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Abstract

Lending retail deposits to SMEs and household borrowers may be the traditional role of commercial banks: but banking in Britain has been transformed by increasing consolidation and by the lure of high returns available from wholesale Investment activities. With appropriate changes to the baseline model of commercial banking in Allen and Gale (2007), we show how market power enables banks to collect 'seigniorage'; and how 'tail risk' investment allows losses to be shifted onto the taxpayer.

In principle, the high franchise values associated with market power assist regulatory capital requirements to check risk-taking. But when big banks act strategically, bailout expectations can undermine these disciplining devices: and the taxpayer ends up 'on the hook' - as in the recent crisis. That structural change is needed to prevent a repeat seems clear from the Vickers report, which proposes to protect the taxpayer by a 'ring fence' separating commercial and investment banking.

Key Words: Money and banking, Seigniorage, Risk-taking, Bailouts, Regulation

JEL Classification: E41 E58 G21 G28

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'Expansion in the variety of intermediaries and financial transactions has major benefits…[But] it has potential downsides … to do with incentives'. Rajan (2005)

Introduction

With the adoption of Inflation Targeting, monetary policy in the UK came to consist essentially in setting the discount rate, without any special attention to monetary aggregates. The shift of focus from monitoring developments in money and banking to policy rules for interest rates was reflected in the widespread adoption of DSGE models by Central Banks -- with Taylor rules used to determine interest rates and the assumption of efficient markets used to justify 'light touch' regulation. The granting of operational independence in setting interest rates to the Bank of England in 1997 was, indeed, accompanied by a transfer of responsibility for Financial Stability to the FSA – a newly created agency that *ipso facto* lacked practical experience .

In fact, the combined forces of increased globalization and reduced regulation led to extraordinary developments in UK banking- an unprecedented increase in the size and profitability of banking relative to GDP, (see charts in Appendix A, based on Haldane et al, 2010), with a pronounced degree of market concentration (see ICB, 2010, p.9). Although, at the time, it seemed that this headlong expansion was achieved without any great increase in risk, it ended in severe liquidity runs and solvency crises with two mortgage banks being nationalised and major two universal banks rescued with substantial capital support from the Treasury.

Chastened by this episode, macroeconomists are busy adding financial frictions to their models. For banking, too, there is surely a case for retooling. The account of banking to be found in Allen and Gale's widely acclaimed monograph *Understanding Financial Crisis* published in 2007, for example, is of small, competitive, utility banks. In this paper, therefore, starting with this traditional model of competitive banking as a baseline, we first add the concentration of market power -- and draw out the consequence that banks will collect the seigniorage attached to monopoly in money creation. Next we add the taking on of

risk associated with wholesale and investment banking[2] and why this may not be apparent if it is 'tail risk'. Then we turn to an issue emphasized by Andy Haldane, Director of Financial Stability at the Bank of England, namely the shift in strategic power that has taken place as banks have grown so large in size and complexity that the state is forced to bail them out with taxpayers money -- an issue tackled in the Final Report of the Independent Commission on Banking (2011) in terms of 'getting the taxpayer off the hook'.

Two informational paradigms

Before embarking on detailed analysis, an important issue to be confronted is whether the players in the industry were aware of the severe risk of insolvency to which the banks were exposed, or not. Were they as unaware of the trouble in store as those outside the industry – the politicians, for example, happy to see such success for enterprise in Britain and the taxes it was yielding; or the regulators, willing to let the industry run on a loose leash with 'light touch' regulation; or depositors, amazed at the salaries paid by the rapidly expanding investment arms of previously staid commercial banks, but confident that their money remained in safe hands?

Two contrasting informational paradigms may be considered. The first, that of *asymmetric information*[3], where banks were aware of risk but outsiders were not, is the perspective taken by Hellman et al. (2000) in analysing regulations to check excessive risk-taking ('gambling') by those managing bank portfolios; and by Rajan (2005), whose assessment of the powerful incentives for taking on tail risk is widely regarded as a prescient early-warning of the crisis to come[4]. It is also the view taken subsequently by Paul Wooley in *The Future of Finance* (2010, Chapter Three).

The second paradigm, what de la Torre and Ize (2011) call one of *collective cognition*, is where neither principal nor agent is aware of the downside risks associated with new

[2] Involving the provision of finance to other financial institutions and large corporations, assisting governments and large corporations in raising equity and debt finance, advising on M&A, acting as counterparty to client trades, etc see ICB (2010, p.45).
[3] with the associated principal/agent problem of how to design incentives to promote the objectives of the principal even though the agent is better informed.
[4] It was the approach used, more broadly, to warn of the risks of corporate looting in an earlier paper by Akerlof and Romer (1993).

investment strategies[5]. This is the perspective taken by Gennaioli et al. (2011), for example, in their paper on "Neglected risks, financial innovation, and financial fragility".

Though the policy implications may differ, the two approaches are close to being observationally equivalent: risks are taken which lead to insolvency -- and possibly to emergency rescue packages for failing financial firms. Nor does asking the players help: even if there is asymmetric access to information, the agent may choose to neglect some factors *ex ante* and and/or to feign ignorance *ex post*.

Recognising that the distribution of information is endogenous might help to discriminate between these two approaches, however, as in the discussion of distorted incentives by Rajan (2005). One of these distortions is:

> 'the incentive to take risk that is concealed from investors – since risk and return are related, the manager then looks as if he outperforms peers given the risk he takes. Typically, the kinds of risks that can be concealed most easily, given the requirement of periodic reporting, are risks that generate severe adverse consequences with small probability but, in return, offer generous compensation the rest of the time. These risks are known as tail risks.' Rajan (2005, p. 316)

A simple example, from Rajan (2010, pp. 138-9), is of a financial manager, with a safe security on the balance sheet, who posts returns that include the premiums on an out-of-the-money put – conveniently left off balance sheet. The overall return on such a portfolio will be elevated because of the risk involved – but this will not be apparent for some time (because it is 'in the tail') and, as a contingent liability, can be left off balance sheet. So the investor can collect what is effectively the risk premium as a bonus, leaving the firm badly exposed as and when the downside appears[6]. The names of the trading strategies that were being used also suggest an *ex ante* awareness of risk: they include, apparently:

> IBG (I'll Be Gone if it doesn't work), and in Chicago, the O'Hare Option (buy a ticket departing from O'Hare International Airport: if the strategy fails, use it; if the strategy succeeds, tear up the ticket and return to the office). That such strategies were common enough in the industry as to have names suggests that not all traders were oblivious of the risks they were taking. Rajan (2010, p.139).

[5] In the words of Charles Goodhart at the Herriot Watt Conference: 'The depositors didn't know, the regulators didn't know; the banks themselves did not know [of the risks inherent in expanding their portfolios]'.

[6] Foster and Young (2011) demonstrate further that the use of financial derivatives to reshape portfolio returns makes it almost impossible to discriminate the true alpha investor from a mimic on the basis of realised returns for an extended period of time.

In these circumstances, we have opted for the principal/agent paradigm in the analysis of the banking crisis that follows[7], grafting the 'gambling' model of Hellman *et al*. (2000) onto the base-line model of Allen and Gale (2007), modified to include seigniorage and risk as discussed above. But it is important that proposed reform measures be robust to the choice of paradigm.

Strategic balance of banks and the state

To the extent that seigniorage increases the 'franchise' value of banking, so, it might be reasoned, monopoly power will help to check excessive risk-taking, and complement official regulation in the form of required capital and real time monitoring. But this ignores the strategic threat that large banks can pose for society in terms of negative externalities that will ensue if they are not rescued after risky gambles that fail -- as can be seen in terms of a game where the banks have first-mover advantage. In this setting, a universal bank realises correctly that, given the threat of economic disruption that would follow from liquidation, a bail out after a gamble that fails is a subgame perfect response for the regulator. As the monopoly bank is insured against risk, it has the incentive to gamble.

To promote prudent behaviour when banks possess significant strategic power, structural reform to shift the balance between large banks and the regulatory authorities is surely required. A key issue with regard to the recommendations of ICB in particular is whether the proposal to ring-fence retail banking – with the associated ban on many risky strategies – will shift strategic power back to the regulator so that bank resolution is a credible threat.

The model used in this paper is admittedly stylised and compact; and there is, of course, an extensive literature on the market structure of the financial sector from the perspective of industrial organisation, succinctly summarised in Allen and Gale (2000) and Freixas and Rochet (2008), for example. Recent research has used network theory to analyse the structure of banking system, focusing on how inter-bank connectivity affects the transmission of systemic risk. Gai and Kapadia (2010a) and May and Arinaminpathy (2010), for example, study the stability of the banking system using random graphs and find that it is typically "robust-yet-fragile" (robust to the failures of periphery banks but fragile in respect of failure by central players). Our 'moral hazard'

[7] When we come to discuss regulatory responses, however, we will consider the extent to which the measures proposed are robust – i.e. will work even if the problem is one of 'collective cognition'.

approach suggests that concentration may arise for strategic reasons; and we investigate how concentration may impact on banks' incentives to behave prudently, focusing for convenience on the case of monopoly.

The paper is organised as follows. Section 1 reviews the traditional model of competitive banking and modifies it to allow for market concentration. In Section 2 we analyse the equilibrium when 'tail risk' investment opportunities are available to a monopoly bank with an information advantage; and investigate how far the franchise value and/or loss-absorbing capital can ensure prudent behaviour. Section 3 extends the analysis to look at the strategic factors that arise when banking is highly concentrated and economic externalities come into play. Section 4 looks at implications for banking reform -- the ICB proposals in particular. Section 5 concludes.

1. Utility Banking: competition and concentration

To fix ideas, we first use the standard three-date model with 'early and late' consumers (depositors) to see how market concentration affects bank profitability. This is done by comparing the optimal 'take it or leave it' deposit contract offered by a monopoly bank with the competitive equivalent.

Following Bryant (1980), Diamond and Dybvig (1983), and Allen and Gale (2007), each round has three dates, $t = 0,1,2$. There are two assets available to the bank, short and long, all associated with constant return to scale technology. The short asset – representing accessible storage – lasts only one period, and converts one unit of good today into one unit tomorrow. The long asset – representing illiquid but productive investment – takes two periods to mature, and converts one unit invested at t = 0 into $R > 1$ units at t = 2 later. There is a continuum of *ex ante* identical depositors with measure 1, each endowed with one unit of good at $t = 0$. At $t = 1$, the types of depositors are known, a fraction $0 < \lambda < 1$ of them being early consumers who derive utility from consumption only at $t = 1$; and $1 - \lambda$ fraction being late consumers who derive utility from consumption at $t = 2$.

The ex ante utility of depositors is

$$U(c_1, c_2) = \lambda U(c_1) + (1 - \lambda)U(c_2) \qquad (1)$$

where c_1 and c_2 are consumptions for early and late consumers, while $U(.)$ is strictly increasing and strictly concave.

Assume that depositors have an outside option which gives a minimum utility of $U(1, R)$.[8] For depositors to participate in banking, the utility from the deposit contract offered should be at least at the level of this outside option,

$$\lambda U(c_1) + (1-\lambda)U(c_2) \geq \underline{U} \equiv \lambda U(1) + (1-\lambda)U(R). \qquad (3)$$

The other incentive constraint is that the banking contract should be able to separate early and late consumers (so late consumers have no incentive to withdraw earlier), so

$$c_2 \geq c_1 . \qquad (4)$$

Returns from short and long assets are used to finance early and late consumptions as follows

$$x \geq \lambda c_1 \qquad (5)$$

and

$$(1-\mathrm{x})\mathrm{R} \geq (1-\lambda)c_2 . \qquad (6)$$

The sequence of events is such that at $t = 0$, a bank offers a contract (c_1, c_2) in exchange for the depositor's endowment. At $t = 1$, the types of the depositors are realised: and, if they are the early consumers, they receive c_1. At $t = 2$, the late consumers receive consumption c_2.

1.1 The competitive case

The competitive banking solution is illustrated in Figure 1, where the horizontal axis represents consumption in date 1 and the vertical the consumption at date 2, and the indifference curves represent expected utility of the average depositor. The participation constraint on banking outcomes is indicated by the downward sloping convex curve passing through the point $(1, R)$ labelled Market Equilibrium: so feasible deposit contracts are restricted to consumption points in the convex set defined by (3). The downward sloping straight line l_0 passing through the Market Equilibrium indicates the resource constraint

[8] Specifically potential depositors can, after the realisation of types, exchange their endowments with each other for early and late consumption goods in capital markets to ensure that $(c_1, c_2) = (1, R)$. See Allen and Gale (2007, pp. 60-64) for discussion of such a market equilibrium.

applying to banking equilibria. Bank profitability is zero on l_0 (but positive on l_1, i.e. when the line is shifted to the left).

The competitive contract is illustrated at point A in the figure, where the indifference curve (iso-EU) is tangent to the zero profit line (l_0). For risk aversion greater than 1, it can be seen that $1 \leq c_1 \leq c_2 \leq R$.

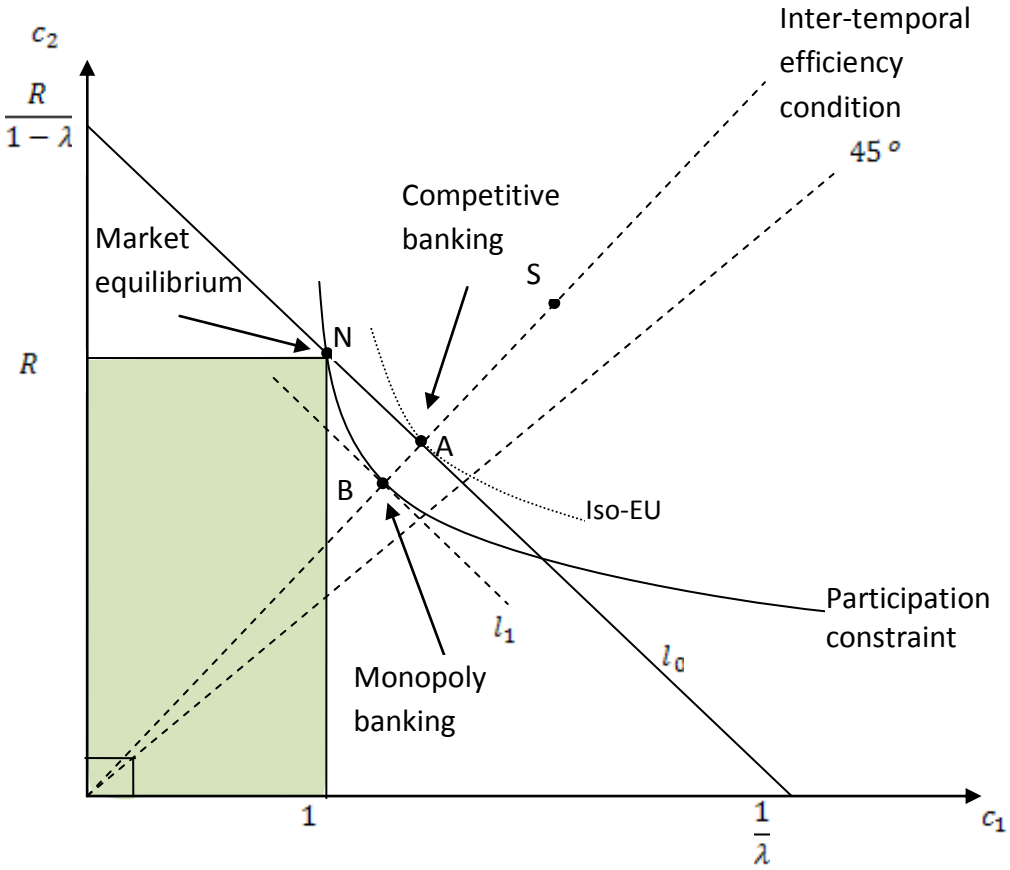

Figure 1. Competitive and monopoly banking

In the standard model of competitive banking discussed above, the capital structure may be varied without any implications for the asset side of the balance sheet: and Diamond and Dybvig's (1983) model of debt-financed banking was promptly complemented by Jacklin's (1987) version of pure equity banking. The Modigliani and Miller Theorem applies because of the assumptions of perfect competition, full information and no risk.[9]

[9] Where the bank is fully equity financed, with the shareholders paid dividends in each period, the cost of capital is $d_2/(1-d_1)$ where d_i is the per share dividend paid to all shareholders in period *i*, i.e., the cost of capital is the second period dividend per unit invested – corrected for the interim dividend paid out in period 1. With perfect competition and no risk, this will match the return on capital, R.

1.2 Monopoly banking and the 'seignorage' on money creation

'It is well known that financial intermediaries can extract rents by exploiting monopoly power through some combination of market share, collusion and barrier to entry' (Woolley, 2010, p.124). This can be accommodated in the traditional banking model without much difficulty by allowing for positive profits, as in Chang and Velasco (2001). Here we explicitly consider the case of monopoly: in addition to being analytically tractable, this has the implication that any failure will be 'systemic'.

A risk-neutral monopoly bank is assumed to maximise its undiscounted, one round, profits by choosing a suitable deposit contract (c_1, c_2) and investment in short asset, x, i.e

$$\Pi = \max_{x,c_1,c_2}\{x + (1-x)R - \lambda c_1 - (1-\lambda)c_2\}, \qquad (7)$$

The first two terms from the profit function are returns from the short and long assets respectively, and the last two terms represent early and late consumption. The optimal deposit contract is determined when the monopoly bank maximises its profits in (7) subject to constraints (3)-(6).

Since the short asset earns lower returns, the bank will have incentive to minimise its holding of x. This implies that (5) must always be binding, i.e.

$$x = \lambda c_1 \qquad (5')$$

Replacing x using (5'), the above problem can be rewritten as

$$\Pi = \max_{c_1,c_2}\{(1-\lambda c_1)R - (1-\lambda)c_2\} \qquad (7')$$

subject to

$$(1-\lambda c_1)R \geq (1-\lambda)c_2 \qquad (6')$$

plus (3) and (4).

The outcome with monopoly can be characterised as follows:

Proposition 1:

The optimal monopoly banking contract (c_1^*, c_2^*) satisfies the first order condition for inter-temporal efficiency, $\frac{U'(c_1^*)}{U'(c_2^*)} = R$, and the participation constraint, $\lambda U(c_1^*) + (1-\lambda)U(c_2^*) = \underline{U}$. This contract exists if and only if

$$\underline{U} \leq U\left(\frac{R}{1-\lambda+\lambda R}\right). \qquad (8)$$

and it must satisfy $c_2^* > c_1^*$.

Proof: The existence condition is trivial because otherwise the feasible set is empty. When (8) is given by a strict inequality, constraint (6') is not binding while (3) binds. In this case, the first order condition is given by $\frac{U'(c_1^*)}{U'(c_2^*)} = R$, which implies $c_2^* > c_1^*$ since $R > 1$ and the utility function is strictly concave. QED

Thus the monopoly bank uses its market power to deny depositors any of the welfare gains available to risk pooling. This monopoly solution is shown at point B in Figure 1. Profit maximisation subject to the participation constraint is achieved when the profit function l_1 is tangent to the indifference curve of the depositor's ex ante utility function, $\lambda U(c_1^*) + (1-\lambda)U(c_2^*) = \underline{U}$.

As regards the distribution of monopoly profits, we assume that these accrue to a limited number of shareholders. Thus, while all members of the population have the same unit endowment of goods, a small fraction of the population, $\sigma << 1$, are also entitled to share in the profits of the monopoly bank.

The final outcome, as shown in the figure, is one of inter-temporal efficiency but income inequality. The majority of the population will expect to achieve the utility associated with no banking, being constrained to consume at point B on the participation constraint. Shareholders, however, will expect to consume an additional amount which takes them to point S, which is the sum of the contract offered by the monopoly bank and their entitlement as shareholders. See Appendix B for brief discussion of how this may affect the Gini coefficient.

2. Banking with 'tail risk'

In discussing its extraordinary expansion of the US banks just before the financial crisis, Reinhart and Rogoff (2009, p.210) comment:

> The size of the US financial sector more than doubled, from an average of 4% of GDP in the mid-1970s to almost 8% of GDP by 2007… Leaders in the financial sector argued that in fact their high returns were the result of innovation and genuine value-added products, and they tended to grossly understate the latent risks their firms were undertaking[10].

For analytical convenience, in what follows we leave the real productivity gains generated by the financial sector to one side, and focus on the profit to be made due to distorted incentives to shift risks into the tail.

As in Hellman *et al.* (2000), we assume that the bank exploits the asymmetry of information to invest in a risky asset with mean return $\tilde{R}$, whose true prospects for high and low returns are private information to the bank. These prospects – to be realised in $t = 2$ – are denoted $R_H > R$ and $R_L < R$ respectively, with probabilities π and $(1-\pi)$; and we only consider the case where $\tilde{R}$ is a mean-preserving-spread[11] of R, i.e., $R = \pi R_H + (1-\pi)R_L$. Because of the information asymmetry, the downside possibility is not known to the depositors who treat the prospect of high returns as safe – the sweet fruits of innovative financial engineering. As these high, and seemingly safe, returns are not available outside banks, there is no shift to the outside option.

2.1 'Tail risk' in a Monopoly bank

We assume there is concentration in banking and focus especially on a monopoly bank which offers the non-risky contract (c_1, c_2) to consumers. Its expected profits are then

$$\tilde{\Pi} = \max_{c_1,c_2}\{\pi[(1-\lambda c_1)R_H - (1-\lambda)c_2] + (1-\pi)max[(1-\lambda c_1)R_L - (1-\lambda)c_2, 0]\} \quad (13)$$

[10] That the value added from the banking system may be overestimated in the absence of tail risk has been documented in Colangelo and Inklaar (2010). Wang et al. (2009) suggest a way to measure properly the contribution of the banking sector in a general equilibrium setting.

[11] Hellman et al. (2000) use the word gamble to describe the taking-on of the tail risk with lower mean return. Note that, we use the term gamble below even when there is no lowering of expected return. Our results would remain the same even if the expected return for taking risky investment is lower than the safe return.

where the term $[(1-\lambda c_1)R_H-(1-\lambda)c_2]$ represents the realised profits in the high state, and $max[(1-\lambda c_1)R_L-(1-\lambda)c_2,0]$ represents the realised profits in the low state. Note that if $(1-\lambda c_1)R_L<(1-\lambda)c_2$, the bank will not be able to fulfil its contract to late consumers, and will be insolvent. What happens in this case is not apparent to the depositors ex ante, however: the low-probability financial crisis will be unanticipated.

To find the optimal deposit contract, one maximises (13) subject to (4) and (5'). Note that here we cannot impose constraint (7'), even in expected terms, because it is possible that the bank is protected by limited liability – and might even be bailed out by the government in the low state, as discussed further below.

The optimal deposit contract is summarised in the following proposition, which covers two cases, only the first being relevant here:

Proposition 2:

(1) If the bank uses the risky technology, and if $R_L<(1-\lambda)c_2^*/(1-\lambda c_1^*)$, then the optimal contract is a solution to $\frac{U'(c_1^*)}{U'(c_2^*)}=R_H$ and $\lambda U(c_1^*)+(1-\lambda)U(c_2^*)=\underline{U}$.

(2) If $R_L\geq(1-\lambda)c_2^*/(1-\lambda c_1^*)$, the optimal deposit contract is the same as that in Proposition 1.

Proof: See Appendix C.

It is worth noting that the gambling bank will offer a deposit contract with dated consumptions further apart than for a bank that does not gamble. The optimal deposit contract with a gambling monopoly is shown in Figure 2, using the same axes as in Figure 1. As long as the gamble succeeds, the effective returns for the long asset will apparently have increased to R_H, so the iso-profit functions show a clockwise rotation (see l_0' and l_1') and the efficiency locus also shifts as if there has been a positive productivity shock. But as discussed above there is no change in the outside option, so the deposit contract shifts along the original participation constraint. Consequently, the optimal deposit contract offered by the gambling bank is at B'' where the iso-profit function l_1' is tangent to the binding participation constraint (2). Compared with the contract without gambling, date 1 consumption falls and date 2 consumption increases. As long as the gamble succeeds, so bank profits, ($A'-B''$), will rise

sharply, as is suggested by the point S representing consumption of owner-managers of the monopoly bank.

2.2 Franchise values and capital buffers as checks on gambling

Hellmann, Murdock and Stiglitz (2000) consider two regulatory restraints on gambling behaviour: either to impose minimum capital requirements and/or to limit deposit rates so as to allow banks to make excess profits (as with Regulation Q in the U.S.) – subject to the loss of the bank licence if the bank fails in either case.

As Bhattacharya (1982) points out, however, the threat of losing its franchise could alone inhibit gambling by a financial institution; and Allen and Gale (2000, p. 269) note that 'the incentive for banks to take risks in their investments … is reduced the greater the degree of concentration and the higher the level of profits'.[12] Before looking at regulatory intervention, consider the possibility of self-regulation via franchise values.

Self-regulation: franchise value without capital requirements

Will monopoly profits suffice to check gambling without regulation? To compute the franchise value of the monopoly, we consider a repeated game with infinite number of possible rounds. Each round has three dates, and the bank exchanges its deposit contract with consumers at the beginning of each round. There is no discounting within the round but the discount factor between two consecutive rounds is $0 < \delta < 1$. If the bank does not gamble, its capitalised profits are given by the following value function:

$$V_N = \Pi/(1-\delta) \tag{14}$$

In the context of the model we are using, this quantity V_N is the "seigniorage" accruing to the monopoly bank by virtue of its right to create money. Is this seigniorage large enough such that its loss will prevent gambling?

If the bank gambles, the value function is:

$$V_G = \tilde{\Pi} + \delta\pi V_G \tag{15}$$

[12] Boyd and De Nicolo (2005) have, however, argued that monopoly behavior which generates franchise values may also have adverse selection effect as loan rates increase and loan quality deteriorates.

This means that the gambling bank can capture current-round profits and future discounted profits if the gamble succeeds. But if the gamble fails, losses are taken over by the government and shareholders lose the franchise.

Simplifying (15) yields,

$$V_G = \tilde{\Pi}/(1-\delta\pi). \tag{16}$$

To remove the incentive for the bank to gamble, we have to ensure that

$$V_N > V_G. \tag{17}$$

Using (14) and (16), one can rewrite (17) as

$$\tilde{\Pi} - \Pi < (1-\pi)\delta V_N \tag{18}$$

where the left hand side indicates the one round gain from gambling, and the right hand side represents the ex ante cost of gambling: the probability of failed gamble, $1-\pi$, times the franchise value, δV_N. This 'no-gambling-condition' is similar to that in Hellmann, Murdock and Stiglitz (2000).We may characterise the boundary of the no-gambling-constraint, NGC, (where (18) holds as an equality, the specific form is given in Appendix C) in terms of R_H, π and δ.

Proposition 3:

(1) Given δ, the boundary of the no-gambling-constraint, $R_H(\pi;\delta)$, is downward sloping in π.

(2) An increase in δ will result in a upward shift of the boundary $R_H(\pi;\delta)$.

Proof: See Appendix C.

The boundary of the no-gambling-condition is shown labelled NGC in Figure 2, where the horizontal axis indicates the higher returns for the gambling asset in good state and the vertical the probability of gambling success. For the distribution of returns on risky investment lying below the NGC boundary, the bank will invest prudently; while for the area above the NGC boundary, the bank will take on excessive risks.

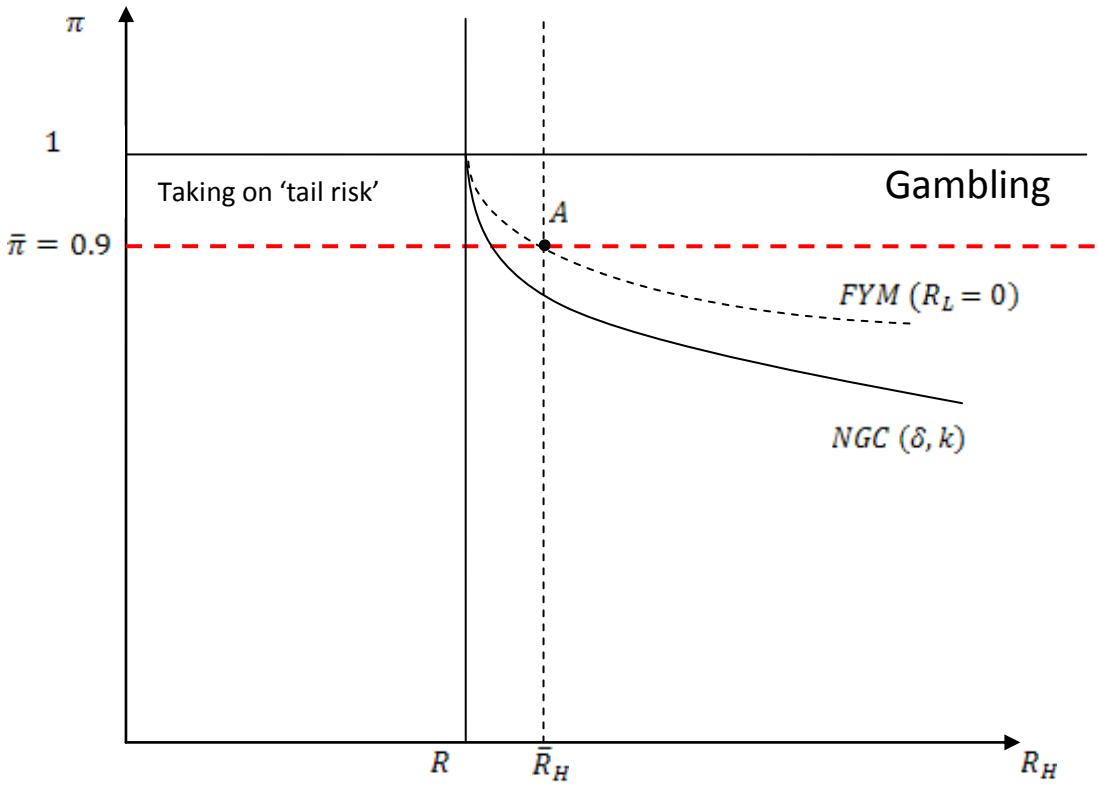

Figure 2. No-gambling-condition (NGC) and the mimicking constraint

The dotted curve, FYM, in Figure 2 indicates the mimicking strategy of Foster and Young (2011), which replicates the safe pay-off with mean-preserving risky investments such that $\pi\bar{R}_H + (1-\pi)R_L = R$, where R_L is set to zero and $\bar{R}_H$ is chosen to reflect the targeted alpha investor. For the parameters used in Table 1 below, FYM lies above the NGC, so the bank will gamble, as shown at point A for example, where the alpha target $\bar{R}_H$ is achieved by taking on tail risk[13](see the entry for $\pi = 0.9$ and $R_H = 2.2$). This may be countered by imposing capital requirement, k, as discussed in the next Section.

The essential features of the boundary of no-gambling constraint given in Proposition 3 are illustrated by the numerical example in Table 1, where $\mathrm{R} = 2, \lambda = 0.5, \gamma = 2$. For these parameter values, the monopoly bank makes a seignoirage profit of 0.057, measured in date 2 consumption. (Given $\mathrm{R} = 2$, this implies that almost 3 percent of the endowment will be transferred from the depositors to the shareholders even without taking on tail risk.) Entries in the table indicate how profits may be boosted by risk-taking for various values of $\mathrm{R_H}$ and π.

[13] Using standard definition for tail risk, the lower threshold for tail risk is $\pi = 0.9$ in our binominal model with mean preserving spread, as shown by the dashed horizontal line in the figure.

R_H	2.1	2.2	2.3	2.4
π=0.95	0.096	0.137	0.180	0.222
π=0.9	0.091	0.13	0.17	0.210
π=0.7	**0.070**	0.101	0.132	0.164
π=0.5	**0.050**	**0.0723**	**0.0945**	0.117

Table 1: Expected flow of profit for monopoly bank that gambles ($R = 2, \lambda = 0.5, \gamma = 2$)

Clearly, the opportunity for a monopoly bank to take on tail risk can substantially undermine its incentive to behave prudently. But the higher the discount factor, the less the incentive for the bank to gamble, as the franchise is valued higher. For a discount factor of $\delta = 0.7$, entries in bold[14] (in blue) towards the lower left of the table satisfy the no-gambling condition, while others fail; however, for a more long-sighted bank with a discount factor of $\delta = 0.9$, the underlined entries (in red) also satisfy no-gambling condition.[15]

Capital requirements as a check in gambling

It is clear from the numerical examples above that when δ is small, the franchise value itself may not be sufficient to deter gambling. In this case, extra measures are needed to ensure correct incentives. So, in what follows, we consider imposing regulatory capital requirements.

With the imposition of a positive capital requirement, k, a gambling bank's expected profit becomes:

$$\tilde{\Pi}(k) = \max_{c_1, c_2}\{\pi[(1-\lambda c_1)R_H - (1-\lambda)c_2] + (1-\pi)max[(1-\lambda c_1)R_L - (1-\lambda)c_2, -k]\}$$

where k is measured against total deposits. In the good state, capital will not bring additional cost; but in the bad state, the bank will have more to lose.

The imposition of the capital requirement modifies the no-gambling condition

$$\tilde{\Pi}(k) - \Pi \leq (1-\pi)\delta V_N.$$

[14] Note that equation (18) is used to check whether each entry satisfies the no-gambling-condition.
[15] Raising δ to 0.95 would be sufficient to ensure that point A satisfies the NGC.

Note that k has no effect on the optimal deposit contract offered by the gambling bank, and has no effect on Π and V_N, so the no-gambling-condition above can be rewritten as

$$\tilde{\Pi}(k=0) - \Pi \leq (1-\pi)(\delta V_N + k). \qquad (18')$$

It is clear that in checking gambling k is a perfect substitute for the franchise value δV_N. Since $\tilde{\Pi}$ is increasing in π and R_H, the imposition of the capital requirement shifts the no-gambling boundary, NGC, in Figure 2, upward, reducing the incentive to gamble for any given π and R_H.

It is worth bearing in mind, however, that the efficacy of regulatory capital will also be limited by outside options. Securitisation may be one of these: if regulatory burden on banks becomes excessive, securitisation may be a form of 'regulatory arbitrage', helping to move the business of banking off-balance sheet. In Appendix D we look ex-ante monitoring – the loss of franchise value in particular – an important complement to the ex-post measures considered above.

3. Concentration, strategic behaviour and the U-shaped No-Gambling Boundary

A further key element not yet considered is the role of negative externalities, what de la Torre and Ize (2011) refer to as collective action problem. If the banking sector is highly concentrated, the failure of one bank is likely to spread to the whole sector, generating systemic risk; so, to prevent a wholesale banking collapse – with all the externalities that will involve -- the government may see no alternative but to bailout the failing bank.[16] Seeing itself as "too big to fail" can greatly undermine a bank's incentive to invest prudently , as Haldane and Alessandri (2009) point out in a paper with the suggestive title "Banking on the State".

Here too there is a choice of informational paradigms – the view that these are issues of which agents are unaware (precisely because they are externalities) and the view that they

[16] As the then Chancellor reports: "The risk of one bank collapsing and taking all the others with it was acute. I suppose it could have been tried, but I would not have wanted to be responsible for the economic and social catastrophe that might follow." (Darling, 2011, p142)

simply chose to keep quiet. Again one might want to look at the incentives to find things out. An interesting case in point arose when the FSA sought to establish why big financial firms operating in the City of London only looked at minor shocks when conducting stress tests.

> The public officials asked the bankers why their firms had failed to explore the possibility of a real blow-up. Was it a result of disaster myopia, or a failure to appreciate the dangers of contagion? No, one of the attendees replied. It was nothing like that. The problem was that risk departments didn't have any incentive to simulate genuine disasters. If such an awful eventuality materialized, the simulators would likely lose their bonuses and possibly their jobs. And, in any case, the authorities would step in and rescue the bank. Cassidy (2009, p.317)

As Rajan (2010, p. 151) notes, the same logic may apply even for small firms if traders believe that the risky strategies are being so widely used that there will be official intervention when collectively they fail:

> But as enough banks imitated the innovators and took on similar risks, and as it became common wisdom among market participants that the market would be supported in the event of a crisis, there would have been strong incentives to load up on tail risks, even if such activity became visible. Rajan (2010, p.151).

3.1 Bailout as the sub-game perfect equilibrium

Before discussing in detail how the no-gambling-condition might be modified in the presence of "too big to fail" policy, consider the strategic elements involved with the aid of a simple two-player game between the banking industry – represented by a monopoly bank -- and the state – represented by the taxpayer.[17]

In the extensive game shown in Figure 3 we focus on a big bank with substantial franchise value.[18] The players are a Bank and the Taxpayer – assumed also to be a Depositor. It is the Bank that moves first, choosing either to pursue traditional *Prudent* banking or to experiment with *Innovative* behaviour, where for simplicity we ignore capital requirements. The figures in parentheses indicate the notional payoffs to the Bank and Taxpayer-cum-Depositor. Note that, in order to see whether the Bank is able to profit from risk per se (as argued by Sinn for example), Innovative behaviour is taken to involve a *mean preserving widening of the spread* of returns on the portfolio of the Bank. We also assume that there is *asymmetric information*

[17] This is a heroic simplification, of course, as in practice protecting the interests of the taxpayer is delegated to a troika of agencies, the Bank of England, Treasury and the FSA.
[18] Prior to this game being played, banks as a group will have chosen whether or not to concentrate as is discussed further below.

about probabilities of Success or Failure, with the Bank knowing the probabilities (π and $1-\pi$, respectively) but not the Taxpayer. (Appendix E is a more realistic case with payoffs calculated for a dynamic game using parameter values based on Sinn (2010).)

If the Bank chooses to act Prudent, the safe return of 2 is split equally between Bank and the Taxpayer. But if it chooses to innovate the payoffs depend on Nature and the response to failure. Nature moves next, awarding *Success* or *Failure* to the innovation with equal probability, the former generating attractive returns of 4 (with the depositor getting 1 and the rest going to the bank) the latter yielding nothing. It is now the Taxpayers turn; action is only called for if the Bank fails, however, and there is a choice of closure (*Liquidation*) or granting a *Bailout*. In the latter case, with payoffs shown as (0,0), the depositor is bailed out by the Taxpayer, at zero net gain; and the Bank gets nothing either. If the Bank goes into Liquidation, however, (as for Lehman Brothers) it also loses its franchise, ***f;*** and, in addition, there is a large negative externality for the Taxpayer in the form of economic disruption, ***x***.

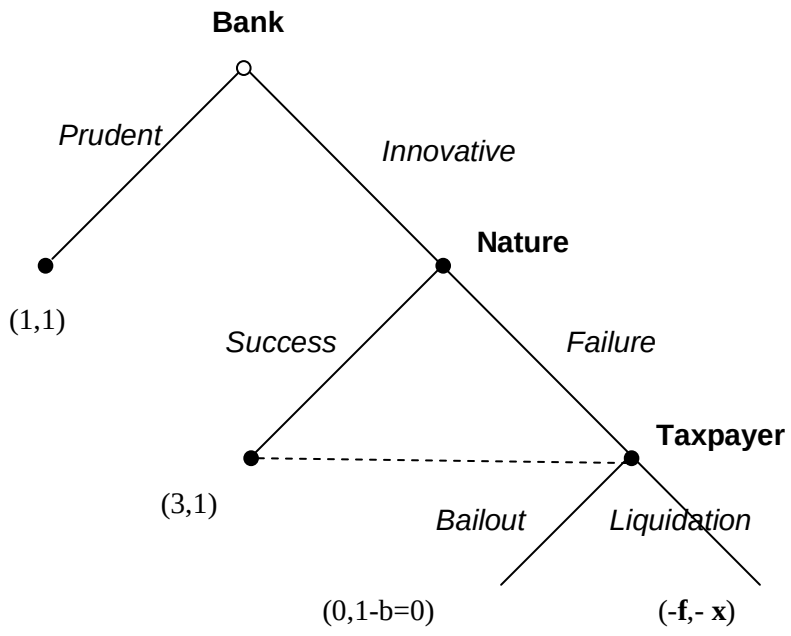

Figure 3. Moral hazard as the Taxpayer underwrites risky behaviour

Proceeding by backward induction, we note that the Taxpayer will opt for a Bailout as the preferred action at the last stage. Given the expectation of a Bailout, and equal probabilities for success and failure, the expected payoffs for the Bank and Taxpayer are (1.5, 0.5) Compared to the payoffs from prudent banking (1,1). Innovative behaviour will induce a net transfer of 0.5 from the Taxpayer to the Bank. So the Bank can expect to get more from taking risks than sticking to prudent banking.

It is clear from the payoffs that the Taxpayer would prefer the Bank to act prudently and avoid risky innovation, but this is not the outcome of the game. Using backward induction, the Bank will choose to take risks knowing that the Taxpayer will bail it out as the sub-game perfect equilibrium. Since the Taxpayer (who takes the down-side of risky bets) is effectively providing insurance for the Bank, this is a classic case of moral hazard. Note that the Taxpayer could choose Liquidation were it not for the high social cost of bank failure[19], the externality labelled **x**, which appears to act as a credible threat: 'Liquidate if you dare!'. If this is so, a key element of banking reform will be how to limit this threat.

The fact that the negative externality acts as a credible threat will surely be relevant to prior bank decisions on choosing the level of concentration. If high concentration were chosen, bank failures are likely to be systemic, i.e. impose significant negative externality: so failed banks will be bailed out. Anticipating this, the dominant strategy for banks is to proceed with Mergers & Acquisitions so as to put the Taxpayer on the hook in the event of failure.

As to the puzzle of why the Taxpayer-cum-Regulator would allow the Bank to innovate if the outcome is a net transfer, one must bear in mind that the Taxpayer is assumed to be unaware of the probabilities; and may for example believe that the Bank will attract true alpha investors who will deliver a high payoff ('success') for sure -- in which case, innovation would lead to better returns to the bank without any transfers (– and the Taxpayer may hope to share in some of these benefits by a tax on extra profits).

[19] Assuming that Liquidation is chosen as a tie breaker.

3.2 Concentration and U-shaped No Gambling Boundary

Can these strategic features be incorporated within the framework developed in Section 2? In what follows, we analyse how given concentration can affect bank's incentives; then we discuss the strategic incentives for choosing high concentration.

For analytical simplicity, let the degree of concentration, β ($0 \leq \beta \leq 1$) be defined by the fraction of the monopoly franchise value , V_N, that is obtained if a bank plays safe or is bailed out after a failed gamble. To model "too big to fail" policy, TBTF, let the probability the government will come to the bank's rescue, $\tau(\beta)$, increase with β, with $\tau\left(0 \leq \beta \leq \underline{\beta}\right) = 0$ and $\tau(1) = 1$. The rationale for specifying the bailout policy in this way is as follows: when the degree of concentration is low, no bank is "too big to fail", so the failure of a bank is less likely to have systemic effect; when the degree of concentration increases, any bank failure is more likely to be systemic, so the probability of attracting bailout increases. The TBTF policy used here specifies that if the bank gambles and fails, it <u>may</u> be bailed out by the government which will honour all deposit contracts. In this case, the bank loses its equity buffer but its franchise is not revoked.

With a given degree of concentration, the bank's profit if it plays safe is a fraction of that under monopoly, so the deposit contract offered by these safe banks will be a scaled-up version of that offered by the non-gambling monopoly (though each bank makes less profits per unit of deposit).

For the gambling bank under market concentration, β, its expected profit, assuming $R_L \geq (1-\lambda)c_2^*/(1-\lambda c_1^*)$, is given by

$$\tilde{\Pi}(\beta,k) = \max_{c_1,c_2}\{\pi[(1-\lambda c_1)R_H - (1-\lambda)c_2] + (1-\pi)[-k]\}$$

$$= \max_{c_1,c_2}\{\pi[(1-\lambda c_1)R_H - (1-\lambda)c_2] + (1-\pi)(-k) \qquad (19)$$

where the probability of losing capital for the gambling banks is $(1-\pi)$. Note that the optimal deposit contract with market concentration of β, if they exist, would be the same as that of a gambling monopoly.

Given the capital requirements and the TBTF policy specified above, the no-gambling condition is then modified to

$$\tilde{\Pi}(\beta,k) - \Pi(\beta) \leq (1-\pi)(1-\tau)\beta\delta V_N, \qquad (20)$$

where δV_N represents franchise value under full monopoly and $\beta\delta V_N$ the franchise value with market concentration of β and the failed gambling bank will be bailed out with probability τ. To summarise the results for the no-gambling boundary (above which banks will not gamble) in β and k space for some given π and $\mathrm{R_H}$:

Proposition 4:

(i) For $0 \leq \beta \leq \underline{\beta}$, the no-gambling boundary is downward sloping in beta and k space.

(ii) For $\underline{\beta} \leq \beta \leq 1$, the no-gambling boundary is U-shaped in β and k space.

(iii)Increasing R_H and/or π shift the U-shaped no-gambling boundary upwards.

Proof: See Appendix C.

The significance of Proposition 4 (iii) is that if the bailout is restricted to banks with less attractive gambles (i.e., low π and/or low R_H) the U-shaped no-gambling boundary will be much less pronounced, as we discuss further below.

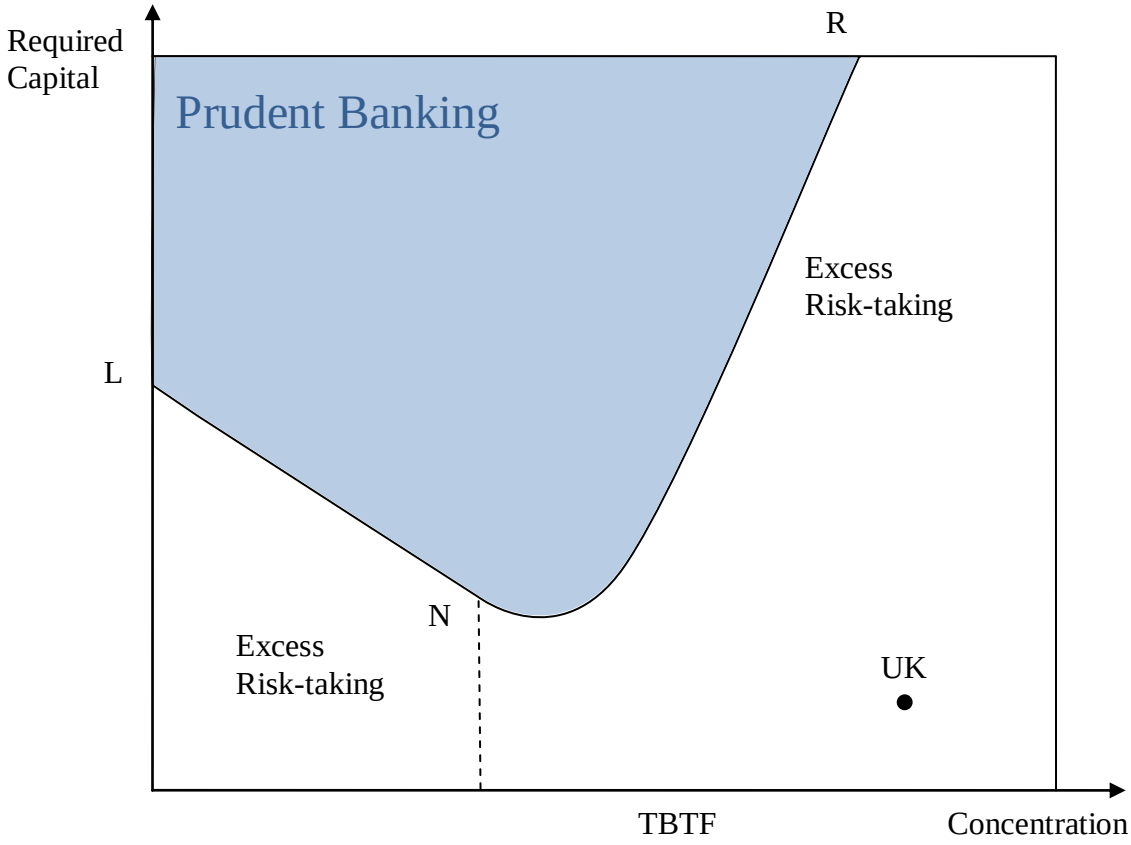

Figure 4. How bailouts increase the risk of imprudent banking

The above framework may be used in a heuristic discussion of options for the reform of the UK banking system, distinguishing in particular between reforms related to structure of bank **balance sheets** (the degree of leverage, for example) and those related to **markets** (such as the degree of concentration). For this purpose, we use Figure 4, with market concentration, β, on the horizontal axis (acting as a proxy for franchise value, assuming that high concentration implies high franchise value), and minimum capital requirement, k, on the vertical axis (to represent variations in bank leverage).

The no gambling boundary, defining the shaded area of Prudential Banking, is the U-shaped schedule LNR in the figure. The downward slope LN reflects the trade-off between bank's profitability (franchise value) and the official capital requirement in terms of prudential behaviour: as banking becomes more competitive and franchise values fall, so the minimum capital requirement will need to be raised to ensure prudence, for any given degree of tail

risk.[20] So the point L in Figure 4 will represent the minimum capital requirement needed under perfect competition.

As Haldane (2010, p.7) points out -- on the basis of commercial ratings -- an increase in concentration increases the likelihood of an official bailout, as banks become 'Too Big To Fail'. The evidence confirms that risky M&A activity earns the perverse privilege of increased access to state bailouts[21]. Taking this factor into account will of course greatly encourage bank mergers that lead to high concentration. In circumstances like these, where banks can, so to speak, have their cake and eat it, the likelihood of banks behaving prudently is sharply reduced, as shown in Figure 4. Let $\underline{\beta}$, represented by the dashed line, indicate the point at which banks become Too Big To Fail. To the left of this point, between L and N, the risk of losing franchise value is sufficient to check gambling: to the right, however, the rise of franchise value increases the probability of bailout which encourages gambling. Consequently, the region for prudential banking becomes U-shaped, as indicated by the shaded area bounded by LNR in the Figure. In the next Section we discuss structural reform as a way to remove the strategic threat.

4. Regulatory Reform: the Vickers report

Various measures for prudential regulation are discussed in Haldane (2011), including equity capital requirements (supplemented as appropriate by contingent convertible securities, CoCos), strengthening bank governance by modifying control rights, and improving performance criteria and remuneration schemes. Here we focus on the recommendations of the ICB, chaired by Sir John Vickers, in its Final Report released in September 2011.

4.1 Key features of the report

Turning to the key recommendations of this Report, we note that they involve changes in market structure as well as balance sheet restrictions.

[20] And, a shown in Proposition 4, heightened 'tail risk' (i.e. increasing R_H and/or π) shifts the no gambling boundary LN'R upwards.

[21] Compare the treatment of High Street banks which were bailed out by official purchase of equity shares (Lloyds Banking Group and RBS) as against the mortgage banks (Northern Rock and Bradford & Bingley) which were nationalised.

Structural separation is recommended in the form of a 'retail ring-fence' designed to isolate and contain banking activities where the continuous provision of service is vital to the economy and a bank's customers so as to ensure that such provision is protected from incidental activities and that it can be maintained in the event of bank failure without government solvency support. 'In essence, ring-fenced banks would take retail deposits, provide payments services and supply credit to households and businesses.' ICB (2011, para. 3.1) These services are divided into those which are *mandated* (involving about 18% of assets as of end 2010); are *permitted* (another 18%); and those which are *prohibited* (about 64%).

Ring-fenced banks will thus be banned from a very considerable range of activities currently conducted by universal banks. Depending on how much of the second category are taken inside the fence, 'the ring fence might include between a sixth and a third of the total assets of the UK banking sector of over £6 trillion.'' ICB (2011, para. 3.40). (As banks inside the fence can stay linked with those outside, subject to arms length and other restrictions, however, this is not the complete separation mandated by the Glass-Steagall Act in the USA.)

In addition several steps are recommended in order to increase competition on the High Street – increased transparency of costs and transferability of accounts, in particular.

Balance sheet requirements involve substantial loss-absorbing capacity in the form of equity and bonds so as to avoid claims on the taxpayer following bank insolvency. Specifically, the Commission recommends that 'large UK ring-fenced banks (and the biggest UK Globally Significant Banks) be required to hold *primary loss-absorbing capacity of at least 17% of RWAs* which can be increased to *a further buffer of up to 3%* of RWAs for a bank to the extent that its supervisor has doubts about its resolvability', ICB (2010, para. 4.118).

This loss absorbing capacity can be split between equity and bail-in bonds, where the equity-to-RWAs ratio is at least 10% for ring-fenced banks with 3% or more of UK GDP in RWAs (falling to 7% for those with RWAs of 1% of UK GDP), ICB (2010, para. 4.132-134).

As regards *monitoring and transparency*, issues discussed in Appendix C, the Commission notes that: "[a] ring-fence of this kind would also have the benefit that ring-fence banks would be more straightforward than some existing banking structures and thus easier to manage, monitor and regulate." (ICB, 2010, para 3.4)

4.2 Getting the taxpayer off the hook: bailout no longer guaranteed

How can ring-fencing change the strategic relation between the state and banks? With reference to the game tree in Figure 3, the fundamental requirement is that the severe externalities triggered by unpremeditated bank closure be removed i.e. the payoff to the Taxpayer in the case of liquidation be changed from -x to zero[22]. The means to this end include (a) improved *ex ante* monitoring of risk-taking; (b) a great reduction of risks that may be taken; (c) substantially increased loss-absorbing capacity on the part of the bank to cover what risk remains, and (d) better resolution procedures should the retail bank need to be reconstituted.

Heuristically, this strategy can be illustrated with reference to Figure 5, referring only to banks within the ring-fence, where some of the measures should act to expand the region of "Prudential Banking" (beyond that in the earlier Figure 4, indicated here by the dashed U-shape); others to shift the locus of a ring-fenced bank into this enlarged area.[23]

[22] Assuming that in the event of a tie the taxpayer will prefer liquidation to bail-out.

[23] As access to more exotic gambles was found to shift the U-shaped frontier upwards according to Proposition 5, so the *prohibition of many risky assets* – two thirds of the current portfolio of UK banks, in fact – should have the reverse effect, as indicated by the shift from L to L' in the No Gambling frontier. *Improved monitoring* - backed by a threat of losing one's licence if caught – should further reduce the region of excess risk by making the frontier slope down more steeply from L'. Steps to move the locus for ring-fenced banks towards Prudential Banking include both the decisive *increase in the level of capital required* for the operation of a ring-fenced bank and steps to *increase competition* among High Street banks, see the arrow pointing NW in the figure.

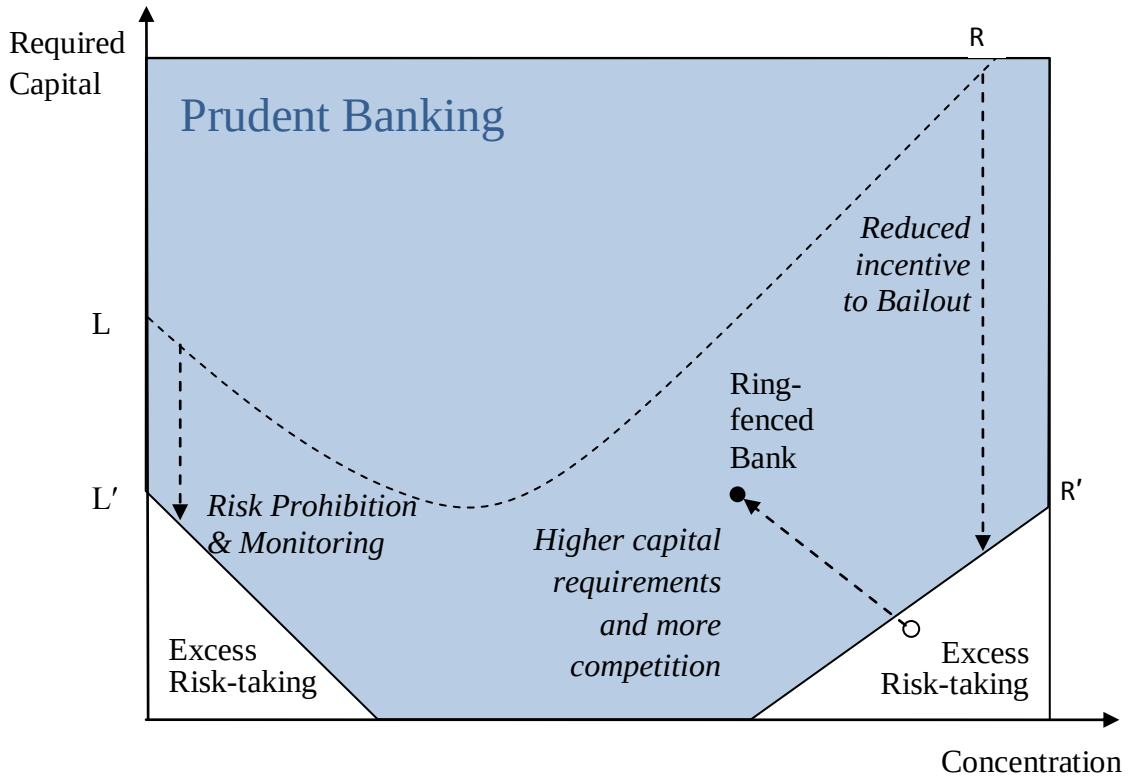

Figure 5. Checking risk-taking in 'ring-fenced' banks

The various regulatory changes indicated in the Figure– together with arrangements such as 'Living Wills' for prompt resolution – are, according to the ICB Final Report, designed to get the taxpayer 'off the hook' of bailing out universal banks in trouble.

The stated purpose of retail 'ring-fencing' is to get such banks back to the business of taking retail deposits, and supplying credit and liquidity to households and businesses. Thus the proposed reforms would:

> put the UK banking system of 2019 on an altogether different basis from that of 2007. In many respects, however, it would be restorative of what went before in the recent past – better capitalised, less leveraged banking more focussed on the needs of savers and borrowers in the domestic economy. ICB (2011, p.18)

We have analysed the Vickers Report from the perspective of asymmetric information. Are the proposals still appropriate if there are problems of 'collective cognition'? Perhaps the emphasis on *ex ante* monitoring -- and especially the outright banning of products that appear risky -- could be seen as a step away from the Anglo-Saxon principle of common law (where

products are permitted unless found to be dangerous) towards the Roman law principle (that products are banned unless shown to be safe). In this case, as with new medicines, society may be protected by shifting the burden of proof onto the innovator -- with some loss of efficiency but gains in stability.

5. Conclusion: back to banking basics

There clearly is a dangerous propensity for banks to take on excessive risks in the current regulatory environment: as Vickers (2011, p.2) remarks: "One of the roles of financial institutions and markets is efficiently to manage risks. Their failure to do so – and indeed to amplify rather than absorb shocks from the economy at large – has been spectacular."

Financial innovations, such as securitisation and Credit Default Swaps, have increased the ease with which banks can take risky assets onto their balance sheets while satisfying the regulatory norms set by Basel. There are clear private incentives for High Street banks to expand into investment banking, raising their balance sheets well beyond the needs of households and SME borrowers and shifting risk onto depositors and/or the taxpayer by greatly increased leverage. But the social cost of interrupting the nationwide provision of payments services and credit supply associated with bank failures means that banks that combine retail and wholesale activities will be rescued by the government, a threat to the economy that effectively puts tax-payers on the hook to underwrite the risks taken by large universal banks.

Nor has the incidence of crisis itself changed these incentives, apparently. As Diane Coyle (2011), a former member of the UK Competition Commission, noted as bank profitability recovered in 2010-11 despite a still-fragile economy: 'The truth is that banks are again doing well out of banking, but businesses and consumers are not... Bonuses are back... they are a measure of monopoly rents in the business, it does not take great talent to make a profit by taking excessive risk, safe from effective competition and sure of a bailout if needed.'

As a contribution to the debate on problems besetting modern banking in Britain, we began with a simple model of retail banking and showed how, behind the veil of asymmetric information, the incentive to take on risk can easily exceed the threat of losing the franchise – especially if the probability of losing the franchised is reduced by the prospect of an official

bailout. As the prudential benefits of increased concentration are progressively offset by the prospect of rescue, the ‘prudential frontier’ relating capital requirements to concentration becomes U–shaped.

This framework – of concentrated banking with asymmetric information – is used to discuss the impact of regulatory reforms involving changes to market structure, balance sheet restrictions and the efficacy of monitoring. Considering the reforms advocated by the ICB in their Final Report in particular, we note that they are designed to offset excess risk-taking and promote competition, i.e. to eliminate the very features that we have added to the basic banking model to capture current distortions! But they go further.

A key aim of Mrs Thatcher’s industrial policy was to reduce the threat to the provision of goods and services posed by strikes in the public sector – the confrontation with coal miners being a decisive case in point. An important – perhaps the most important – aspect of the ‘ring-fence’ proposal viewed as industrial policy is how – by reducing the threat of abrupt contagious closure on the part of retail banks – it aims to change the strategic balance between banking and the state.

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Appendices

Appendix A Salient features of banking in Britain

Two salient characteristics of UK banking are that the key players are universal banks[24] and that the industry is concentrated, 'especially in the retail and commercial sector, where the top six banks account for 88% of retail deposits' ICB (2010, p.9). Two other striking features are the rapid expansion of balance sheets prior to the crisis; and the increase in measured value added, especially in profits. As can be seen from Chart A1, banking assets doubled relative to GDP since 1990, rising to more than five times annual GDP – which represents a 10-fold increase above the long run historical average of around 50%.

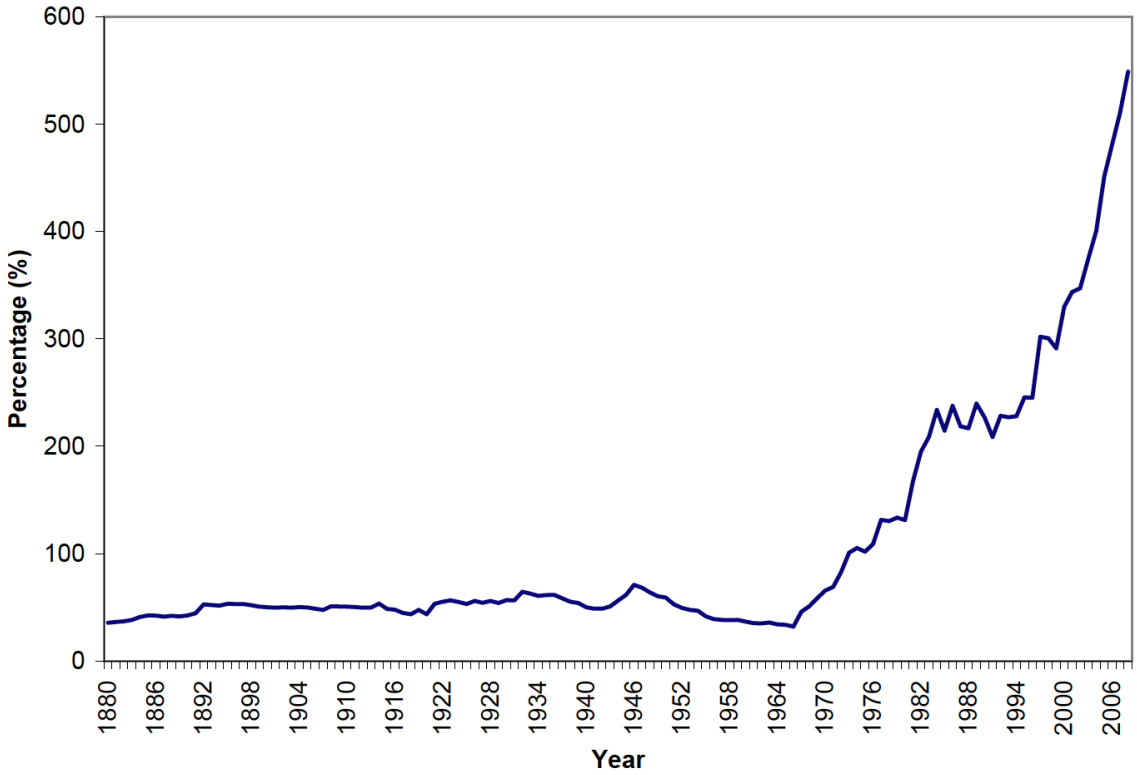


Chart A1: UK banking sector as % of GDP.
Note: The definition of UK banking sector assets used in the series is broader after 1966, but using a narrower definition throughout gives the same profile.

Source: Haldane et al (2010, p.84)

[24] i.e., they combine both categories of banking - retail & commercial and wholesale & investment.

Evidence of the sharp rise in the measured contribution of banking to national income in the run-up to the financial crisis is provided by Haldane et al. (2010), where it is reported that, using conventional measures of value added:

> In 2007, financial intermediation accounted for more than 8% of total GVA, compared with 5% in 1970. The gross operating surpluses of financial intermediaries show an even more dramatic trend. Between 1948 and 1978, intermediation accounted on average for around 1.5% of whole economy profits. By 2008, that ratio had risen tenfold to about 15% (See Chart A2).

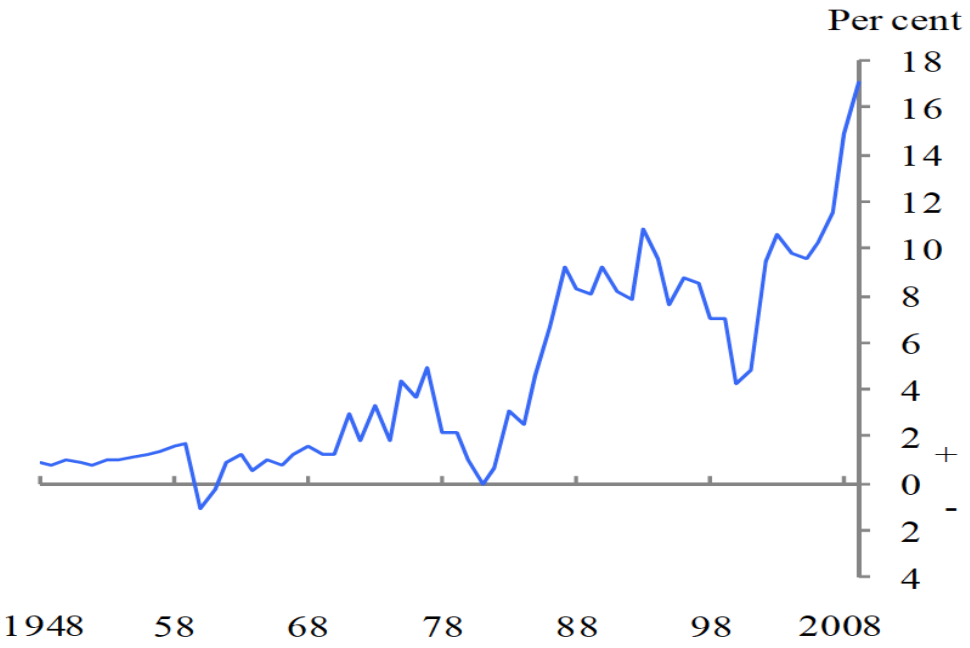


Chart A2: Gross operating surplus of UK private financial corporations (% of total)

Source: Haldane et al (2010, p.68)

Perhaps the most extraordinary feature, however, is that the recent rapid expansion of balance sheets and profitability was accompanied by an apparent *reduction* in the riskiness of bank portfolios. As shown in Chart A3, the doubling of leverage from the late 1990s until just before the crisis was accompanied by a halving of the fraction of risk-weighted assets. Thus – despite the efforts of the Basel Committee to ensure banks were adequately capitalised -- for the period 2005-2008, leverage was around 40 for UK banks on average, and considerably higher for some.

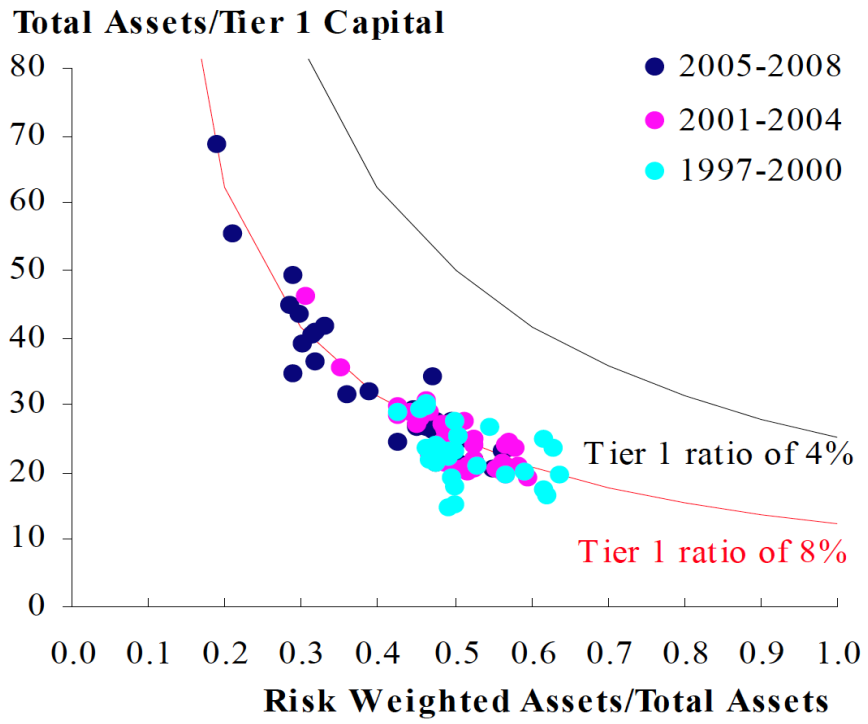


Chart A3: Leverage and risk-taking in UK banks.

Source: Haldane et al (2010, p.89)

Ex-post, the sliver of equity turned out to be far too slender to absorb the risks actually being taken. In the event, official support for the financial sector running to 74 % of GDP (including capital injections of more than 5% of GDP) had to be supplied to prevent banking collapse[25].

[25] See Haldane and Alessandri (2009, Annex, Table 1) who also describe various profit-making strategies - including taking on tail risk - that contributed to these losses and may have been induced by expectations of state support.

Appendix B. Gambling and Gini Coefficient: Miracle and Mirage?

It is evident that in this simplified model, bank concentration will lead to an increase in the Gini coefficient compared with competitive banking: and this effect will become much more pronounced with gambling. This is illustrated by the stylised Lorenz curves in Figure A1, where σ represents the fraction of the population owning shares in the all-deposit bank. If ω represents the consumption bundle available to depositors under monopoly banking, and ω(1+μ) is the consumption available to the depositors who are also shareholders enjoying the monopoly premium, μ, then $\omega = 1/(1+\sigma\mu)$ and the Gini coefficient[26] turns out to be $(1-\sigma)\sigma\mu/(1+\sigma\mu)$. When the bank gambles, the premium paid to owner-managers will of course rise, say to $\tilde{\mu}$, shifting the Lorenz curve to $O\tilde{L}P$ in the figure.

In discussing whether the contribution of financial sector is 'Miracle or Mirage', Haldane et al. (2010, pp. 79-80) report that the share of financial intermediation in employment in UK is around 4%, and that:

> the measured 'productivity miracle' in finance …has been reflected in the returns to both labour and capital, if not in the quantity of these factors employed. For labour, financial intermediation is at the top of the table, with the weekly earnings roughly double the whole economy median. This differential widened during this century, roughly mirroring the accumulation of leverage within the financial sector.

Using the above formula, a doubling of consumption opportunities for those in finance would add about 4% to the Gini coefficient, i.e. about half the rise in Gini coefficient for the UK from 1986 when the Big Bang took place, to just before the crisis in 2007. (Focusing more narrowly on Investment Banking, however, the Financial Times reports compensation running at 6 times the median income in both US and UK.[27]

[26] i.e. the area OLP divided by O1P in the diagram.
[27] FT, Feb 17th, 2011, 'Banker's pay: time for deep cuts.'

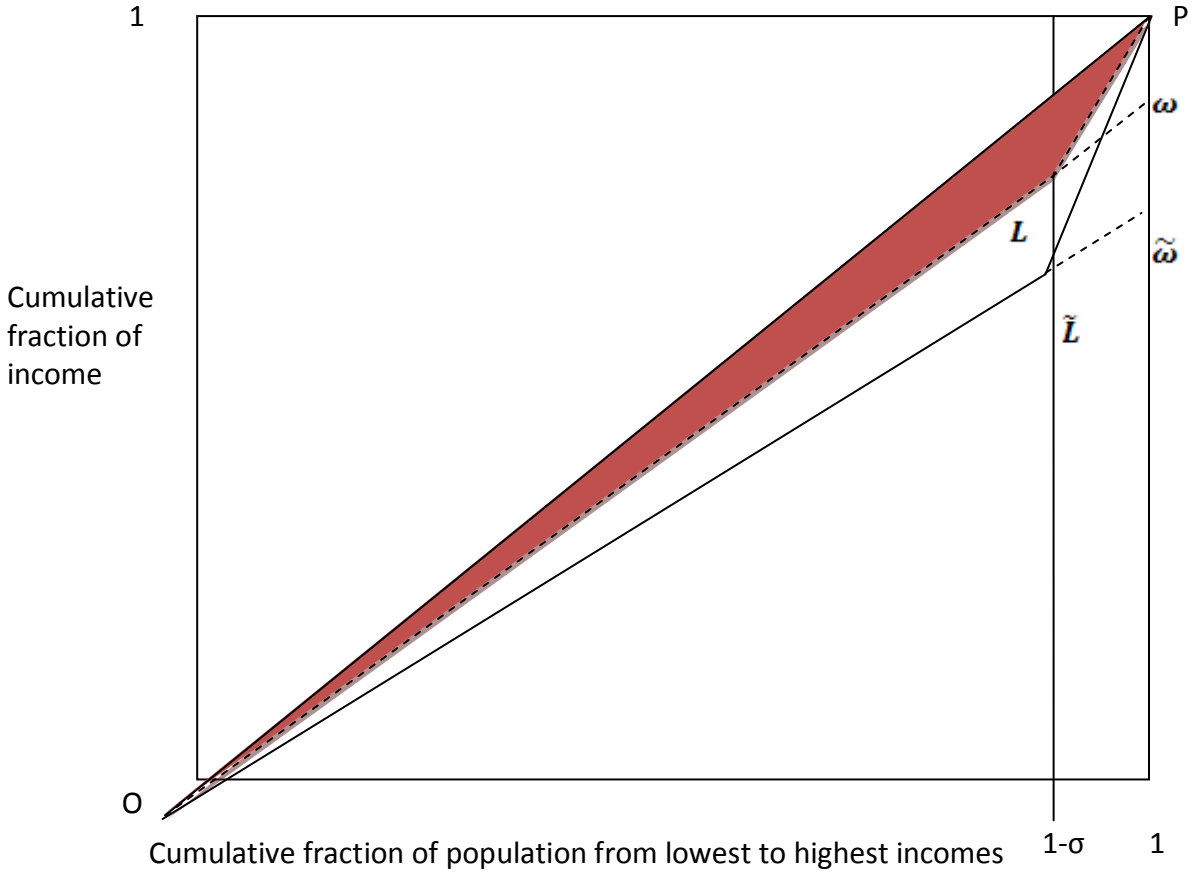


Figure A1: Raising incomes in financial services and inequality

Appendix C. Proof of Propositions

Proof of Proposition 3

If R_L is low enough, the bank cannot honour the contract to the late consumers in the low state (the late consumption in this case is honoured by the insuring agency). So the bank's profits are given by $\pi[(1-\lambda c_1)R_H-(1-\lambda)c_2]$. This changes the first order condition to $\frac{U'(c_1^*)}{U'(c_2^*)}=R_H$. Together with the binding participation constraint, one can then determine the optimal contract as in the second part of Proposition 4. (Since case (2) has the same deposit contract as that under certainty and no default from the bank, we use case (1) to represent gambling.)

If R_L is large, the bank can honour the contract to the late consumers in either state. So the optimal contract satisfies the first order condition $\frac{U'(c_1^*)}{U'(c_2^*)}=\pi R_H+(1-\pi)R_L=R$. With the binding participation constraint the same as in Proposition 1, the optimal contract must be the same.

Proof of Proposition 4

Given the monopoly bank will gamble, it is best for it to choose the deposit contract (C_1^*, C_2^*) specified in Proposition (4). In this case, to ensure that the bank will gamble, condition (18) becomes

$$\widetilde{\Pi}(C_1^*, C_2^*)-\Pi(C_1^*, C_2^*)\geq\delta(1-\pi)V_N(C_1^*, C_2^*). \qquad \text{(B1)}$$

Similarly, given the monopoly bank will not gamble, it is best for it to choose the deposit contract (C_1, C_2) specified in Proposition (3.1). To ensure that the bank will not gamble, condition (18) becomes

$$\widetilde{\Pi}(C_1, C_2)-\Pi(C_1, C_2)\leq\delta(1-\pi)V_N(C_1, C_2). \qquad \text{(B2)}$$

For some given parameters of π, R_H and δ, it is always possible to have

$$\tilde{\Pi}(C_1^*, C_2^*) - \Pi(C_1, C_2) = \delta(1-\pi)V_N(C_1, C_2). \quad \text{(B3)}$$

If (B3) is satisfied, then both (B1) and (B2) are true as $\tilde{\Pi}(C_1^*, C_2^*) \geq \tilde{\Pi}(C_1, C_2)$, $\Pi(C_1, C_2) \geq \Pi(C_1^*, C_2^*)$ and $V_N(C_1, C_2) \geq V_N(C_1^*, C_2^*)$. So for the set of parameter values such that (B3) holds, the monopoly bank may choose either to gamble or to play safe.

Now we show that in R_H and π space, for a given delta, the boundary specified in (B3) lies below the boundary where (B2) holds as an equality and above the boundary where (B1) holds as an equality. To simplify comparison, we fix the value for π. Then, we can select the appropriate value for R_H such that (B3) holds. In this case, (B2) is satisfied. To ensure (B2) holds as an equality, we have to increase the value of $\tilde{\Pi}(C_1, C_2)$. Since $\frac{\partial \tilde{\Pi}(C_1, C_2)}{\partial R_H} > 0$, the R_H which ensures that (B2) is an equality must be greater than or equal to the R_H for which (B3) holds. So the boundary of (B3) lies below the boundary where (B2) is an equality. Similarly, one can show that (B3) also lies above the boundary where (B1) is an equality.

In R_H and π space, multiplicity of equilibria occurs in the area bounded by the boundaries of (B1) and (B2). So the sufficient condition to ensure no gambling is to choose the parameters of R_H and π such that they lie below the boundary of (B1). In what follows, we characterise the general properties of this boundary.

(1) Rewrite the no-gambling condition as

$$\tilde{\Pi}(C_1^*, C_2^*) - \left[1 + \frac{\delta(1-\pi)}{1-\delta}\right]\Pi(C_1^*, C_2^*) = 0. \quad \text{(B4)}$$

Note that the contract offered by the gambling bank, (C_1^*, C_2^*), must satisfy the first order condition

$$u'(C_1^*) = R_H u'(C_2^*), \quad \text{(B5)}$$

and the binding participation constraint

$$\lambda u(C_1^*) + (1-\lambda)u(C_2^*) = \underline{U}. \quad \text{(B6)}$$

So, it is clear that $\frac{\partial C_1^*}{\partial \pi} = \frac{\partial C_2^*}{\partial \pi} = 0$, $\frac{\partial C_1^*}{\partial R_H} < 0$ and $\frac{\partial C_2^*}{\partial R_H} > 0$. This implies $\frac{\partial \Pi(C_1^*, C_2^*)}{\partial \pi} = 0$.

Using (B5) and (B6), one can show that

$$\frac{\partial \Pi(C_1^*, C_2^*)}{\partial R_H} = \lambda(R_H - R)\frac{\partial C_1^*}{\partial R_H} < 0 \qquad \text{(B7)}$$

Applying the envelope theorem, one obtains,

$$\partial \widetilde{\Pi} / \partial R_H = \pi(1 - \lambda c_1^*) > 0, \qquad \text{(B8)}$$

and

$$\frac{\partial \widetilde{\Pi}}{\partial \pi} = (1 - \lambda c_1^*)R_H - (1 - \lambda)c_2^* > 0. \qquad \text{(B9)}$$

Differentiating the no-gambling condition (B4) with respect to π and R_H yields

$$\left\{\pi(1 - \lambda C_1^*) - \left[1 + \frac{\delta(1-\pi)}{1-\delta}\right]\lambda(R_H - R)\frac{\partial C_1^*}{\partial R_H}\right\} dR_H + [(1 - \lambda C_1^*)R_H - (1 - \lambda)C_2^*]d\pi = 0$$

(B10)

Since both terms before dR_H and $d\pi$ are positive, the no-gambling condition must slope downward in R_H and π space.

Finally, note that if $\pi \to 1$ and $R_H \to R$, then (B4) holds. So the no-gambling boundary starts from $(R, 1)$ in the R_H and π space and goes asymptotically towards the R_H axis.

(2) An increase in δ increases the coefficient of the second term in (B4), $\left[1 + \frac{\delta(1-\pi)}{1-\delta}\right]$. To maintain equality, R_H has to increase for a fixed π. Note that all no-gambling boundaries start from $(R, 1)$, so an increase in δ swivels the no-gambling boundary upwards in the R_H and π space.

Proof of Proposition 5

As is shown in the proof of Proposition 5 above, it is sufficient to specify the no-gambling condition (20) as

$$\widetilde{\Pi}(C_1^*, C_2^*; \beta, k) - \Pi(C_1^*, C_2^*; \beta) \leq (1 - \pi)(1 - \tau)\beta\delta V_N(C_1^*, C_2^*), \qquad \text{(B10)}$$

where (C_1^*, C_2^*) is the optimal deposit contract offered by the gambling bank.

For $0 \leq \beta \leq \underline{\beta}$, $\tau = 0$, so (B10) can be rewritten as

$$\widetilde{\Pi}(C_1^*, C_2^*; \beta, k = 0) - \Pi(C_1^*, C_2^*; \beta) \leq (1 - \pi)[\beta\delta V_N(C_1^*, C_2^*) + k] \qquad \text{(B11)}$$

Note that the deposit contract (C_1^*, C_2^*) is unaffected by either β or k, so to keep (B11) as an equality, a reduction in β must be compensated by an appropriate increase in k. This generates the downward sloping section of the no-gambling condition in β and k space.

For $\underline{\beta} \leq \beta \leq 1$, we rewrite (B10) as

$$\widetilde{\Pi}(C_1^*, C_2^*; \beta, k = 0) - \Pi(C_1^*, C_2^*; \beta) \leq (1 - \pi)[(1 - \tau)\beta\delta V_N(C_1^*, C_2^*) + k]. \qquad \text{(B12)}$$

Since the left hand side is independent of β and k, maintaining (B12) as an equality requires the right hand side to be a constant. Differentiating the right hand side with respect to β or k, one can obtain the slope of the no-gambling condition as

$$\left.\frac{dk}{d\beta}\right|_{NGC} = [\beta\tau'(\beta) + \tau - 1]\delta V_N. \qquad \text{(B13)}$$

It is clear from (B13) that the numerator is negative if $\beta \to \underline{\beta}$ and positive if $\beta \to 1$. So the no-gambling condition is U-shaped.

Appendix D. Real-Time Monitoring

For the case discussed above, the regulatory capital required to deter gambling can be substantial, even for moderate gambles (see rows 1 and 3 in Table 2 below). One way to reduce the capital charge is to introduce real-time monitoring. Real-time monitoring will be characterised by a given probability of detecting gambling before it fails; and an associated punishment. For simplicity, we assume that the probability of detection is q and the punishment is the loss of franchise. (Later, we discuss the effect of other punishments.) In this case, the value function of the gambling bank becomes

$$V_G^m = (1-q)[\tilde{\Pi}(k) + \pi\delta V_G^m]$$

or

$$V_G^m = \frac{(1-q)\tilde{\Pi}(k)}{1-(1-q)\pi\delta}$$

Note that introducing real-time monitoring simply scales down the profits of a gambling bank, so the functional form of deposit contracts offered by the gambling bank are unchanged.

Applying the no-gambling-condition $V_G^m \leq V_N$ and re-arranging yields

$$\tilde{\Pi}(k=0) - \Pi \leq (1-\pi)\{\delta V_N\left[1 + \frac{q}{\delta(1-q)(1-\pi)}\right] + k\} \qquad (18'')$$

Given capital requirements, imposing real-time monitoring reduces gambling profits and so decreases the incentive to gamble. By comparing (18'') with (18'), it is clear that the net effect is "as if" there is an increase in franchise value. So, in terms of Figure 2, introducing real-time monitoring further shifts the no-gambling-condition upwards in π and R_H space.

Using the no-gambling-condition (18''), one can obtain the minimum capital requirements as:

$$k^* = \frac{\tilde{\Pi}(k=0) - [\frac{1}{1-q} - \pi\delta]V_N}{1-\pi}$$

To gauge quantitative significance of real-time monitoring of this form, we compare minimum capital requirements (measured in terms of deposits) for the mimicking strategy, $R_H = R/\pi$, both under perfect competition and under monopoly. Results are summarised in Table 2 where $\gamma = 2$, $\lambda = 1/2$, $q = 0.3$, $\delta = 0.9$ and $\pi = 0.81$. For returns under prudent investment, we choose $R = 2$ as in Allen and Gale (2007), $R = 1.04$ as in Foster and Young (2011) and an intermediate case where $R = 1.5$.

Regime	**R = 2**	**R= 1.5**	**R = 1.04**
Monopoly without monitoring	0.315	0.550	0.528
Monopoly with monitoring	0	0.209	0.522
Perfect competition	0.854	0.693	0.528

Table 2: Minimum capital requirements under different regimes

The first row in Table 2 indicates that, without monitoring, decreasing safe returns, R, increases the minimum prudential capital requirement. This is because smaller R implies a smaller franchise value, so capital requirements have to be increased to offset this and preserve proper incentives. The second row shows that the effect of introducing real-time monitoring depends crucially on the franchise value. When this is high (R=2), a moderate probability of detecting the gamble (30%) can substantially reduce the minimum capital requirement.[28] When the franchise value is low (R=1.04), the effect on the minimum capital requirement is minimal.

The third row illustrates minimum capital requirements under perfect competition: as R decreases, gambling by using mimicking strategy becomes less attractive, so minimum capital requirements decline. Note first that, for any given R, the minimum capital requirements under perfect competition are generally greater than those under monopoly. This is because there is no franchise value under perfect competition; so the gap between

[28]Similar results are found elsewhere. Thus, in a careful calibration of the Hellmann, Murdock and Stiglitz (2000) model, Kuvshinov (2011) shows that real time monitoring can reduce minimum capital adequacy ratio from around 40% to 20%.

them shrinks as the franchise value decreases. Note also that, because of the specific form of the punishment used above, real-time monitoring has no effect on minimum capital requirements under perfect competition.

The numerical examples illustrate how the effectiveness of our form of the real-time monitoring depends on the level of franchise values: becoming ineffective when the franchise value is low (either because of high degree of competition or low returns on prudent investment). One way to overcome this would be to impose an alternative (or additional) sanction in the form of fixed fine, for example, the loss of regulatory capital in the case where capital requirements are in force. By combining these two forms of sanction, real-time monitoring could be effective regardless of the level of franchise value. In Kuvshinov (2011), for example, the assumption that a competitive bank that is gambling will lose all of its equity capital if caught has the dramatic effect of halving the risk weighted capital requirement even if the chance of being detected is only 10%.

These numerical exercises are, however, subject to a major qualification: they take no account of bank bailouts, so they exaggerate the prudential benefits of concentration.

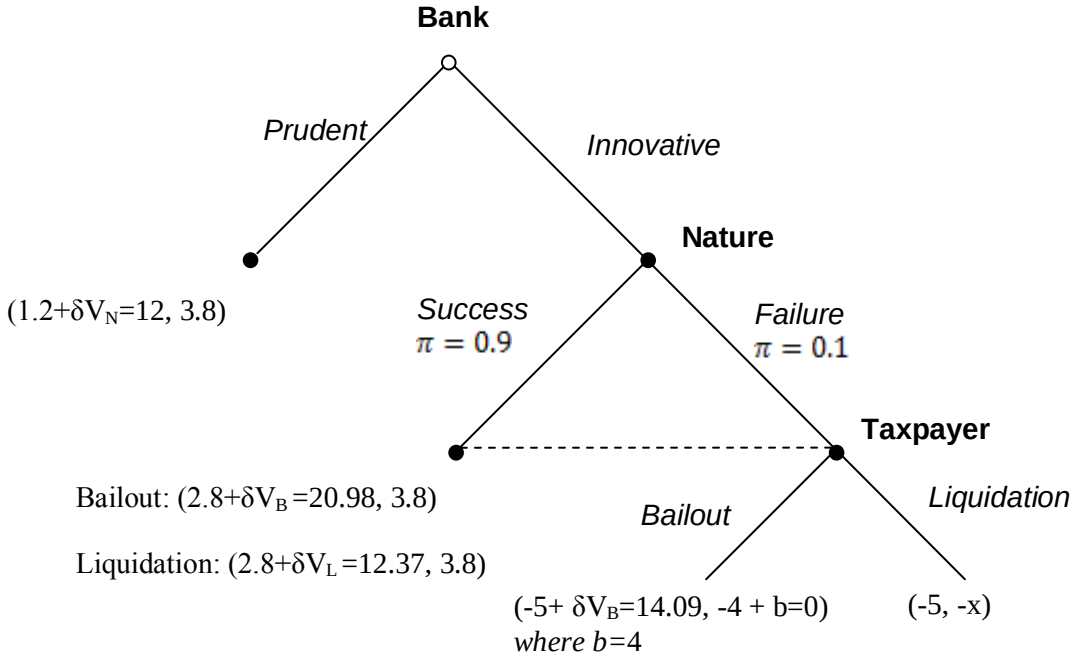
Appendix E. Bailout and the incentive to take on tail risk: a numerical illustration

As our framework assumes monopoly profits even when investing in the prudent asset, the deposit rate r is set below the prudent rate α. The parameters are as in Hellmann et al (2000) with values based on Sinn (2010).

Prudent Rate α=1.05
Downside of gamble β=0.91
Discount factor δ=0.9
Deposit rate r=1.04

Success return on risky asset γ=1.066
Probability of failing gamble π=0.9
Capital holdings of bank k=5

Payoffs (Bank, Taxpayer)



<u>Expected Payoff for the shareholder:</u>

Bailout: 0.9*(2.8+δV_B)+0.1*(-5+ δV_B)=**20.9> 12**

Liquidation: 0.9*(2.8 δV_L)+0.1*(-5)=**10.63< 12**

The profits of a monopoly (concentrated) bank are given by

$$\Pi = 100\alpha - (100 - k)r - k$$

Profits:

Profit of investment in the prudent return: Π_N=1.2

Profits of investment in risky return: Π_G=2.8

Payoffs and Expected Values:

<u>Prudent:</u>

Payoff and expected value to bank if it invests in the prudent investment:
EV=1.2+δV_N=12

<u>Bailout:</u>

Payoff to the bank if it invests in the risky return and assumes to be bailed out (***success***):
2.8+δV_B=20.98

Payoff to the bank if it invests in the risky return and assumes to be bailed out (***failure***):
-k+δV_B=14.09

The expected value for the bank of the gamble assuming it will be bailed out becomes 20.29.

<u>Liquidation:</u>

Payoff to the bank if it invests in the risky return and assumes liquidation (***success***):
2.8+δV_L=12.36

Payoff to the bank if it invests in the risky return and assumes to be bailed out (***failure***):
-k =-5

The expected value for the bank of the gamble assuming it will be bailed out becomes 10.63.

It becomes clear that if the bank knows it will be bailed out, risky innovation is preferred, otherwise it will invest prudently assuming liquidation is the tie breaker for the Taxpayer.

Note

$$V_N = \frac{\Pi_N}{(1-\delta)}$$

$$V_B = \frac{\pi\Pi_G - (1-\pi)k}{(1-\delta)}$$

$$V_B = \frac{\pi\Pi_G - (1-\pi)k}{(1-\delta\pi)}$$

and $V_B > V_N > V_L$.