THE UNIVERSITY OF WARWICK

June 2013 No.135

The Invisible Hand and the Bank Trade: Seigniorage, Risk-shifting and More

Marcus Miller and Lei Zhang

WORKING PAPER SERIES

Centre for Competitive Advantage in the Global Economy

Department of Economics

CAGE Competitive Advantage in the Global Economy

E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

The Invisible Hand and the Banking Trade: seigniorage, risk-shifting, and more*

Marcus Miller† and Lei Zhang‡

March 2013

Abstract

The classic Diamond-Dybvig model of banking assumes perfect competition and abstracts from issues of moral hazard, hardly appropriate when considering modern UK banking. We therefore modify the classic model to incorporate franchise values due to market power; and risk-taking by banks with limited liability. We go further to show how the capacity of franchise values to mitigate risk taking may be undermined by the bailout option; with explicit analytical results provided for the case of extreme risk-aversion. After a brief discussion of how this may impact on the distribution of income, we outline the ways in which the Vickers Report seeks to remedy these problems.

Key Words: Money and banking, Seigniorage, Risk-taking, Bailouts, Regulation
JEL Classification: E41 E58 G21 G28

---

*Acknowledgments: We are grateful for comments received from Ken Binmore, Herakles Polemarchakis, Thijs van Rens and Michael McMahon, and from those at a Bank of England seminar, in particular Dmitry Kuvshinov and David Miles. Thanks are due to Han Xu and Katie Roberts for research assistance, funded by ESRC CAGE.

†University of Warwick, Department of Economics, UK. Email: marcus.miller@warwick.ac.uk

‡University of Warwick, Department of Economics, UK; and School of Economics, Sichuan University, Chengdu, China. Email: l.zhang@warwick.ac.uk

There are few ways a man may be more innocently employed than in getting money. Samuel Johnson (1775, letter to his printer)

1 Introduction

This quotation from the illustrious lexicographer was penned shortly before Adam Smith published his metaphor of the Invisible Hand. Yet it seems to express the same sentiment – that the pursuit of profit may be good for economic welfare. Adam Smith cited the butcher, the brewer and the baker to make his point; but should the same logic not apply to the banker? To judge from the textbooks, it should.

In the classic paper by Diamond and Dybvig (1983), for example, it is shown how banks can provide liquidity insurance to their customers while at the same time providing finance for longer term investors; and that the magic of maturity transformation (that raises the expected utility of all its customers) can be achieved under a zero profit constraint.[1] As Stiglitz (2012) argues forcefully in *The Price of Inequality*, however, a less benign view of the operations of banks is called for in the light of the recent North Atlantic financial crisis – involving not only the US and the UK but also Iceland and Ireland, countries whose economies were ravaged by losses in banking.

In this spirit, we modify the model of Diamond and Dybvig to include *imperfect competition* and *excess risk-taking*. The monopoly profits implied by the former can be thought of as the seigniorage collected by private banks who have the licence to create money; while excess risk-taking is used to symbolise the problems of moral hazard in an industry where bankers can allocate funds without depositors being aware of what is being done with their money.[2] An alternative – and less flattering – characterisation of the moral hazard problem is that offered by Gertler et al. (2010) and Gertler and Karadi (2012), where the hidden action taken by bank managers is to divert profits to their own benefit[3].

It has been argued, however, that seigniorage profits may have the beneficial side effect of checking moral hazard; that the prospect of losing ones banking licence will inhibit excess risk-taking by big banks who see themselves as *Too Big To Gamble*. This optimistic line of reasoning is, we believe, fatally flawed because it ignores the leverage that large banks can exert on

[1]It is, of course, subject to the curse of coordination failure (in the form of bank runs); but this can be handled by a Lender of Last Resort or by deposit insurance.

[2]See Allen and Gale (2007), Chapter 9 for the asset price implications of agency problems of this kind.

[3]i.e., it is a model of looting to use the terminology of Akerlof and Romer (1993).

society to provide bailouts. If the market power that yields seigniorage also means that the bank is *Too Big to Fail*, then it will exacerbate rather than curing excess risk-taking[4].

The paper proceeds as follows. After a brief review of the high concentration and profitability characteristic of recent UK banking, we use a graphical exposition of the Diamond-Dybvig model – and a focus on a monopoly bank – to show how restricted competition allows banks to raise profits and collect seigniorage, essentially by restricting the supply of money so that the marginal cost matches marginal (not average) revenue. The incentive for risk-shifting due to limited liability is discussed next; and the impact that monopoly profits augmented by risk-taking can have on income inequality is illustrated using Lorenz curves.

Using an example with extremely risk-averse depositors to illustrate the notion that banks may be Too Big To Gamble[5], the incentive to play safe so as to keep ones licence is set against the temptation to take on excess risk. For the same type of depositors, we then show how bailout prospects (that effectively insure the banking licence) can undermine prudence as banks become Too Big To Fail. (Noss and Sowerbutts (2012) have used empirical methods to estimate the option value of bailout prospects for UK banks: in the same vein, explicit results for the value of prospective bailout in our simple model are presented in an Annex.)

We argue heuristically that, when regulatory capital is plotted against market concentration, these contrary effects of market power will produce a U-shaped prudential frontier. Finally, this framework is used to appraise the proposals in the Vickers report (Independent Commission on Banking, 2011), designed both to promote competition in British banking and to get the taxpayer "off the hook" by reducing risk-taking.

2 Some key features of UK Banking

Historically, UK bank balance-sheets have stood at half one years GDP. But banking has grown much faster than GDP in recent times – to about twice GDP by 1988 and five times by 2008 (Haldane et al., 2010, p.84). The key players are universal banks which combine retail & commercial banking with wholesale & investment activities; and the industry is highly concentrated.

[4]In 2008, for example, a UK High Street bank tried to buy Lehman Brothers New York before bankruptcy (a gamble that was blocked at the last minute by the Chancellor of the Exchequer).

[5]Numerical examples of low and high risk- taking call for regulatory capital requirements that stand comparison with those proposed by Miles et al. (2012).

This is especially true of the retail and commercial sector where the top five banks account for almost 85% of current accounts, 82% of residential mortgages and handle 91% of the customers from Small and Medium Enterprises (Independent Commission on Banking, 2011, p.21-22).

The increase in balance sheets described above was accompanied by a dramatic rise in measured value added, especially profits. For 30 years after World War II, financial intermediation had accounted for around 1.5% of economy wide profits on average: but by 2008, its share of profits had risen to 15%. Those in the industry argued that this resulted from financial innovation and financial engineering; and, since 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, it seemed plausible that banks were expanding their business and profits without taking excessive risk. But subsequent developments tell a very different story. As Vickers (2011, p.2) remarked: "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." Two insolvent UK mortgage banks had to be nationalised; and two universal banks were bailed-out with taxpayers money. Capital support provided by the Treasury totalled £70b (5% of GDP) by the end of 2009; and these operations were accompanied by Quantitative Easing (bond purchases) to the tune of £200b (14% of GDP) by the Bank of England. Adding in other measures, such as guarantees and collateral swaps, Alessandri and Haldane (2009, p.24) calculate that total emergency financial support provided by the Central Bank and the Treasury amounted to almost three quarters of one years GDP!

3 Adding Seigniorage and Gambling to a Classic Model of Banking

The classic model of banking, Diamond and Dybvig (1983), focuses on the efficiency of banks in providing liquidity insurance to customers. In its basic form, as presented in Allen and Gale (2007, Chpater 3) for example, banks are assumed to be perfectly competitive and free of moral hazard problems. This is where we start, before looking at the profits that may be collected by a monopoly bank. (By analogy with the seigniorage that the state derives from its monopoly in supplying notes and coin, this revenue flow will be referred to as private seigniorage.)

For convenience we proceed diagrammatically, using Figure 1 where the axes measure early and late consumption. The indifference curve shows the expected utility of consumers who will not discover whether they need to consume early or late until after the investment decision has been made, but do know the probability of being one or the other. The investment options for banks that take consumer endowments as deposits are either to invest in a *short-term* asset (cash), which has a payoff of 1 in period 1 or in period 2; or in a *long-term asset*, which has a higher payoff of $R > 1$, but this is only available in period 2. The outside option, upon which banks must improve if they are to attract risk-averse depositors, is the so called *no-banking equilibrium* at point N, where agents initially hold either short or long (in proportions that reflect known population parameters) and then trade with each other when their preferences become known[6].

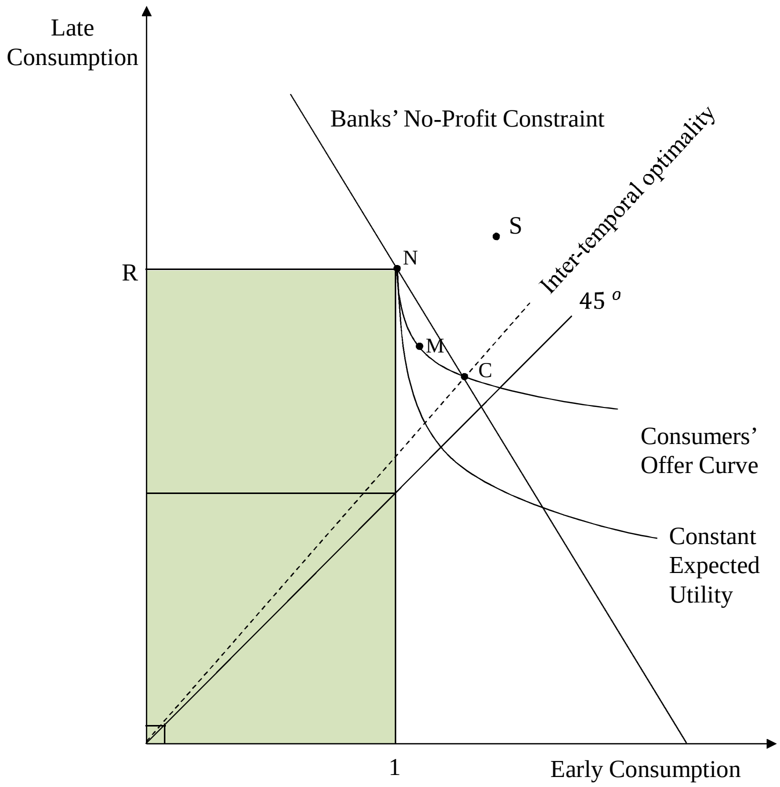

Figure 1: Banks as providers of liquidity: monopoly vs. perfect competition.

The resource constraint shown passing through line N indicates the combinations of early and late consumption which the bank can provide while

[6]See Allen and Gale (2007, Chpater 3) for further discussion.

satisfying the No-Profit Constraint[7]. Clearly, the more early consumption they offer the less the bank can invest in the long-term asset.

In the *competitive equilibrium* at point C, where the Consumers Offer Curve[8] intersects the No-Profit Constraint, the provision of liquidity insurance by the banks improves on the outside option by offering extra first period consumption, at the cost of less long-term investment[9].

The point selected by a *monopoly bank* is at point M on the Offer Curve where profits are at a maximum. As the monopolist keeps some of the returns on long-term investments as profit, consumption now lies below the No-Profit Constraint, so the average depositor will be worse off[10]. It also involves redistribution, as bank shareholders will be better off as they enjoy the seigniorage collected by private sector banks (with their consumption indicated by a point such as S lying above the No-Profit Constraint). Capitalising such profits gives the franchise value of those involved in non-competitive banking.

The offer curve in Figure 1 above implicitly gives the demand for liquidity supplied by commercial banks: in what follows, we derive the "demand for money" explicitly and use it to estimate the seigniorage profits earned by the private sector.

3.1 Monopoly Bank

With competetion, the demand for liquidity at an opportunity cost of R, is shown at point C in Figure 1. Using the notation of Allen and Gale, we analyse how a monopoly bank can "adjust" the effective price of liquidity $\tilde{R}$ so as to affect depositors demand for liquidity $c_1 - 1$ (where 1 is the early consumption available as an outside option). Since the actual interest rate is R the profit of the monopoly bank will be

$$\begin{aligned}\pi &= \lambda(\tilde{R} - R)(c_1 - 1) \\ &= \lambda\tilde{R}(c_1 - 1) - \lambda R(c_1 - 1) \qquad (1)\end{aligned}$$

[7]With competition, late consumers receive all payoffs from the long-term investment of funds not held in cash for early consumers: but this will not be true with imperfect competition.

[8]Indicating the ex ante choice between early and late consumption at different interest rates, i.e., points at which lines of different slopes emanating from N are tangent to the indifference curves.

[9]As indicated, the competitive equilibrium satisfies the condition for inter-temporal optimality (i.e., the interest rate matches the ratio of marginal utility of consumption at different dates).

[10]With monopoly restriction in the supply of liquidity, the condition for inter-temporal optimality is no longer satisfied.

where the first term indicates the revenue to the bank obtained by raising the "price" to $\tilde{R}$, and the second indicates the cost of holding cash reserves to meet the requirements for early consumers.

Assuming CRRA utility with risk aversion $\gamma > 1$, the demand function of depositors can be written as

$$c_1 - 1 = \frac{R - \tilde{R}^{1/\gamma}}{\tilde{R}^{1/\gamma} + \lambda\tilde{R}/(1-\lambda)} \equiv f(\tilde{R}), \quad R \leq \tilde{R} \leq R^{\gamma}. \tag{2}$$

Given $R \leq \tilde{R} \leq R^{\gamma}$, the demand function is downward-sloping in $\tilde{R}$, i.e., $f'(\tilde{R}) < 0$.

The liquidity demand under perfect competition is the when the price of liquidity is equal to the marginal cost $\tilde{R} = R$, i.e.,

$$c_1^c - 1 = \frac{R - \tilde{R}^{1/\gamma}}{\tilde{R}^{1/\gamma} + \lambda\tilde{R}/(1-\lambda)}. \tag{3}$$

What if the supply is restricted under conditions of imperfect competition? Consider specifically the case of a monopolist who rations the quantity of liquidity so as to maximise profits, i.e., maximises (1) subject to (2). This yields the first order condition (FOC)

$$\lambda[(\tilde{R} - R) + (c_1 - 1)(\partial\tilde{R}/\partial c_1)] = 0.$$

Hence we may write

$$\tilde{R} - R + (c_1 - 1)/f'(\tilde{R}) = 0, \tag{4}$$

where the second term in (4) reflects the fact that the bank takes into account that price adjustment can affect demand for liquidity.

Replacing $c_1 - 1$ in (4), using (2), one has

$$\tilde{R} - R + f(\tilde{R})/f'(\tilde{R}) = 0. \tag{5}$$

Note that for $R \leq \tilde{R} \leq R^{\gamma}$, $f'(\tilde{R}) < 0$; so clearly the price of liquidity under monopoly $\tilde{R}^M$, the solution to (5), must lie above R. This is illustrated in Figure 2 below.

The resulting profit, measured by $\lambda(\tilde{R}^M - R)(c_1^M - 1)$ is the flow of seigniorage accruing to the private sector. In the analytically tractable case of infinite risk aversion, $(\gamma \to \infty)$, discussed further below, seigniorage profits are simply: $(R-1)(1-\lambda)$, where λ is the fraction of the population who are early consumers. How seigniorage changes with the degree of risk aversion and the degree of concentration is discussed elsewhere.

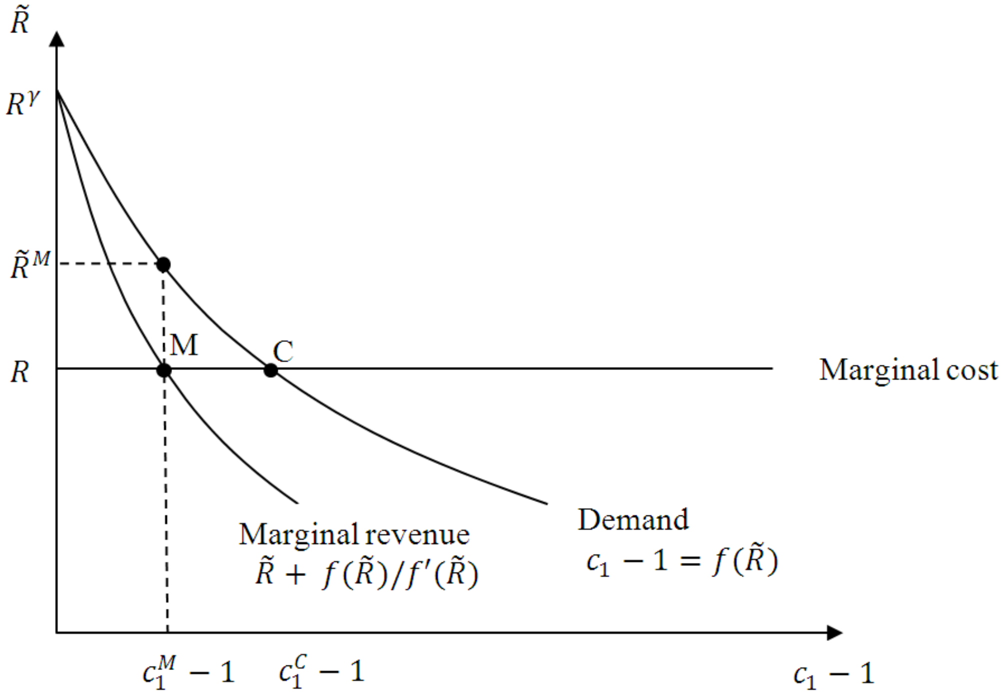

Figure 2: The demand for money and the flow of private seigniorage.

How, with oligopoly, equilibrium will lie between C and M in Figure 2 is discussed in detail in Miller et al. (2013). It is easy to see, however, that increasing the number of banks will take equilibrium from monopoly to competition.

In the Cournot-Nash equilibrium with two banks, with each maximising its profits conditional on the supply of the other, the supply of liquidity will expand beyond that of the monopolist, as suggested in Figure 3.

4 Bank profits: productivity miracle or mirage?

Of the extraordinary expansion of US banking in the lead-up to the financial crisis, Reinhart and Rogoff (2009, p.210) remarked:

> 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

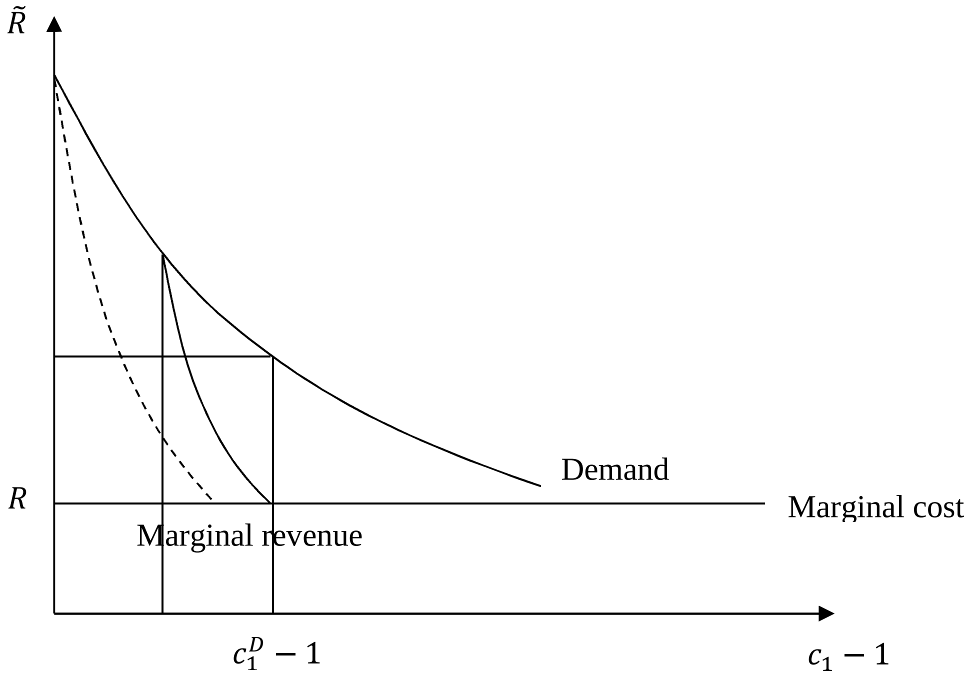

Figure 3: Seigniorage flow with duopoly.

> products, and they tended to grossly understate the latent risks their firms were undertaking.

This parallels closely what we have reported above for the UK. But, before looking at the profits that might be expected to arise from excessive risk-taking (given limited liability), consider first the case of a genuine improvement in the return to long term investment available only to banks – a *productivity miracle* that raises the return available to banks – but not outsiders – from R to R_H.

How this affects profits and liquidity provision is indicated in Figure 4, where the No-Profit Constraint swivels clockwise, but the Intertemporal Optimisation schedule swivels the other way. As a consequence, the competitive bank equilibrium shifts from C to C', with no increase in profits. With monopoly banking, however, consumers gain much less. Since the productivity gain is, by assumption, not available outside banking, there is no change in the outside option, so equilibrium moves from M to M' along the existing offer curve. Profits will increase greatly.

So far so good: but what if the so-called productivity increase is a mirage? What if – along the lines suggested by Reinhart and Rogoff – there was

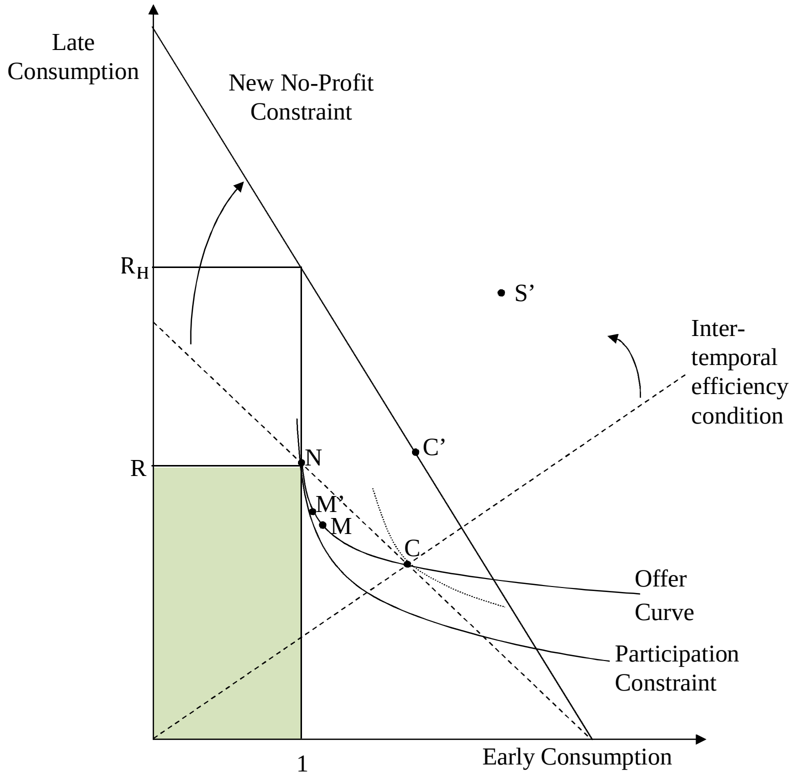

Figure 4: A productivity improvement in banking: competition vs. monopoly.

little or no increase in expected return; and the apparent increase in bank profitability is the upside of a gamble whose downside was concealed? Then, as long as the gamble pays off and regulators and depositors are both fooled, equilibrium will shift to M just as before, with little increase in consumption for the average depositor, but a large increase in profits and shareholders consumption as in the Figure. When the gamble fails the truth will out and the bank will fail too.

To see whether and when banks will be tempted to take on excessive risk, we use the analytically tractable case of Leontief preferences for which consumers choose the same consumption in both periods. As can be seen from Figure 5 the expected utility curves in this case are L-shaped, with the kink lying on the 45 degree line. Gambling is assumed to take the form of mean preserving spreads whose attraction lies in the "risk-shifting" that limited liability permits.

4.1 Perfect competition

For this case, the competitive equilibrium without gambling is defined by

$$c_1 = c_2 = c, \tag{6}$$

$$(1-\lambda)c_2 = R(1-\lambda c_1); \tag{7}$$

where equation (7) is the zero profit condition. Solving (6) and (7) yields the competitive contract is (c, c) where $c = R/(1-\lambda+\lambda R)$, as shown at the point labelled C in Figure 5.

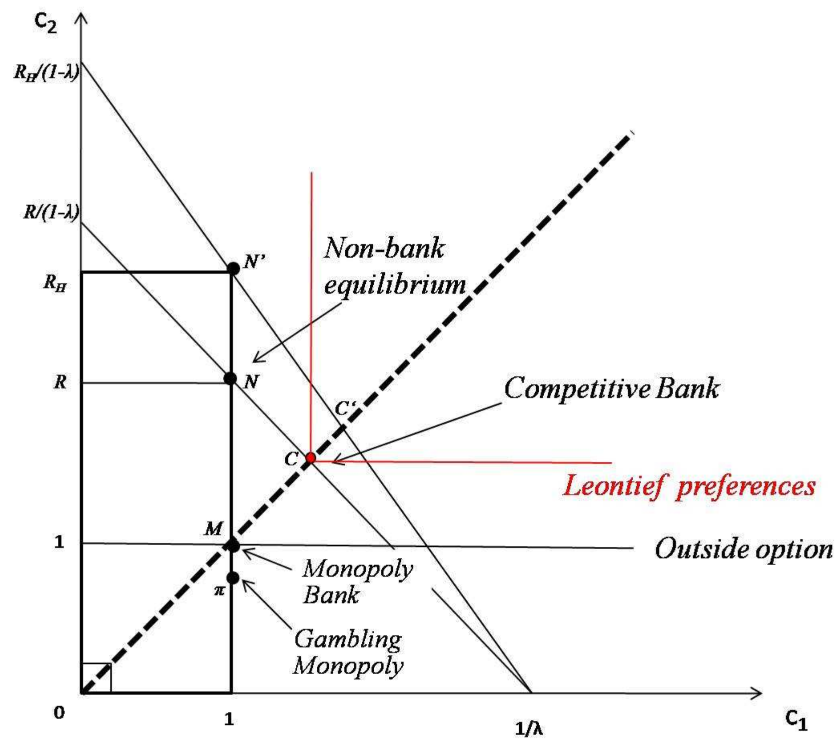

Figure 5: Commercial banking with Leontief preferences.

What would be the deposit contract under perfect competition if banks can gamble? Assume that there is a gamble available with high and low payoffs, $R_H > R > R_L$, and probabilities π, $1-\pi$ respectively, and that it is a meanpreserving spread relative to the return of R, so $\pi R_H + (1-\pi)R_H = R$. For simplicity, we also assume that the cost of capital is R. Given Leontief preferences and the capital requirement of k, the deposit contract must satisfy

(6) and the zero profit condition

$$\pi[(1+k-\lambda c_1)R_H-(1-\lambda)c_2-Rk]+(1-\pi)(-Rk)=0, \tag{8}$$

where the first term on the LHS of (8) represents expected payoff to the bank in the high state and the second term reflects limited liability, i.e., in the bad state, the bank loses at most its capital.

Solving for the deposit contract using (6) and (8) yields

$$c_G=[R_H+(R_H-R/\pi)k]/(1-\lambda+\lambda R_H). \tag{9}$$

To avoid gambling under perfect competition, one has to choose k such that $c \geq c_G$. This implies the critical capital requirement of

$$k_C=\frac{\pi(1-\lambda)(R_H-R)}{(R-\pi R_H)(1-\lambda+\lambda R)}. \tag{10}$$

4.2 Monopoly

A monopolist will maximise profits by increasing the cost of liquidity supplied to its customers. In the case of extreme risk aversion where long returns are R, profits will be at a maximum at the point shown as M, where the second period consumption is reduced to 1 and the consumer is no better off than in the non-bank equilibrium, shown at point N.

How much seigniorage will the monopoly bank collect? Monopoly profits measured at date 2 defined as: $\Pi_M \equiv R(1-\lambda c_1)-(1-\lambda)c_2$. So given the contract of (c_m, c_m) where $c_m=1$, we can write the flow of seigniorage accruing to the bank as

$$\Pi_M=(1-\lambda)(R-1). \tag{11}$$

When this is capitalised at a discount rate of δ, this provides the franchise value of the monopoly bank, namely

$$V \equiv \frac{\Pi_M}{1-\delta}=\frac{(1-\lambda)(R-1)}{1-\delta}. \tag{12}$$

What if the monopolist can increase profits by risk taking? With the monopoly contract of (1,1) as before, the expected monopoly profit (measured at date 2) will be:

$$\Pi_G \equiv \pi[(1-\lambda c_1)R_H-(1-\lambda)c_2]+(1-\pi)\cdot 0$$

so

$$\Pi_G=\pi(1-\lambda)(R_H-1). \tag{13}$$

To see graphically how this increases expected profits, note that – with a mean preserving spread – the expected second period value of the banks portfolio will be measured by the same line as that showing the return on the safe investment R (the line passing through NC in Figure 5). But owing to limited liability the expected cost of payments to depositors will fall, so the expected cost of the $(1, 1)$ contract in period 2 becomes π, as indicated by the point so labelled in the Figure. Compared to M, this implies an increase in the flow of expected profits. Nevertheless, the risk of losing the franchise may prevent gambling.

For the *franchise value* V to prevent gambling, it is necessary that:

$$\Pi_G - \Pi_M \leq (1-\pi)\delta V, \tag{14}$$

or equivalently,

$$\pi(R_H - 1) \leq \frac{(1-\pi\delta)(R-1)}{1-\delta}. \tag{15}$$

For checking gambling, *capital requirements* may be imposed as a supplement to, or a substitute for, the franchise value. Note that, if the cost of capital is R, the profit function to a monopoly bank who invests prudently remains unchanged even with added regulatory capital. This is because

$$\Pi_M(k) = R(1 + k - \lambda c_1) - (1-\lambda)c_2 - Rk = \Pi_M(k = 0).$$

However, adding the risk of losing regulatory capital at end of period, expected profits for a gambling monopoly become:

$$\begin{aligned} \Pi_G(k) &\equiv \pi[(1 + k - \lambda c_1)R_H - (1-\lambda)c_2 - Rk] + (1-\pi)(-Rk) \\ &= \pi(1-\lambda)(R_H - 1) - k(R - \pi R_H) \\ &= \Pi_G(k = 0) - k(R - \pi R_H). \end{aligned} \tag{16}$$

The second line is obtained under monopoly contract $c_1 = c_2 = 1$.

So NGC is

$$\Pi_G(k) - \Pi_M \leq (1-\pi)\delta V. \tag{17}$$

This can be rewritten as

$$\Pi_G(0) - \Pi_M(0) \leq (1-\pi)[\delta V + k(R - \pi R_H)/(1-\pi)],$$

indicating that k is a substitute for δV.

The critical value of k can be found when the above is an equality, yielding

$$k^* = \frac{1-\lambda}{R - \pi R_H}\left[\pi(R_H - 1) - \frac{(1-\pi\delta)(R-1)}{1-\delta}\right]. \tag{18}$$

4.3 Monopoly with Bailout prospect

A monopoly bank may well be able to count on a bailout by the authorities, where the bank loses its regulatory capital but retains its franchise. Let the probability of such a bailout be denoted as β, where β can range from 0 to 1. For the discounted franchise value δV to prevent gambling it is necessary that:

$$\Pi_G(k) - \Pi_M \leq (1-\pi)(1-\beta)\delta V. \tag{19}$$

Note that a greater prospect of bailout calls for higher k. When $\beta = 0$, the above NGC reverts to that without bailout. When $\beta = 1$, the critical level of capital requirements becomes

$$k_B^* = \frac{1-\lambda}{R-\pi R_H}\left[\pi(R_H-1)-(R-1)\right] > k^*. \tag{20}$$

Similar calculations may of course be repeated for oligopoly cases.

In the Table that follows, franchise values, etc. are computed for gambles involving "tail risk" as discussed in Foster and Young (2010). For the two point process being considered $\pi \geq 0.9$ is sufficient for tail risk; and we set that $\pi = 0.9$. In both cases the gambles have an expected return equal to the safe rate which is set at 1.04, as in Foster and Young (2010). But we depart from their assumption that the downside is zero. As the upside in the first case we consider is 1.06 and in the second 1.10, so for a probability $\pi = 0.9$ the downside returns are 0.86 and 0.50 respectively. For convenience, we assume that $\lambda = 0.5$ and the appropriate formulae are given in column 2. The numerical results are shown in columns 3 and 4 of the table.

It may be interesting to start by considering the incentives for gambling by competitive banks and the capital requirements needed to check them, see Kuvshinov (2011) for such calculations in respect of the model of Hellmann et al. (2000). Without regulation, free competitive banking would result in contracts which mimic those available to alpha investors who can obtainR_H for sure, namely $2R_H/(R_H+1)$, instead of$2R/(1+R)$. If such gambling is to be checked, the attractive offers that gambling permits, see (8) above, need to be brought down to what prudent investment allows by capital requirements set at the level as indicated earlier in equation (10). The numerical results for low and higher variance gambles shown in the bottom line of the Table are capital ratios of 10% or 53% of deposits respectively, which, with $\lambda = 0.5$ correspond to ratios of 17% and 52% of RWA respectively.

Notice that, for the parameters we use, the critical capital requirements for monopoly with bailout (k_B^*) are only a little smaller than those for competitive banks (k_C) - compare the last two rows of the Table. Thus for the low variance gamble in the third column, the capital requirement needed to

Table 1: Outcomes with risk aversion with Leontief preferences and $R_L > 0$.[a]

	Formula for $\lambda = 0.5$		
No Gambling		$R = 1.04$	
Competitive contract	$2R/(1+R)$	(1.02, 1.02)	
Monopoly contract	$(1, 1)$	(1, 1)	
Monopoly Profit	$(R-1)/2$	0.02	
Franchise Value (Seigniorage)	$V = (R-1)/[2(1-\delta)]$	0.2	
Gambling		$R_H = 1.06$, $R_L = 0.86$ $\sigma = 0.06$	$R_H = 1.1$, $R_L = 0.5$ $\sigma = 0.18$
Expected Monopoly Profit	$\pi(R_H - 1)/2$	0.027	0.045
NGC (monopoly) see equation (14)	$\pi(R_H - 1)/2 - (R-1)/2 \leq (1-\pi)\delta V$	**Satisfied**	**Not satisfied**
k^* (monopoly)	See (18).	**No need for capital buffer**	0.14 $\approx$ **22% RWA**
Capital requirement in special case of $\beta = 1$.	See (20).	0.08 $\approx$ **14% RWA**	0.50 $\approx$ **50% RWA**
k^* (competition)	See (10).	0.10 $\approx$ **17% RWA**	0.53 $\approx$ **52% RWA**

[a] Notes: $R = 1.04$, $\pi = 0.9$; $\delta = 0.9$; $\lambda = 0.5$; $\pi\delta = 0.81$.

ensure prudent investment by a monopolist is 8% of deposits which, with $\lambda = 0.5$, is 14% of risk weighted assets. In the last column, where the gamble has higher variance, so risk shifting is more profitable, the critical capital requirement increases to half the level of deposits and half of RWA.

These prudential ratios are broadly comparable to those obtained by Miles et al. (2012): using a different methodology they suggest that appropriate levels of capital need to absorb risks are 16-20% of RWA for moderate shocks, rising to 45% of RWA for large shocks.

Expressed as a percentage of banks balance sheets, the proportion of the balance sheet of banks to be funded by equity for a monopoly bank are about 7% and 33%, depending on the variance — much higher than the

4% suggested by the ICB and a fortiori the 3% by the Basel Committee on bank supervision. Our results are more in line with the recommendations of Admati and Hellwig (2013): they want to cut bank leverage down to single figures with an equity ratio of 20-30%.

5 Gambling and Gini Coefficient

In the *Price of Inequality*, Stiglitz emphasises how rent-seeking in the financial sector has skewed the income distribution to the benefit of high earners. In the model being used here, it is evident that 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 6, where σ represents the fraction of the population owning shares in the all-deposit bank.[11] Where ω represents the consumption bundle available to depositors under monopoly banking, and $\omega(1+\mu)$ is the consumption available to the depositors who are also shareholders enjoying the monopoly premium, μ, in this case $\omega = 1/(1+\sigma\mu)$ and the Gini coefficient[12] 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, p.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.[13])

[11] See Miller et al. (2011) for details.

[12] i.e., the area OLP divided by $O1P$ in the diagram.

[13] FT 17th, 2011, Feb Bankers pay: time for deep cuts.

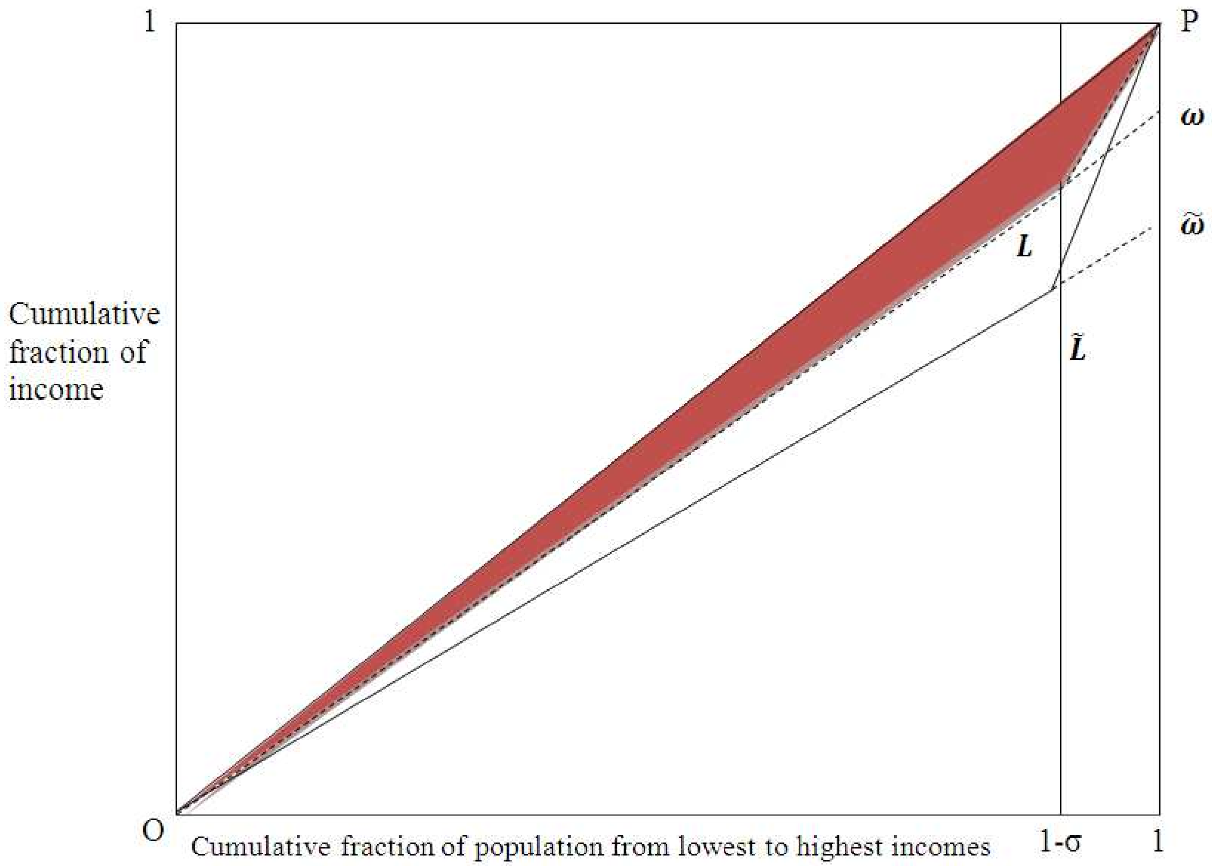

Figure 6: Rising incomes in financial services and income inequality.

6 Bailouts, Moral Hazard and Crisis

Hellmann et al. (2000) discuss how the loss of franchise, like the loss of regulatory capital, may inhibit the incentive to gamble. In their case, franchise values were generated by the regulator fixing a ceiling on deposit rates, but what if franchise values derive from concentration in the banking industry, as is being assumed here? If the authorities are in fact willing to bailout large banks, this will pose a serious problem of moral hazard as high franchise values will effectively be insured by official action.

This problem has been analysed above by comparing competition and monopoly where it is assumed, as a special case, that the monopolist is sure to be bailed out — is definitely "Too Big To Fail" (TBTF). The interesting result obtained was that regulatory capital required to check gambling was not too different for these polar extremes of concentration. If we assume that the willingness of the authorities to bailout banks only kicks in above a certain level of concentration, then franchise values will work to reduce gambling below this level, but moral hazard will act the other way above this level.

6.1 The U-shaped Prudential Frontier

How the concentration of market power and seigniorage profits in banking may at first mitigate moral hazard — and then promote it, as banks become TBTF — is shown in Figure 7, with regulatory capital plotted on the vertical axis and concentration on the horizontal (measured by the reciprocal of the number of banks).

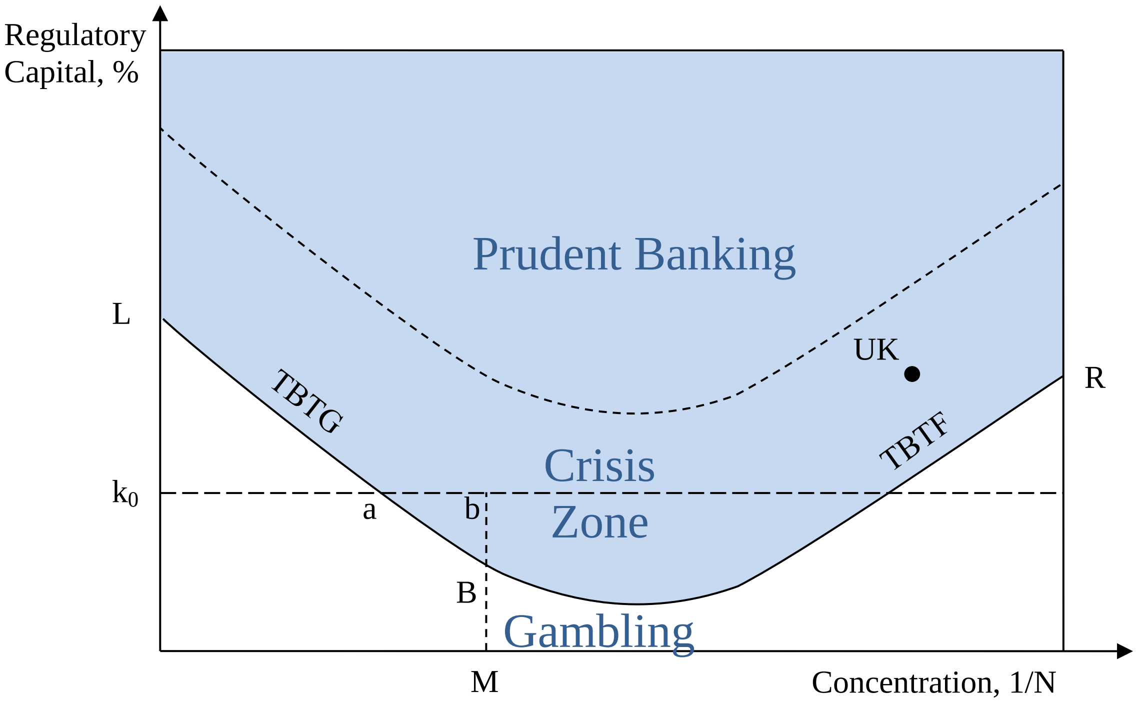

Figure 7: TBTG, TBTF and the U-shaped region of prudent banking.

For a given low-variance risky investment prospect, the region of prudential banking, where regulatory capital and/or franchise values are sufficient to prevent gambling, is defined by the U-shaped curve LBR. The section LB of the no-gambling boundary shows how franchise values may substitute for regulatory capital so long as there is no prospect of a bailout. But as bailouts become increasingly likely when concentration increases beyond point M, the incentive to gamble changes the curvature of the boundary beyond B.

To see why the NGC is U-shaped, consider the incentive effects of increased concentration at a given degree of leverage, i.e., by moving from left to right along the dotted line in the Figure. It is evident that the capital requirement, k_0, is insufficient to check risk-shifting for perfectly competitive banks protected by limited liability; but as the level of concentration increases (and franchise values grow to absorb more losses), prudent behaviour will be observed at point a in the Figure as banks become TBTG. With bailouts increasingly likely for very large banks, however, the government effectively begins to insure banks against loss of franchise as concentration moves beyond point b. (For a monopoly bank, indeed, there is no risk of losing its franchise). At some point therefore, the incentive effects of franchise value will be overwhelmed by the temptation to gamble by banks that are TBTF; who are motivated to take on excessive risk.

6.2 The Crisis Zone

If the U-shaped NGC actually matched the gambles in prospect, and the UK banking industry lies above it, as indicated in the Figure, there should be no crisis. As in Hellmann et al. (2000), the regulatory regime will be so designed that gambling is not incentive compatible in this rational expectations equilibrium.

What if banks are able to take much higher risks unknown to the regulator? In that case, the U-shaped NGC will shift upwards, as indicated by the dotted schedule, leaving UK banking system in the area labelled Crisis Zone, where the expectations of the regulators are inconsistent with the activities of banks. Innovation which allows banks to mimic high returns temporarily by financial engineering is not sustainable in the long run, however, as Foster and Young point out; and crisis will occur as a tail risk phenomenon. With expectations lagging behind the reality, the regulators are in line for a nasty shock.

If - thanks to rapid financial innovation - the banking system is in the crisis zone and the relevant authorities are unaware of the excessive risks being taken, this could be characterised as regulatory failure. Given limited liability, there are definite incentives for risk-taking (so investors keep the upside of gambles but walk away from the downside); and we see it rather as a problem of moral hazard. With bailouts, moreover, these incentives are greatly strengthened: banks that would have behave prudently, despite free access to risky investments, will be tempted to take risks if bailouts are expected - a classic example where insurance against failure leads to hidden actions that makes failure more likely.

How is this moral hazard to be checked, while avoiding negative externalitieis of banking collapse? In the next section, we discuss how the Vickers report seeks to ensure that the banking system no longer lies in such a crisis region.

7 Regulatory Reform in the UK: the Vickers report

On options for reform, consider the 2011 report by the Independent Commission on Banking (ICB) chaired by Sir John Vickers.

To change the strategic relation between the state and banks, the threat of severe externalities triggered by unpremeditated bank closure must be thwarted. For retail banks, the means to this end recommended in the Report effectively 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, additionally, (d) better resolution procedures should a retail bank need to be reconstituted.

In more detail, the key thing to note is that the report recommends changes in market structure as well as balance sheet restrictions. In particular, *structural separation* is recommended in the form of a retail ring-fence designed to isolate and contain banking activities vital to the economy so as to ensure they can be maintained in the event of bank failure without government solvency support. Hence, ring-fenced banks would be restricted to taking retail deposits, providing payments services and supplying credit to households and businesses[14], i.e., they would be constrained to abide by what Adam Smith would think of as the "principles of the banking trade"!

Ring-fenced banks will in fact be banned from a very considerable range of the activities currently conducted by universal banks[15]. This is not the complete separation mandated by the Glass-Steagall Act in the USA, however, as banks inside the fence can stay linked with those outside, subject to arms length dealing and other restrictions. In addition steps are recommended to *increase competition* on the High Street - more transparency of costs and transferability of accounts, in particular.

Balance sheet requirements involve substantial loss-absorbing capacity in the form of equity and convertible bonds so as to avoid claims on the taxpayer following bank insolvency.

As regards *monitoring and transparency*, ring-fenced banks would be more straightforward than some existing banking structures and thus easier to manage, monitor and regulate.

Heuristically, these recommendations can be shown as in Figure 8, which

[14] ICB (2011, para. 3.1)

[15] Depending on how the liabilities to large corporations 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 (relative to GDP of £1.4 trillion).

refers only to banks within the ring-fence. Some of the measures should act to expand the region of Prudential Banking (beyond that in the earlier Figure 7, indicated here by the dashed U-shape); others to shift the locus of a ring-fenced bank into this enlarged area.

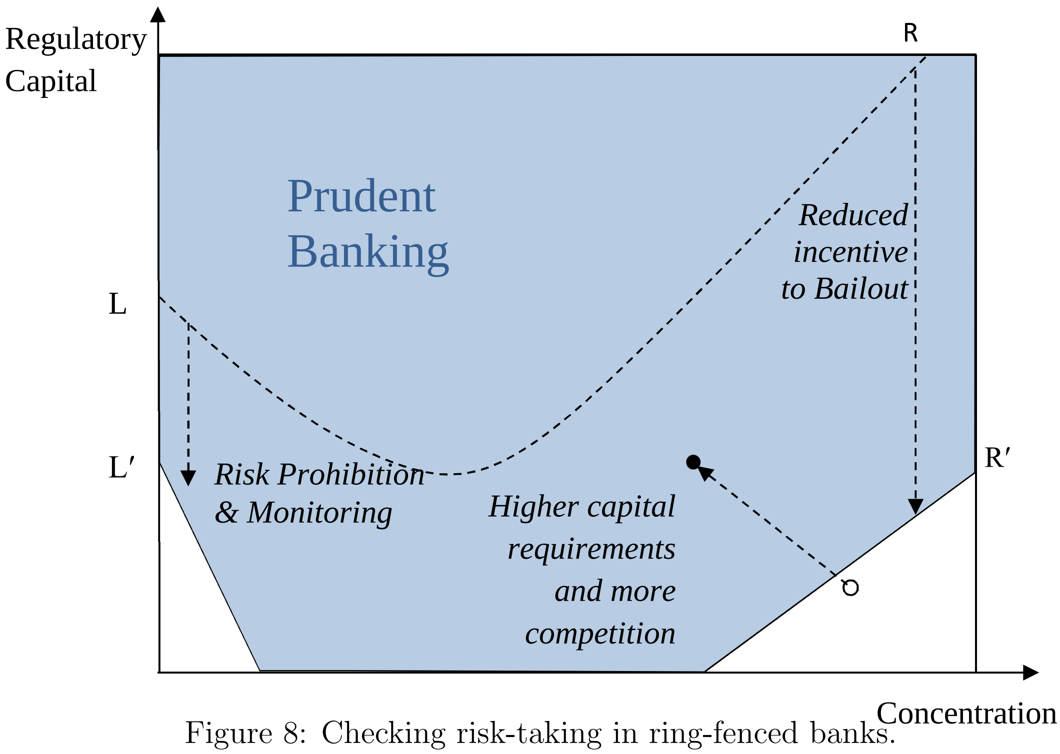

Figure 8: Checking risk-taking in ring-fenced banks.

The *prohibition of many risky assets* - two thirds of the current portfolio of UK banks, in fact - should move the U-curve downwards, as indicated by the shift from L to L in the No Gambling frontier. Improved monitoring – backed by a threat of losing ones licence if caught - should further reduce the region of excess risk by making the frontier slope down more steeply from L. Steps to move ring-fenced banks towards Prudential Banking include both a 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, as indicated by the arrow pointing NW in the Figure.

The effect of the planned reforms would be to:

> 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 cap-

italised, less leveraged banking more focussed on the needs of savers and borrowers in the domestic economy. ICB (2011, p.18)

Although the government plans to implement the principal recommendations of the Report, there is considerable lobbying pressure to allow for risk-taking inside the fence, with retail banks providing simple derivatives, for example. If permitted, this will surely undermine the principles of structural separation, Wolf (2012). It has been argued by the Parliamentary Commission on Banking Standards (2012) that the threat of Glass-Steagall, i.e., complete separation between investing and commercial banking[16], should be held as a sword of Damocles above the banks to ensure implementation.

8 Conclusion: back to banking basics?

Adam Smith himself would surely have been disturbed by recent developments in British banking. His concern over the tendency of businesses to collude and appropriate consumer surplus by monopoly pricing is well known. And as for risk-taking, he warned in the *Wealth of Nations* that:

> To depart on any occasion from [the principles of the banking trade], in consequence of some flattering speculation of extraordinary gain, is almost always extremely dangerous and frequently fatal to the banking company which attempts it. (Book V, Ch 1, Article 1.)

Banking in Britain before the crisis was alas! no example of the benign operation of the invisible hand at work. The reforms advocated by the ICB in their Final Report are however designed to offset these distorted incentives. If they succeed in eliminating the features that we have added to capture current distortions, then the basic model could be back in business!

[16]What the Commission refers to as an electrified ring-fence!

References

Admati, A. and Hellwig, M. (2013). *The Banker's New Clothes: What's Wrong with Banking and What to Do About It*, Princeton NJ: Princeton University Press.

Akerlof, G. and Romer, P. (1993). Looting: The economic underworld of bankruptcy for profit, *Brookings Papers on Economic Activity* **24(2)**: 1–74.

Alessandri, P. and Haldane, A. (2009). Banking on the state.
URL: *http://www.bankofengland.co.uk/publications/speeches/2009/speech409.pdf*

Allen, F. and Gale, D. (2007). *Understanding Financial Crises*, New York: Oxford University Press.

Diamond, D. and Dybvig, P. (1983). Bank runs, deposit insurance, and liquidity, *Journal of Political Economy* **91(3)**: 401–419.

Foster, D. P. and Young, P. (2010). Gaming performance fees by portfolio managers, *The Quarterly Journal of Economics* **125(4)**: 1435–1458.

Gertler, M. and Karadi, P. (2012). QE 1 vs. 2 vs. 3...a framework for analyzing large scale asset purchases as a monetary policy tool, *Central Banking: Before, During and After the Crisis*.

Gertler, M., Kiyotaki, N. and Queralto, A. (2010). Financial crises, bank risk exposure and government financial policy.
URL: *http://www.princeton.edu/∼kiyotaki/papers/GertlerKiyotakiQueraltoJune7wp.pdf*

Haldane, A., Brennan, S. and Madouros, V. (2010). *What is the Contribution of the Financial Sector: Miracle or Mirage? in The Future of Finance: the LSE report*, London: LSE., chapter 2, pp. 87–120.

Hellmann, T. F., Murdock, K. C. and Stiglitz, J. E. (2000). Liberalization, moral hazard in banking, and prudential regulation: Are capital requirements enough?, *American Economic Review* **90(1)**: 147–165.

Independent Commission on Banking (2011). Final report: Recommendations.

Kuvshinov, D. (2011). *The optimal capital requirement for uk banks: a moral hazard perspective*, Master's thesis, University of Warwick. MSc Dissertation, Department of Economics, University of Warwick.

Miles, D., Yang, J. and Marcheggiano, G. (2012). Optimal bank capital, *Economic Journal* **Early view**: June.

Miller, M., Zhang, L. and Li, H. (2011). When bigger isn't better: bailouts and bank behaviour, CEPR Discussion Papers No. 8602 (September). CEPR, London.

Miller, M., Zhang, L. and Li, H. (2013). When bigger isn't better: bailouts and bank behaviour, *Oxford Economic Papers* **forthcoming**.

Noss, J. and Sowerbutts, R. (2012). The implicit subsidy of banks.
URL: *http://www.bankofengland.co.uk/publications/Documents/fsr/fs_paper15.pdf*

Parliamentary Commission on Banking Standards (2012). First report paper 98 hc 848.

Reinhart, C. and Rogoff, K. (2009). *This Time It's Different: Eight Centuries of Financial Folly*, Princeton: Princeton University Press.

Stiglitz, J. (2012). *The Price of Inequality*, London: Penguin Group.

Vickers, J. (2011). How to regulate the capital and corporate structures of banks?, Speech. Speech to LBS.

Wolf, M. (2012). Seven ways to clean up our banking 'cesspit'.
URL: *http://www.ft.com/cms/s/0/7a95df3e-cb50-11e1-b896-00144feabdc0.html#axzz2OCNumb26*

Wolf, M. (2013). Why bankers are intellectually naked.
URL: *http://www.ft.com/cms/s/2/39c38b74-715d-11e2-9b5c-00144feab49a.html#axzz2OCNumb26*

A Derivation of bank's profit function

The profit of the bank is defined as

$$\Pi = (1 - \lambda c_1)R - (1 - \lambda c_2). \tag{A.1}$$

The cost of liquidity $\tilde{R}$ is defined as $\tilde{R} \equiv U'(c_1)/U'(c_2)$. Using CRRA utility, we have

$$\tilde{R} = c_1^{-\gamma}/c_2^{-\gamma}. \tag{A.2}$$

Replacing c_2 in (A.1) using (A.2), (A.1) becomes

$$\Pi = (1 - \lambda c_1)R - (1 -)\tilde{R}^{1/\gamma} c_1. \tag{A.3}$$

After simplification, (A.3) becomes:

$$\Pi = (1 - \lambda)(R - \tilde{R}^{1/\gamma}) - (\lambda R + (1 - \lambda)\tilde{R}^{1/\gamma}(c_1 - 1). \tag{A.4}$$

Simplifying further yields:

$$\Pi = (1 - \lambda)(\tilde{R}^{1/\gamma} + \frac{\lambda R}{1 - \lambda}) \left(\frac{\tilde{R}^{1/\gamma} + \lambda \tilde{R}/(1 - \lambda)}{\tilde{R}^{1/\gamma} + \lambda R/(1 - \lambda)} - 1 \right) (c_1 - 1). \tag{A.5}$$

Therefore:

$$\Pi = \lambda(\tilde{R} - R)(c_1 - 1). \tag{A.6}$$

B Valuing the Bailout Prospect

In a recent working paper from the Bank of England, Noss and Sowerbutts (2012) provide empirical estimates of the value of bailout prospects for banks in the UK. In our simple model we use here, it is straightforward to obtain the value analytically by taking the difference of bank values with and without bailout.

To value a monopoly bank which is gambling **without bailout**, solve:

$$W = \Pi_G(k) + \pi\delta W.$$

So

$$W = \frac{\Pi_G(k)}{1 - \pi\delta} = \frac{\pi(1 - \lambda)(R_H - 1) - (R - \pi R_H)k}{1 - \pi\delta},$$

where $\Pi_G(k)$ is given by (16).

To value bank with bailout, solve

$$W^b = \Pi_G(k) + [\pi + (1 - \pi)\beta]\delta W^b,$$

where β represents the probability of bailout. So

$$W^b = \frac{\Pi_G(k)}{1-[\pi+(1-\pi)\beta]\delta} = \frac{\pi(1-\lambda)(R_H-1)-(R-\pi R_H)k}{1-[\pi+(1-\pi)\beta]\delta}.$$

Note that the ratio of these valuations can be written

$$W^b/W = (1-\pi\delta)/[1-\pi\delta-\beta(1-\pi)\delta]$$

which tends to $(1-\pi\delta)/(1-\delta)$ as β tends to one, and future profits are discounted by the discount factor δ and not $\pi\delta$, as bank never fails. This is the case analysed in the text.

Using the same parameters and assuming $\lambda = 0.5$, $\beta = 1$ and $k = 0$, the values are shown in Table 2. The value of the bailout shown in the last line ofthe Table is defined as

$$V_{BP} \equiv W^b - \max\{V, W\}.$$

Table 2: Outcomes with risk aversion $\gamma \to \infty$ (Leontief preferences) and $R_L > 0$.[a]

	$\lambda = 0.5$	Low variance	High variance
Gambling	$R_L > 0$	$R_H = 1.06$, $R_L = 0.86$ $\sigma = 0.06$	$R_H = 1.1$, $R_L = 0.5$ $\sigma = 0.18$
Expected Monopoly Profit	$\pi(R_H-1)/2$	0.027	0.045
Capitalised Value without Bailout ($k = 0$)	$W = \pi(R_H-1)/[2(1-\pi\delta)]$	0.142 **less than** V	0.236 **more than** V
Capitalised Value with Bailout ($k = 0$)	$W^b(k=0) =$ $0.5\pi(R_H-1)/[1-\pi\delta-\beta(1-\pi)\delta]$	0.27	0.45
Value of bailout	V_{BP}	0.07	0.214

[a] Notes: $R = 1.04$, $\pi = 0.9$; $\delta = 0.9$; $\lambda = 0.5$; $\beta = 1$; $k = 0$; and $V = 0.2$.

,

Note that, for the case of low varaiance, there will be no gambling in the absence of the bailout. So the value of the bailout prospect is the excess of W^b over the franchise value V, an increase of about a third. For high variance, however, where the bank is tempted to gamble in the absence of any bailout, the prospect of guaranteed official rescue is much more valuable.

It more or less doubles the value of the bank from 0.24 to 0.45, substantially more than twice the franchise value. Both cases illustrate what Martin Wolf says in his review of Admati and Hellwig (2013) on where he argues that "financial fragility is a feature of the system, not a bug. ... The public have, willy nilly, become risk-bearers of last resort. Protected by this generosity, bankers gain vastly on the upside while shifting the downside on to others. At worst, they can devour a states fiscal capacity." (Wolf, FT, March 17, 2013)