However, the very lack of enforcement in the early eighties raises doubts about the viability of this system of regulation. After all, the failure to enforce capital adequacy requirements in the early eighties was due to a fear of the macroeconomic implications of strict enforcement in a situation where the equity shortfall of depository institutions was a macroeconomic phenomenon. As an alternative more thought ought to be given to the possibility of promoting the securitization of macroeconomic risks in deposit contracts themselves (Hellwig, 1994). This might altogether eliminate the possibility of bank insolvency due to the incidence of such risks. Moreover, the usual impediments to securitization are not relevant for macroeconomic risks as these risks provide little scope for manipulation by the parties to the deposit contract.

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