1 Limited Liability, Risk Taking and the Competition of Bank Regulators

Banks can go bankrupt, which obviously would have devastating affects for some citizens.

Large bank crises have, for example, recently taken place in Korea and in Mexico.

To keep the risks under control, the banking business is heavily regulated in most countries.

This chapter of the book provides a welfare analysis of banking regulation and studies the competitive forces affecting this type of regulation in systems competition.

We start by discussing the basic problem of so called "lemon bonds".

1.1 Lemon Bonds

Let's first discuss original problem of lemon products (Akerlöf).

Consumers and producers have assymetric information about the quality of a product.

Consumers' lack of information implies that sellers who would have liked to offer good quality products and charge a higher price for them refrain from doing so.

The sellers who offer poor products will try to persuade consumers that these are of high quality.

So the market for good quality products will disappear.

The problem is not about justice but one of allocative efficiency.

The consumers will not be fooled because they can foresee producers behavior and pay a low price.

The problem is that they will be unable to buy high-quality cars at higher prices.

Let's now consider the market for lemon bands.

If bond purchasers could observe the bank's investment decisions and make a judgement on the appropriateness of its equity base, they would punish any kind of opportunistic bank behavior.

The way to do this is to require a sufficiently high rate of interest to compensate for the reduced quality of the bonds, or not to buy the bonds at all.

However, in the presence of asymmetric information the bank may be able to get away with lowering the quality of the bonds.

It simply reduces the expected value of loan repayment without offering a higher rate of interest in return.

Banks can decide to offer a safer product, i.e., a bond with higher expected repayment value.

But it may not be able to convey this information to its lenders and may therefore not be able to borrow at a lower rate of interest than its competitors can.

The bank lenders typically only have some idea of the average probability of failure and the funds repaid in this case.

Therefore, banks have incentives to offer low-quality bonds, or “lemon bonds”.

This scenario is unfortunately probably realistic because banking is such a complicated enterprise and it is difficult for lenders to get correct information.

It may not help that institutes, such as Standard & Poor, develop ranking systems.

Therefore, many countries are using strict regulation.

However, when bankers and lenders are not from the same country, the government's choice of regulation may not be efficient from a global perspective.

In the following I present a model of lemon banking, which shows welfare aspects and also the effects of systems competition.

1.2 A Model of Lemon Banking

- There is a capital market with three types of assets, a safe asset, a risky bond and a business loan.

- Safe assets give the return $s - 1$.

- Risky bonds give the return $r - 1$.

- Business loans pay a rate of return $q - 1$.

- The business is successful with probability $p(q)$ where $p'(q) < 0$.

- If the business fails it pays no return.

- Only banks can invest in businesses because of large transaction costs.

- s is exogenous and r and q are endogenous.

- Each bank selects the level of q and r is set on the market.

- The inelastic demand for funds is given by F.

- There is a fixed number of competitive banks.

- Banks are required to invest the equity C at the safe rate of return $s - 1$.

- All agents are risk-neutral.

Let's first study what the lemon problem does in the model.

The rate of return to lenders may depend on the actions of the bank.

Risk neutrality implies that a capital market equilibrium is characterized by the equality between the expected repayment of a bank bond and the repayment of a safe asset

$$p(q)rF + (1 - p(q))sC = sF. \tag{1}$$

There are two interpretations of this equation.

(1) It shows the lender's required risk premium as a function of a bank's policy choices.

(2) It is only an equilibrium condition, determining the market rate of interest paid by banks without implying that the single bank can affect this rate through its own policy decisions.

This is the plausible case when information is asymmetric.

1.2.1 Consider first the case of unlimited liability

In this case, the banks will always keep their promises. Because the bank is not at all risky we have

$$r = s.$$

The bank's problem is to solve

$$\max_q E\pi = (p(q)q - r)F \tag{2}$$

$p(q)q$ is the bank's return and r the interest it has to pay to savers.

The optimal risk strategy maximizes the expected return from business lending.

So the bank selects the rate of return on the project such as

$$p'(q)q + p(q) = 0 \tag{3}$$

The bank goes to the point where the increase in the target rate of return from business lending is outweighed by the corresponding reduction in the probability of success.

1.2.2 Consider now the case of limited liability

In many cases unlimited liability is unrealistic given that no one can lose more than he has.

In this case the BLOOS rule, or the MAHKMINN-Regel, applies.

BLOOS- You cannot get BLood Out Of a Stone.

MAHKMINN - Mehr Als Er Hat Kann Man Ihm Nicht Nehmen.

So assume the banks have limited liability.

If the business project is successful, the bank will be able to service the bonds it issued and its value will be $sC + (q - r)F$.

If the projects fails, the value of the bank will be either $sC - rF$ or 0 (when the bank goes bankrupt), whichever is higher.

Hence, the expected utility of the bank is equal to

$$E\pi = p(q)(sC+(q-r)F)+(1-p(q))\max(sC-rF, 0)-sC \tag{4}$$

If $sC > rF$ this is identical to the case of unlimited liability because the limited liability constraint is not binding.

Consider the more interesting case of limited liability when $sC < rF$.

We assume that, because of assymetric information, the bank does not have to alter the promised rate of return, $r - 1$, when it changes its risk policy, given that the other banks stick to whatever policies they choose.

So assuming that the interest rate, r, is taken as given by the bank, the profit is now

$$E\pi = p(q)(sC + (q - r)F) - sC.$$

This can be written as (add and subtract rF)

$$E\pi = (p(q)q - r)F + (rF - sC)(1 - p(q)).$$

The first term on the right hand side measures the expected profits provided that the bank services its bonds under all circumstances.

The second item measures the advantage resulting from the fact that the bank does only service its bonds in case of survival.

The point is that in case of bankruptcy the bank can avoid the part of the promised loan repayment which exceeds its equity capital, $rF - sC$.

There is a negative externality imposed on the bank's lenders!

In other words, when the equity base is low, limited liability effectively truncates the probability distributions of income among which a bank can choose and thus creates an artificial type of risk-loving behavior.

Now, the bank's choice variables are the return in case of success, q, and the amount of equity capital, C.

Assume that $C \geqslant \varepsilon \geqslant 0$ where ε is a regulated level of the equity capital.

So, when $rF \geqslant sC$, it solves

$$\max_{q,C}(p(q)q - r)F + (rF - sC)(1 - p(q)) \quad (5)$$

$$s.t \qquad C = \varepsilon \quad (6)$$

The Lagrangian is

$$L = (p(q)q - r)F + (rF - sC)(1 - p(q)) + \lambda(C - \varepsilon) \tag{7}$$

where λ is the Kuhn-Tucker multiplier.

The optimality conditions are

$$p'(q)qF + p(q)F - p'(q)(rF - sC) = 0, \tag{8}$$

$$s(1 - p(q)) = \lambda, \tag{9}$$

and

$$\lambda(C - \varepsilon) = 0. \tag{10}$$

Note that since $s > 0$ and $p > 0$ we know that $\lambda > 0$.

This means that the restriction in binding, i.e., that $C = \varepsilon$.

In other words, banks will choose as little equity as they possible can.

Intuition: the higher the equity capital, the higher is the payment to lenders in the case of failure, and the higher is the expected refinancing cost.

In a nutshell, equity capital is more expensive than debt capital for the banking firm since an increase of equity capital increases the payments to lenders in the case of bankruptcy, which ignorant lenders will not honor with a lower interest requirement.

So the bank wants to minimize the equity capital.

Next, note that the bank's risk choices are distorted.

With unlimited liability the first-order condition with respect to q was equal to

$$p'(q)q + p(q) = 0. \tag{11}$$

With limited liability there is an additional effect

$$-p'(q)(rF - sC), \tag{12}$$

which is positive because $p'(q) < 0$.

The bank's optimum now lies beyond the point of maximum expected revenue from business lending.

The reason is that there is a negative marginal externality it can impose on lenders by reducing the probability of success.

Summary of the results: the combination of limited liability and incomplete information of its lenders induces the banks to minimize their equity volumes and to choose riskier strategies of business lending than in the case of unlimited liability.

Banks choose to offer their lenders lemon bonds which will not be serviced with certainty.

2 An Example of Lemon Bond Banking

Consider the same model of lemon banking as before but now use an explicit probability of business success function.

- Safe assets give the return $s - 1$.

- Risky bonds give the return $r - 1$.

- Business loans pay a rate of return $q - 1$.

- Only banks can invest in businesses because of large transaction costs.

- The business is successful with probability
$$p(q) = a - bq.$$
We note that $p'(q) = -b < 0$.

- If the business fails it pays no return.

- s is exogenous and r and q are endogenous.

- Demand for funds is given by F.

- There is a fixed number of competitive banks.

- Banks are required to invest the equity C at the safe rate of return $s - 1$.

- All agents are risk-neutral.

- Banks can have unlimited liability or limited liability.

2.1 Unlimited liability

In this case, the banks will always keep their promises to repay lenders' money.

Because the bank is not at all risky we have

$$r = s.$$

The bank's problem is to solve

$$\max_q E\pi = ((a - bq)q - r)F. \quad (13)$$

$(a - bq)q$ is the bank's return and r the interest it has to pay to savers.

To find the bank's optimal risk strategy we calculate the first-order condition with respect to q.

So the bank selects the rate of return on the project such that

$$a - 2bq = 0. \tag{14}$$

We can now solve for the optimal q

$$q^* = \frac{a}{2b}.$$

and the optimal probability of success is

$$p = a - 2b\frac{a}{2b} = \frac{a}{2}.$$

We note that this is identical to a monopoly's optimal sales of good when the demand curve is $p(q) = a - bq$. But this is nothing but a formal similarity.

2.2 Limited liability

Limited liability means that if the bank's equity capital is exhausted, then bank lenders will not be able to collect the promised return and they may even loose part of the loan capital they provided.

What is the bank's expected value?

If the business project is successful, the bank will be able to service the bonds it issued and its value will be

$$sC + (q - r)F.$$

If the projects fails, the value of the bank will be either $sC - rF$, if the bank remains in business, or 0 if the bank goes bankrupt, whichever is higher.

Hence, the expected utility of the bank is in our case equal to

$$\begin{aligned} E\pi &= (a-bq)(sC+(q-r)F)+ \\ &\quad +(1-(a-bq))\max(sC-rF,0)-sC. \end{aligned} \tag{15}$$

Assume that $sC < rF$ so banks go bankrupt if the project fails.

The expected value is then

$$E\pi = (a-bq)(sC+(q-r)F)-sC. \tag{16}$$

Recall that if information is symmetric, there is no problem on this market even though banks have limited liability.

Why? The equilibrium condition, which determines the interest rate is given by

$$(a - bq)rF + (1 - (a - bq))sC = sF. \qquad (17)$$

If the lender can tell if a bank provides lemon bonds she will require an interest rate, r, sufficiently high to make sure lending to the bank gives identical revenue as an safe investment.

The interest rate will therefore be

$$r^* = s(\frac{1}{(a - bq)} - (\frac{1}{(a - bq)} - 1)\frac{C}{F}). \qquad (18)$$

Let's do some comparative statics on the interest rate.

We have that

$$\frac{\partial r^*}{\partial b} > 0.$$

The steeper the "probability of success curve" the lower is the probability of success for any given q.

If the probability of success is low, then lenders require a high interest rate.

Also,

$$\frac{\partial r^*}{\partial q} > 0.$$

The higher the return, q, the banks require from the project the higher is, by assumption, the risk involved in the business.

The lenders therefore require a higher interest, r.

Moreover,

$$\frac{\partial r^*}{\partial s} > 0.$$

The higher the safe interest rate is, the higher must the risky interest rate be in order for the safe investment to be identical to the risky investment.

Also,

$$\frac{\partial r^*}{\partial C} < 0.$$

The higher the equity banks hold the more money will be paid back to lenders in case of failure. The risky bond therefore becomes less risky.

In consequence, lenders are satisfied with a lower interest rate.

Back to our symmetric information case.

The banks must take the equilibrium interest rate into account in the following way

$$E\pi = (a - bq)(sC + (q - r^*)F) - sC \qquad (19)$$

The equation simplifies to

$$E\pi = ((a - bq)q - s)\,F.$$

Remember that this is just the same as in the case of unlimited liability when $r = s$.

The reason is that lenders can punish banks who offer bad bonds and so no risk-loving externality will occur.

Which level of return, q, will the bank select?

In other words, how much risk will it take?

Remember that the expected utility, when $sC < rF$, boils down to

$$EU = (p(q)q - r)F + (rF - sC)(1 - p(q))$$

In our example, we have

$$EU = ((a - bq)q - r)F + (rF - sC)(1 - (a - bq))$$

The bank's problem is

$$\max_{q,C}((a-bq)q-r)F+(rF-sC)(1-(a-bq)) \quad (20)$$

$$s.t \qquad C = \varepsilon \quad (21)$$

where ε is the regulated level of equity.

The first-order conditions to the Lagrangian are

$$(a - 2bq)F + b(rF - sC) = 0, \tag{22}$$

$$s(1 - (a - bq)) = \lambda, \tag{23}$$

and

$$\lambda(C - \varepsilon) = 0. \tag{24}$$

We can now solve for the rate of return the bank requires

$$q^* = \frac{a}{2b} + \frac{rF - sC}{2F}.$$

Results:

(1) Since $s > 0$ we know that λ and therefore that $C = \varepsilon$.

(2) (i) $(a - 2bq)F$ is the same as under unlimited liability

(ii) $b(rF - sC)$ shows that the banks take excessive risks.

The reason is that there is a negative marginal externality it can impose on lenders by reducing the probability of success!

Let's do some comparative statics on the externality and on the rate of return q (or the risk taking behavior).

Define the externality

$$E \equiv b(rF - sC).$$

(i) Consider first how the steepness of the probability of success curve, b, affects q.

There are two effects, one the one hand there is an externality effect

$$\frac{\partial E}{\partial b} > 0.$$

The higher b, the steeper is the "probability of success curve" and the larger is the effect of increasing the rate of return q on the probability p.

The externality, which follows from a higher q, is therefore larger.

On the other hand, because a higher b reduces the probability of success it also reduces the rate of return q.

This effect is also present in the unlimited liability case (see figure).

Because the second effect is dominating we have

$$\frac{\partial q}{\partial b} < 0.$$

That is, a steeper probability of success curve reduces the rate of interest banks want.

However, because the externality is larger when b is larger, the excessive risk-taking which follows from limited liability compared to unlimited liability is also larger.

(ii) Consider next the interest rates r and s. We have,

$$\frac{\partial q}{\partial r} > 0$$

and

$$\frac{\partial q}{\partial s} < 0.$$

The larger $(rF - sC)$ the larger is the amount that the bank neglects (the amount it should have paid it but does not when it goes bankrupt.).

$(rF - sC)$ is increasing in r (or F), because it increases the amount lenders require.

A higher r therefore leads to more risk taking, or a higher q.

$(rF - sC)$ is decreasing in the value of the equity s (or C) because lenders get more back in case of a failure of the business.

A higher s therefore leads to less risk taking, a lower q.

To sum up, the combination of limited liability and incomplete information of its lenders induces the banks to minimize their equity volumes and to select riskier strategies of business lending than in the case of unlimited liability.

3 Welfare Implications

Assume that

- s measures the true social opportunity cost of bank lending
- q and 0 denotes the true social returns to business lending
- the probability p is both the subjective and objective probability of success.

Welfare W is given by the difference between the expected social return to business lending and the alternative return lenders could have earned in a safe asset

$$W = (p(q)q - s)F.$$

The optimal amount of risk taking follows from

$$\max_q W = (p(q)q - s)F$$

The optimality condition is

$$p'(q)q + p(q) = 0.$$

Obviously, this coincides with the unlimited liability case.

In our example, the optimality condition is

$$a - 2bq = 0.$$

That is,

$$q^* = \frac{a}{2b}$$

is the optimal rate of return from the society's perspective.

In the case of limited liability the first-order condition is

$$p'(q)qF + p(q)F - p'(q)(rF - sC) = 0, \qquad (25)$$

which implies excessive risk-taking behavior compared to the limited liability case.

This behavior generates welfare losses.

Interestingly, it will hurt the banks only and not the lenders.

The intuition can be explained with the help of a figure.

If one bank only would act in this way, it would benefit by the area ACD in the figure.

This is because it reduces its expected loan repayment (ABCD) by more than the decline in the expected return from business lending (ABC).

But if all act the same, different lending conditions will emerge where the banks' lenders will be able to fully avoid a disadvantage.

In terms of the figure, if all banks operate at point C instead of point A, they are unable to reduce the expected loan repayment, and hence their profits fall by the area ABC.

Hence, from the society's perspective, the welfare loss generated by excessive risk-behavior is the area ACD-ABCD=ABC.

Lenders foresee that banks will only offer lemon bonds.

So the interest rate, which is set on the market will be adjusted to take this into account.

The excessive risks banks take therefore hurt themselves only.

In sum, the risk taking, which follows from limited liability, and asymmetric information is too large from a welfare perspective. The welfare loss will be borne by the banks.

In the next step we will discuss what the government can do to remedy this problem

We then study the effects of systems competition on this market.

4 Remedies

The remedies to this would be collective action which imposes restrictions on the banks.

It can come in one of two forms.

(i) Agreement among the banks.

(ii) Banking laws.

Assume that the level of regulation is set by the government.

By increasing ε, equilibrium equity capital can be increased because, remember, the banks select $C = \varepsilon$.

I will now show that increasing the level of regulation reduces the risk taken by the banks.

Formally, we are interested in the sign of the derivative $\frac{dq}{d\varepsilon}$.

Remember that the banks's expected utility, when $sC < rF$, boils down to

$$EU = (p(q)q - r)F + (rF - sC)(1 - p(q)) \quad (26)$$

The first-order condition is given by

$$\frac{dE\pi}{dq} = (p'(q)q + p(q))F - p'(q)(rF - sC) = 0. \quad (27)$$

Because the banks select $C = \varepsilon$ we can substitute C with ε to get

$$\frac{dE\pi}{dq} = (p'(q)q + p(q))F - p'(q)(rF - s\varepsilon) = 0, \quad (28)$$

Let's total differentiate this with respect to q and ε.

We get

$$\frac{d^2 E\pi}{dq^2} dq + sp'(q)d\varepsilon = 0. \quad (29)$$

We can arrange this to get

$$\frac{dq}{d\varepsilon} = \frac{-sp'(q)}{\frac{d^2 E\pi}{dq^2}}. \quad (30)$$

This sign of this expression shows how increased regulation affects the risk-taking behavior.

So what is the sign?

The nominator is positive because $p'(q) < 0$ by assumption.

What about the denominator?

The derivative is equal to

$$\frac{d^2 E\pi}{dq^2} = 2p'(q)F + p''(q)((q-r)F + sC). \qquad (31)$$

Note that this is the second-order condition for the banks, which must be negative for a solution to exist.

We also note that $p''(q) \leq 0$ is a sufficient condition for this to be true.

So the result is

$$\frac{dq}{d\varepsilon} < 0.$$

Increasing the level of regulated equity reduces the target rate of the interest and hence reduces the amount of risk taken by the banks.

This result is of course intuitive.

The higher ε the lower is the marginal externality distorting the bank's behavior, $-p'(q)(rF - s\varepsilon)$, and the lower is the extent of risk-taking as represented by the size of the target return.

What about our example, where $p(q) = a - bq$?

Well, recall that

$$q^* = \frac{a}{2b} + \frac{rF - s\varepsilon}{2F}. \tag{32}$$

It follows directly that

$$\frac{dq}{d\varepsilon} = -\frac{s}{2F} < 0.$$

But let's also do this in the same way as in the general case when

$$\frac{dq}{d\varepsilon} = \frac{-sp'(q)}{\frac{d^2E\pi}{dq^2}}. \tag{33}$$

In our example, we have

$$p'(q) = -b \tag{34}$$

so the nominator is positive.

The second derivative of the profit, $\frac{d^2E\pi}{dq^2}$, must be negative for solution to exist.

Let's check this.

The second derivative is given by

$$\frac{d^2 E\pi}{dq^2} = 2p'(q)F + p''(q)((q-r)F + sC). \quad (35)$$

Because

$$p'(q) = -b \quad (36)$$

it is clear that

$$p''(q) = 0. \quad (37)$$

Therefore

$$\frac{d^2 E\pi}{dq^2} = -2bF < 0 \quad (38)$$

So we do have a solution to the problem!

It finally follows that

$$\frac{dq}{d\varepsilon} = \frac{-sp'(q)}{\frac{d^2 E\pi}{dq^2}} = \frac{sb}{-2bF} = -\frac{s}{2F} < 0, \qquad (39)$$

as expected.

Hence, a higher level of regulation decreases the target rate of return of interest and therefore reduces the risk taking behavior by banks.

Proposition: With the imposition of minimum equity requirements it is possible to reduce and even avoid the welfare loss arising from excessive risk-taking.

5 The Competition of Banking Regulation

Even though banks would benefit from national regulation they typically oppose it.

The argument is that unilateral regulation would be unfair because it implies competitive disadvantages to the banks in the home country relative to the rest of the world.

This may be true, but let's first study the case when banks benefit from regulation.

Assume that bank lenders (home and foreign) can assess the banking laws in each country, ε.

Lenders can in this case infer from the banking law which target return the domestic banks will choose.

They will therefore reward nations who use though banking laws with low required interest rates.

Consumers will be indifferent to the regulation because they always get the safe interest rate s.

Banks would however benefit because of reduced risk-taking.

Lenders would require the interest rate r according to.

$$p(q)rF + (1 - p(q))sC = sF. \tag{40}$$

Because the interest rate is endogenous, we can solve for r to get

$$r^* = s\frac{F - (1 - p(q))C}{p(q)F}. \tag{41}$$

We use r^* in the bank's profit

$$E\pi = (p(q)q - r^*)F + (r^*F - sC)(1 - p(q)), \quad (42)$$

and note that the equation simplifies to

$$E\pi = (p(q)q - s)F. \quad (43)$$

The first-order condition is

$$p'(q)q + p(q) = 0, \quad (44)$$

which is identical to the condition when risk-taking is efficient!

So national governments select the level of ε, which induces banks to choose a target return which satisfies this equation.

The bankers, however, fear that the situation is different and that regulation will hurt them.

The reason is that the situation of a national government may be similar to that of a single bank that faces ignorant lenders.

If it is hard to evaluate a bank's business, then it will be at least as hard to foresee the consequences of a nation's regulation.

If the government imposes a tough banking law it will not be able to convince lenders of the better quality of national bank bonds and will therefore not be able to reduce the rate of interest which the lenders request.

Hence, the interest rate r is exogenous to the regulator as well.

When the national agency sets the regulation, it takes the other countries regulation as given.

Increasing the minium equity, ε, will in this case make domestic banks worse off and lenders (home or foreign) better off.

We now study systems competition in the banking sector analytically.

We will study the winners and losers of banking regulation and whether the level of regulation will be optimal from a supranational perspective.

The domestic government is elected by domestic residents.

So assume that the government takes domestic residents only into account.

In particular,

- α is the share of domestic residents among the people lending to domestic banks.

- β is the share of the domestic banks owned by domestic residents.

The expected utility of bank lenders is

$$EU = p(q)rF + (1 - p(q))s\varepsilon - sF \text{ for } rF \geq s\varepsilon \quad (45)$$

and the expected profit of the banks is

$$E\pi = p(q)(q - r)F - (1 - p(q))s\varepsilon \text{ for } rF \geq s\varepsilon \quad (46)$$

National welfare can then be written as

$$W = \alpha EU + \beta E\pi. \quad (47)$$

The competitive government solves

$$\max_{\varepsilon} W = \alpha EU + \beta E\pi. \quad (48)$$

The first-order condition is

$$\frac{\partial W}{\partial \varepsilon} = \alpha(1 - p(q))s + \alpha\frac{dq}{d\varepsilon}p'(q)(rF - s\varepsilon) - \\ -\beta(1 - p(q))s + \beta\frac{dq}{d\varepsilon}\frac{dE\pi}{dq}. \tag{49}$$

This is equal to

$$\frac{\partial W}{\partial \varepsilon} = (\alpha - \beta)(1 - p(q))s + \alpha\frac{dq}{d\varepsilon}(p'(q)(rF - s\varepsilon) + \frac{\beta}{\alpha}\frac{dE\pi}{dq}). \tag{50}$$

There are two effects at work.

The first item, $(\alpha - \beta)(1 - p(q))s$, represents the redistribution from banks to lenders which is brought about by a marginal increase in the equity requirement, given the bankruptcy probability $1 - p(q)$.

The second item reflects the fact that a higher equity requirement induces the banks to take fewer risks, i.e., to reduce the target return q and the corresponding bankruptcy probability $1 - p(q)$.

This helps the domestic lenders to the extent that the banks' equity capital falls short of the promised loan repayment, $s\varepsilon < rF$, and to the extent that there are such lenders as measured by α.

Banks select the level of q to maximize their profit and, in optimum, we have

$$\frac{dE\pi}{dq} = 0. \tag{51}$$

Banks are hurt by the regulation but they also benefit because they take less risk. In optimum, these two effects exactly out-weight each other.

Therefore, the equation simplifies to

$$\frac{\partial W}{\partial \varepsilon} = (\alpha - \beta)(1 - p(q))s + \alpha \frac{dq}{d\varepsilon} p'(q)(rF - s\varepsilon) \tag{52}$$

Recall that we just showed that

$$\frac{dq}{d\varepsilon} = \frac{-sp'(q)}{\frac{d^2 E\pi}{dq^2}} < 0. \tag{53}$$

so the second item on the right hand side is always positive.

The first item may or may not be positive.

So, in general, the impact on welfare of an increase of ε is ambiguous.

What is $\frac{\partial W}{\partial \varepsilon}$ in our example?

We had

$$p(q) = a - bq, \tag{54}$$

which implies that

$$p'(q) = -b. \tag{55}$$

Also, recall that

$$q = \frac{a}{2b} + \frac{rF - s\varepsilon}{2F}, \tag{56}$$

so

$$p(q^*) = a - b(\frac{a}{2b} + \frac{rF - s\varepsilon}{2F}). \tag{57}$$

Finally,

$$\frac{dq}{d\varepsilon} = -\frac{s}{2F}. \tag{58}$$

We use these expressions in

$$\frac{\partial W}{\partial \varepsilon} = (\alpha - \beta)(1 - p(q))s + \alpha \frac{dq}{d\varepsilon}(p'(q)(rF - s\varepsilon)). \tag{59}$$

The effect of increased regulation on the welfare in the home country is in our example therefore given by

$$\frac{\partial W}{\partial \varepsilon} = \frac{s}{2}((\alpha - \beta)(2 - a + b(r - \frac{s\varepsilon}{F})) + \alpha b(r - \frac{s\varepsilon}{F})). \tag{60}$$

We will now study some interesting cases where

$$s\varepsilon < rF.$$

5.1 $\alpha = 0$, $\beta = 1$. There are no domestic lenders and only domestic bank owners.

In this case we have

$$\frac{dW}{d\varepsilon} = -(1-p)s < 0. \tag{61}$$

The effect is negative and therefore $\varepsilon^* = 0$.

Increasing the regulated level of equity only hurts the domestic banks. So the government does not regulate and the externality remains large.

5.2 $\alpha = 1$, $\beta = 0$. There are only domestic lenders and no domestic bank owners.

We now have

$$\frac{dW}{d\varepsilon} = (1 - p)s + \frac{dq}{d\varepsilon}p'(q)(rF - s\varepsilon) > 0 \qquad (62)$$

The government only cares about the lenders, and they benefit from regulation in two ways.

First, the get more revenues through increased equity.

Second, the externality is reduced.

So the government sets the regulated equity at least as high so that the bank always keeps its promises, i.e. $s\varepsilon \geq rF$.

The regulated equity is therefore

$$\varepsilon^* \geqslant \frac{rF}{s}.$$

5.3 $\alpha \geqslant \beta > 0$. There are both domestic lenders and bankers where the share of lenders is higher.

In general, we have

$$\frac{\partial W}{\partial \varepsilon} = (\alpha - \beta)(1 - p(q))s + \alpha \frac{dq}{d\varepsilon}(p'(q)(rF - s\varepsilon)) \quad (63)$$

Because both the left and the right term on the right hand side is positive we have

$$\frac{dW}{d\varepsilon} > 0.$$

In this case, too, it is optimal for the national government to impose an equity requirement large enough so that the banks will be able to repay their loans even in the case of bankruptcy (i.e. $\varepsilon^* \geqslant \frac{rF}{s}$).

The intuition is again that relatively much weight is put on lenders, who want regulation.

5.4 $\beta \geqslant \alpha > 0$. There are both domestic lenders and domestic bankers where the share of bankers is higher.

The two effects will in this case go in different directions.

On the one hand, the government wants to reduce regulation in order not to hurt the banks.

On the other hand, the government also wants to increase regulation to reduce the externality, which lenders suffer from.

Assume $\frac{dW}{d\varepsilon} > 0$ when $\varepsilon = 0$ and $\frac{dW}{d\varepsilon} < 0$ when $\varepsilon = \frac{rF}{s}$.

We then have an interior solution, which we can solve for.

That is, set $\frac{dW}{d\varepsilon} = 0$ and solve for the optimal level of regulation.

$$\varepsilon^* = \frac{rF}{s} - (\frac{\beta}{\alpha} - 1)\frac{(1 - p(q))}{\frac{dq}{d\varepsilon}p'(q)}. \tag{64}$$

The optimal level of regulation will be in the range of

$$\frac{rF}{s} > \varepsilon^* > 0 \tag{65}$$

since

$$(\frac{\beta}{\alpha} - 1)\frac{(1 - p(q))}{\frac{dq}{d\varepsilon}p'(q)} > 0.$$

This implies that the government imposes some regulation on the banks, but remains nevertheless too lax, which induces banks to take more risks than in the case of unlimited liability.

In our example, we have

$$\varepsilon^* = \frac{rF}{s} - (\frac{\beta}{\alpha} - 1)\frac{(1 - (a - b(\frac{a}{2b} + \frac{rF - s\varepsilon}{2F})))}{\frac{s}{2F}b}. \quad (66)$$

How is the level of regulation affected by, for example, an increase in b? There are two effects.

First, a steeper $p(q)$-curve increases the externality, which generates more regulation.

Because lenders suffer more, there is more scope for regulation.

Second, a higher b reduces the probability of success, $p(q)$, and therefore increases the redistribution effect.

When $\beta > \alpha$ the redistribution effect leads to less regulation.

So there is also a tendency for less regulation.

In sum, the first effect is dominating so $\frac{\partial \varepsilon^*}{\partial b} > 0$.

5.5 $\beta = \alpha = 1$. There are only domestic lenders and bankers.

Here we are obviously back in the original situation without any international problems.

There is no redistribution effect.

We have

$$\frac{\partial W}{\partial \varepsilon} = \frac{dq}{d\varepsilon}(p'(q)(rF - s\varepsilon)) > 0 \tag{67}$$

The government will take care of the externality and set

$$\varepsilon^* = \frac{rF}{s}. \tag{68}$$

Which case is more plausible?

In Germany, for instance, the share of domestic lenders is 83 per cent whereas the share of domestic bank owners is 97 per cent.

In terms of the model, β is larger than α.

A similar pattern can be observed in other countries.

Hence, case (1) and case (4) are most plausible both of which leads to too lax regulation.

Systems competition does not work and there is reason to use international harmonization of banking regulation!