Whither Capitalism? Financial Externalities and Crisis[1]

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Abstract

As with global warming, so with financial crises – externalities have a lot to answer for. We look at three of them. First the financial accelerator due to 'fire sales' of collateral assets -- a form of pecuniary externality that leads to liquidity being undervalued. Second the 'risk-shifting' behaviour of highly-levered financial institutions who keep the upside of risky investment while passing the downside to others thanks to limited liability. Finally, the network externality where the structure of the financial industry helps propagate shocks around the system unless this is checked by some form of circuit breaker, or 'ring-fence'.

The contrast between crisis-induced Great Recession -- and its aftermath of slow growth -- in the West rapid and (so far) sustained growth in the East suggests that successful economic progress may depend on how well these externalities are managed.

Key words: Externalities, financial accelerator, limited liability, risk-shifting, global imbalances, financial networks

JEL classifications: F41, G01, G18, G21

[1]. For comments and suggestions, we are grateful to Peter Hammond, Paulo Santos Monteiro and discussion at the IEA World Congress, Beijing, July 2011.

Introduction

The Pareto-efficiency of competitive economic equilibrium is, of course, a central feature of the Arrow-Debreu paradigm. But in 1986 two papers appeared concerning the welfare *inefficiency* of competitive equilibria. Geanakoplos and Polemarchakis showed that 'missing markets' implied the possibility of Pareto-improving interventions; while Greenwald and Stiglitz demonstrated that missing markets and asymmetric information implied that competitive market prices could generate 'pecuniary externalities' with market prices generating side-effects conceptually similar to technological externalities (such as the productive interactions of Silicon Valley or the negative effects of industrial pollution).

Historical events were soon to lead to a much greater reliance on market forces world-wide, however. The break-up of the USSR signalled the collapse of the Communist challenge to market- oriented models of economic development and encouraged a shift from managed capitalism to market capitalism - with the administrations of Mrs Thatcher and President Ronald Reagan in the vanguard. In the UK, for example, there was widespread privatisation of nationalised industries and the stock of housing; and, in financial services, the Big Bang of 1986 signalled the opening up of the City of London to the forces of global competition. Likewise in the USA -- where Government intervention was increasingly seen as 'part of the problem not the solution' -- there was pressure to deregulate financial services; and the success of Mr Greenspan in handling the US stock market break on Black Monday in 1987 encouraged the belief that self-regulation plus adept interest rate management could head off financial crisis.

New York and London being world-leading financial centres competing for global business, this triggered a 'race to the bottom' -- with reliance on self-regulation on one side of the Atlantic matched by 'light touch' regulation on the other[2]. Over time this led on to repeal of the Glass Steagall legislation in the USA; and to such a rapid expansion of UK banking that at the peak the country now plays host to an industry with a balance sheet more than five times local GDP!

[2] Substantial losses suffered by US banks on Latin American lending in the 1980s did, however, lead to cooperation in searching for internationally accepted baselines for prudential regulation -- resulting in the Basel Accord of 1988, setting a minimum capital requirement of 8% of total risk-weighted assets on individual banks, which led to a substantial recapitalisation of the international banking sector.

What then of the early warnings from 1986? They seemed to be largely forgotten. Even when severe financial crisis erupted in East Asia in 1997/8, this was widely seen as a symptom of nascent capitalism -- of poorly regulated banks, connected lending and excessive foreign currency exposure -- to be solved by upgrading financial regulation to the exemplary standards of the leading economies in the West. The IMF did put to one side its plans for increased deregulation of the capital account[3]; but faith in the efficacy of lightly-regulated markets in advanced economies was largely unshaken. Indeed the assumption of financial market efficiency was to become the hall-mark of macroeconomic models used by central banks to steer the economy in the time of Great Moderation. Even when markets departed from fundamentals, as in the US 'high-tech' bubble which characterised the early years of the 21st century, interest rate policy on its own seemed adequate for handling the consequences of the asset price correction, Greenspan (2002).

But the financial crisis in North Atlantic economies in 2007/8 -- and the threat it posed of collapse for the entire financial system and a possible repeat of the Great Depression - has forced a reconsideration of consensus, with Mr Greenspan himself acknowledging that his faith in the efficiency of market forces had been misplaced.

Do financial crises provide concrete examples of financial externalities in action? A recent study by Majnoni and Powell (2011) using quarterly data for 139 corporate issues from the period 1999-2006 suggests that -- at least for emerging markets - they have. They test the hypothesis that corporate spreads will normally be determined by firm, country and international financial characteristics; and that in addition they will rise at times of crisis due to endogenous risk or amplification effects. Their empirical results show an amplification of shocks during crisis times (for all crisis types) depending on the size of the credit market before the crisis. For banking crises in particular, the weakness of the banking system amplifies shocks by increasing the cost of capital for non-financial firms.[4]

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[3] Just before the crisis, the IMF had been planning to change the Articles of Agreement so as to remove the sovereign right of members to impose capital controls, Fischer (2004).

[4] For advanced economies, Barrell et al (2010) show how the probability of the crisis can be explained by inadequate levels of capital and liquidity.

What are the nature of these externalities? How to reshape the rules and structure of banking world-wide to limit them? How likely are these reforms to be effected? These are the issues to be explored in this paper. In the first section we look at *fire-sale externalities* and the under-provision of liquidity; in the second section we look at the *risk-shifting* due to limited liability; finally in section three at the risk of *contagion* posed by the network feature of banking.

In conclusion, we note how vividly the shock to the Western economies – now mired in recession with the prospect of years of slow growth to come - contrasts with the success of managed capitalism of India and China both in avoiding these crises and in maintaining enviable rates of economic growth. The capacity of an economic system to limit pecuniary externalities may, it seems, be an important determinant of capitalist development.

1. Fire-sales and the under-provision of liquidity

The 'financial accelerator' as pecuniary externality

Even without financial intermediaries, a credit-constrained market economy – where collateral is used to handle repudiation risk – can exhibit liquidity crises and collapsing asset prices. In the model of Kiyotaki and Moore (1997), for example, productive small business entrepreneurs wish to raise outside finance to acquire the fixed capital assets but face an agency problem because the 'human capital' used in the business is unalienable. Recourse is had to the issuance of debt backed by physical collateral, priced to reflect its productivity outside the entrepreneurial sector (i.e. in the hands of the 'deep pocket' lenders). In the face of uncorrelated, idiosyncratic productivity shocks, agents adversely affected can sell capital and pay down debt without affecting asset prices. But in the face of an adverse macroeconomic shock to entrepreneurial productivity, the borrowing constraint can lead' fire-sales' which affect the price of the collateral trigger yet further sales, i.e. there is a pecuniary externality.

This is in sharp contrast with the 'first best' economy where all agents are unconstrained in the credit market, and prices and production are unaffected by net worth. How this externality can impact on allocation in the model of Kiyotaki and Moore (1997) can be seen schematically in Figure 1.

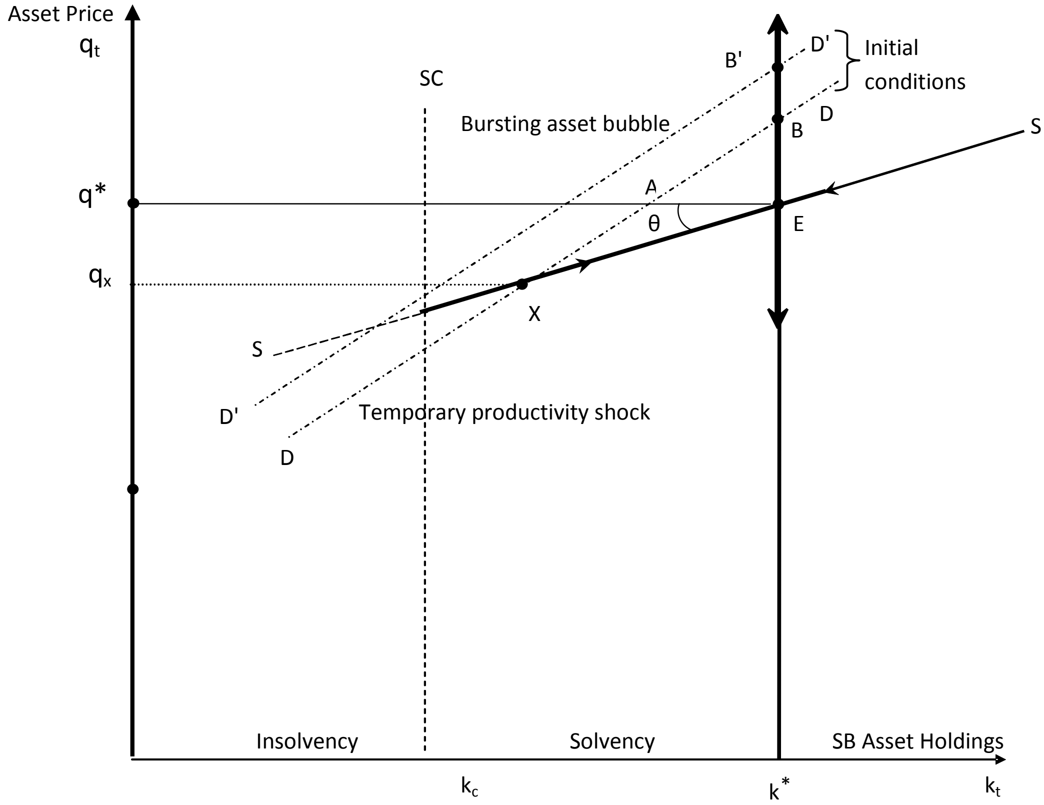


Fig. 1. The financial accelerator as pecuniary externality (Source: Miller and Stiglitz, 2010)

From equilibrium at E, where debt-financed Small Businesses entrepreneurs hold a stock k* of fixed assets at price q*, the immediate impact of an adverse productivity shock is indicated by the 'initial condition' labelled DD -- a schedule for their disposal of fixed assets , k, as needed to match the fall in net worth due to a one-period drop in productivity. This schedule can be interpreted as an unexpected need for liquidity on their part, Krishnamurthy (2009). From this perspective, asset prices have to fall until, at point X, the balance-sheet-driven 'demand for liquidity' by Small Businesses (measured to the left from k* to DD) is matched by the 'supply of liquidity' by the residual buyers who have no balance sheet problems (the agents with 'deep pockets') whose take-up of assets is measured from k* to SS.

As the figure suggests, the impact on asset holding has two components. The distance EA indicates how far Small Businesses need to contract their holdings at a constant price, q*, as they dispose of assets to reduce their borrowing in line with the fall in net worth[5]; the second

[5] This would have little welfare significance if the user cost of capital – its productivity elsewhere -- were constant.

component, AX, indicates the need for further disposals due to the adverse net worth effects of asset prices falling in the face of concerted selling by small businesses to residual buyers with declining marginal productivity -- net worth effects that are exacerbated by expected persistence. In the absence of fresh shocks, the system will gradually return to equilibrium along the stable path[6] SS. Thus the pecuniary externality acts as a 'financial accelerator' that takes short-run equilibrium from A to point X on SS.

Like Gai et al. (2008), Korinek (2011) modifies this framework so that the borrowing is done by financial intermediaries, risk-neutral bankers who raise finance from households and invest in risky projects; and he shows how the externality involved can be thought of in terms their undervaluation of liquidity. Banks who think that in adverse conditions they can sell assets fail to realise that with correlated shocks these sales will help push prices down. A social planner would anticipate the fall and take on less risk, as he explains:

> A planner internalizes the fact that a decline in asset prices leads to financial amplification since it reduces the amount of liquidity that bankers can raise from their sales of each unit of the assets. This pecuniary externality reduces the efficiency of the distribution of capital. By contrast, decentralized bankers take asset prices as given since they realize that the behaviour of an atomistic agent has only an infinitesimal effect on asset prices.

Central bankers and regulators did not generally act like social planners it seems. According to Majnoni and Powell (2011) 'policy makers in the developed world (albeit with notable exceptions) allowed financial institutions to push leverage up to unprecedented limits under a shared optimism regarding the capacity of capital markets to supply an almost infinite amount of liquidity'.

The difference between the private valuation and the planner's social valuation of liquidity, as shown in Fig. 2 , is defined as the pecuniary externality (which falls to zero in unconstrained states). For social efficiency, Korinek (2011) proposes a state-contingent, proportional tax on risk-taking that brings the private cost in line with the social cost. This is a metaphor for macro-prudential regulation because "it closely captures what BIS defines as the macro-prudential approach to regulation: it is designed to limit system-wide financial distress that stems from the correlated exposure of financial institutions and to avoid the

[6] In their discussion of amplification through balance sheets and asset prices, Kiyotaki and Moore (1997) assume that the 'overshooting' will not be severe enough to render the illiquid agents insolvent.

resulting real losses in the economy" (p.26). He also proposes taxation on complex securities such as a CDS swap "which is likely to require large payouts precisely in times of financial turmoil" (p. 27).

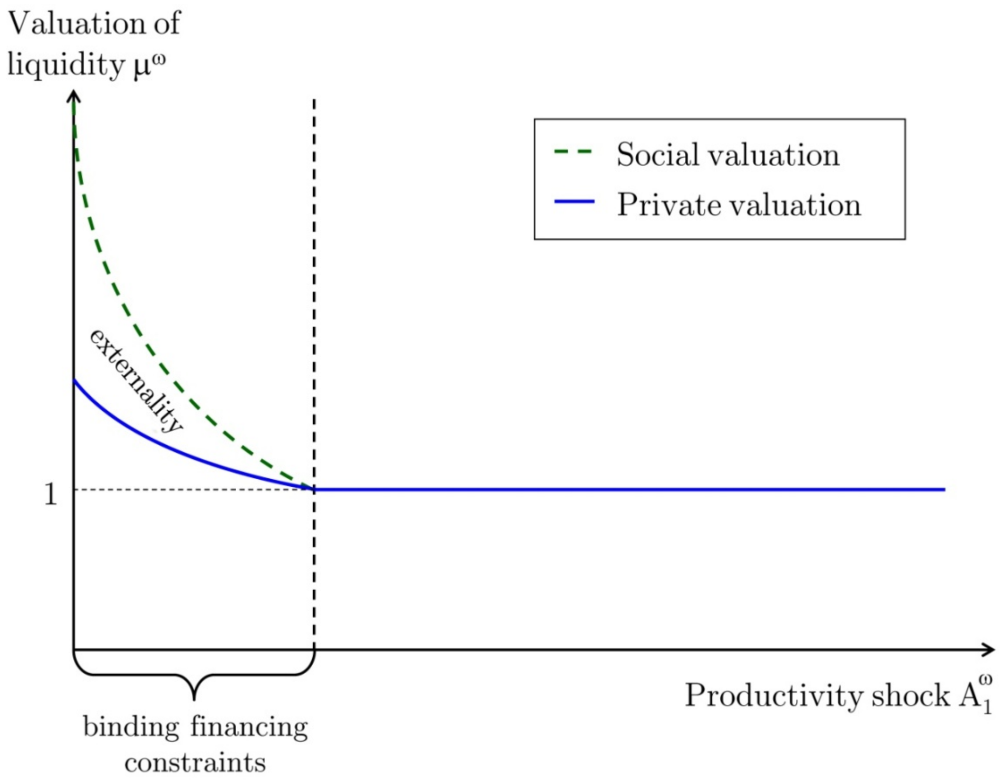


Figure 2: Private and Social Valuation of Liquidity (Source: Korinek, 2011)

While these policy measures are expressed in terms of taxes on externalities, Korinek argues that they are broadly equivalent to capital adequacy requirements "which have tax-like effects because bank capital is costly" (p28). Such capital requirements could be reduced if CDS swaps can be arranged 'that shift systemic risk to agents outside the financial system who are not subject to financial constraint'. (A deal between US banks and Chinese sovereign wealth fund to deliver liquidity in the crisis?)

This welfare perspective seems to match that of Stiglitz (2010) when he argues that:

> 'The financial sector has imposed huge externalities on the rest of society. America's financial industry polluted the world with toxic mortgages, and, in line with the well established "polluter pays" principle, taxes should be imposed on it. Besides, well-designed taxes on the financial sector might help alleviate problems caused by excessive leverage and banks that are too big to fail. Taxes on speculative activity

> might encourage banks to focus greater attention on performing their key societal role of providing credit.'

Risk of insolvency especially after collapse of asset bubble

In the discussing the amplification shocks through balance sheets and asset prices, it is customary to assume that the 'overshooting' will not be severe enough to render the illiquid agents insolvent, Kiyotaki and Moore (1997), Krishnamurthy (2010) and Korinek (2011). This is a rashly optimistic assumption in the aftermath of an asset bubble -- especially if highly levered institutions are involved (as is suggested in Figure 1 where the disposal schedule D'D' associated with an asset bubble fails to intersect SS to the right of SC, the Solvency Constraint).

In Japan, for example, Koo (2008, pp. 14-15) reports that de-leveraging made many firms technically insolvent after the bubble burst. In the recent North Atlantic crisis, Lehman Brothers famously went bankrupt and Fanny May and Freddie Mac were nationalised soon afterwards -- as were two banks in the UK. In both countries rescue plans for the financial sector included substantial injections of equity capital for financial institutions[7].

How the existence of limited liability may induce firms to run the risk of insolvency -- and how this can lead to an asset bubble - is the subject of the next section.

2. Risk-shifting and under-provision of capital

In *Casino Capitalism*, Hans Werner Sinn notes how the limited liability corporation was and is crucial for the mobilisation of savings to fund risky investment, as the limitation of liability is needed to convince the small shareholder to participate. While this corporate form may be 'capitalism's secret of success', however, it can be misused by the addition of massive leverage, which generates negative externalities in the form of excessive risk taking whose downside is borne by the creditors. The case of US investment banks is cited as a case in point:

> Investment banks, until well into the 1970s, were all organized as partnerships, and as such offered their market partners the unlimited private liability of their owners. But they evolved eventually into corporations in order to limit their liability to their equity capital. … For the five big American investment banks in 2006, before the financial

[7] Further detail available in Miller and Stiglitz (2009) and in Sinn (2010).

> crisis erupted, business volume was leveraged by a factor of 22 to 33 of what would have been possible if only equity had been lent. (pp. 76-77)
>
> If a business volume of 100 units of money is only backed by three to four-and a-half units of equity, it can easily happen that in times of crises the losses eat up the equity and lead to bankruptcy. Even worse was the fact that the low level of equity combined with limited liability induced the stockholders to demand ever riskier business models in order to increase their profits. … If some of the losses are borne by the creditors, it pays to take the risk. (p.79)
>
> It is the negative externality that bankers impose on their creditors and possibly the taxpayer that induces excessive risk taking, producing private profits and social losses.(p.81)

This same logic is explored in a piece written about emerging markets by Allen and Gale (2000) (see also Allen and Gale, 2006, Chapter 9). But they go further and show how the incentive for highly levered institutions to shift risk on to their creditors can have the effect of raising asset prices above the fundamental level[8], i.e. create a 'bubble', adding further to the vulnerability of the financial system.

In this section, risk-shifting incentives are presented in the context of a simple two bloc global model, designed to show how financial externalities, weak regulation and missing markets can expose the global economy to the risk of crisis. First we discuss how limited liability and weak regulation of financial intermediaries can lead to an asset price bubble in the Home country; then we look at how precautionary motive in the Foreign country (which saves because of an absence of insurance) can further inflate the asset price in the Home country.

2.1 Limited liability and excessive leverage

To formalise the argument we adapt Allen and Gale (2000) model study asset pricing in the Home country (which, in the light of Sinn's comments, could be thought of as the US). Assume there are two periods and there are two assets are available in the Home country: a safe asset with variable supply and a risky one in fixed supply of 1. The gross return on the safe asset in period 2 is R ($R > 1$) and that on the risky asset is R_H with probability γ and R_L with probability $1-\gamma$.

[8] Prices that would be established without leverage.

The investment in the risky asset has to be done through financial intermediation (e.g., risk neutral banks) which is perfectly competitive. In the absence of adverse incentives in the intermediation sector, the equilibrium price of the risky asset in period 1 must satisfy:

$$\gamma \frac{R_H}{P_F} + (1-\gamma)\frac{R_L}{P_F} = R \tag{1}$$

where P_F represents the fundamental price of the risky asset, i.e.,

$$P_F = \frac{\gamma R_H + (1-\gamma)R_L}{R}. \tag{2}$$

For each unit investment in the risky asset, an intermediary is required to finance a fraction k by issuing equity and borrows the rest from the market at a cost of R. (So $1/k$ indicates the leverage of the intermediary.) Let k be set by a regulatory authority, where a low value of k indicates weak regulation of financial intermediaries. Assume specifically that

$$k \le \frac{\gamma(R_H - R_L)}{P_F} \tag{3}$$

i.e. k is set too low to prevent risk-shifting behaviour on the part of the financial intermediaries.

If all intermediaries are protected by limited liability, then perfect competition implies

$$\gamma(\frac{R_H}{P} - R) + (1-\gamma)(-k) = 0 \tag{4}$$

where P indicates equilibrium price for the risky asset with financial intermediation. For simplicity, we assume that the cost of the intermediary's own capital is R. So, the first term on the right hand side of (4) represents the payoff to the intermediary in the good state, and the second the payoff in the bad state. Note that, given (3), the realisation of the bad state implies that the debt will not be paid in full since $R_L / P \le (1-k)R$. In this case, the liability will be taken over by an insuring agency, and the intermediary will be closed down and lose its own capital, k.

Solving for P in (4) yields

$$P = \frac{\gamma R_H}{\gamma R + (1-\gamma)k} \tag{5}$$

and together with (3) this implies,

$P \geq P_F$

i.e., weak regulation leads to asset price bubbles.

Let $\tau(R,k) = P / P_F$ represent the relative size of the bubble, then from (2) and (5), one finds

$$\tau_R \equiv \partial\tau(R,k) / \partial R < 0 \qquad (6)$$

and

$$\tau_k \equiv \partial\tau(R,k) / \partial k < 0 \qquad (7)$$

i.e., a higher interest rate R reduces demand for the risky asset, damping its price rise; while weaker regulation (lower k) increases intermediaries' incentive to shift risk and so pushes up the price of the risky asset.

As long as households are not aware of the risk-shifting incentives that exist in the financial intermediaries, they will treat the bubble as if it is an increase in their real wealth, as in Laibson and Mollerstrom (2010). In the next section, we look at the global impact of this agency problem.

2.2 Missing insurance markets and precautionary saving

Let the global exchange economy consist of two countries -- Home and Foreign -- and last two periods. Only non-state-contingent assets can be traded between Home and Foreign. Each country is populated by a continuum of ex-ante identical consumers with preferences over consumption in periods 1 and 2, C_1 and C_2 respectively (with * indicates variables for the Foreign country), given by standard additively separable utility function which has a Constant Relative Risk Averse.

Assume there is no uncertainty in the first period and both countries are endowed with 1 unit of the single tradable commodity. . To reflect a higher incidence of macroeconomic shocks in the Foreign country, let two possible states of nature exist in the Foreign country, in period 2, with probability of $1-\pi$ and π respectively, where π is the probability of a low state. Specifically we assume the state-dependent aggregate growth rate of its endowments is $\hat{g}$ in the high state and $\hat{g}-\Delta$ in the low state, giving Foreign's period 2 endowment as $1+\hat{g}$ and $1+\hat{g}-\Delta$ respectively.

Assume also that consumers in the Foreign country are identical ex-ante but, in period 2, they are divided into two groups. The first group, with a measure of $1-\lambda$, is unaffected by the aggregate shock and enjoys the same endowment in either state. The second group, with a measure of λ, suffers the full brunt of the aggregate shock in the low state, so their endowment is disproportionally reduced to $1+\hat{g}-\Delta/\lambda$ in the low state.[9] This formulation is based on Mankiw (1986) model of the concentration of aggregate shocks, and is intended to capture the lack of risk-pooling among residents of foreign country due to the absence of social safety net or the presence of private information and moral hazard considerations.

Given the real global gross interest rate of R, the optimal allocation of consumption in the Foreign country implies its period 1 consumption $C_1^*(R,\lambda)$ has the properties that: $\partial C_1^*(R,\lambda)/\partial R<0$ and $\partial C_1^*(R,\lambda)/\partial\lambda>0$. The first property is because a rise in R, through both income and substitution effects, decreases period 1 consumption. The second is because higher risk concentration leads to higher precautionary saving in the Foreign country, reducing its period 1 consumption. (See Miller et al 2010).

Let the period 1 endowment of a consumer in the Home country's be 1, so period 2 resources will consist in an endowment of $1+g$ and the returns on the investment he/she made through the financial intermediary in period 1. If consumers in the Home country are not aware of incentive problem in financial intermediaries, they would treat an increase in P as an increase in their wealth. So the *ex ante* wealth for the Home consumers is

$$W_H = 1+(1+g)R^{-1}+\xi(\tau)$$

where $\xi'(\tau)>0$ positive wealth effect of the bubble.

[9]The lower is the value of λ, the higher is the degree of risk concentration.

For a given the real global gross interest rate R, the optimal allocation of consumption in the Home country implies period 1 consumption $C_1(R,\tau)$ has the properties: $\partial C_1(R,\lambda)/\partial R < 0$ and $\partial C_1(R,\tau)/\partial\tau > 0$. The reason for the first property is the same as that for the Foreign's period 1 consumption. The second simply reflects the asset price bubbles have positive wealth effect. (See Miller et al 2010).

To complete the model, we introduce the market clearing condition for period 1 to determine the equilibrium global interest rate R:

$$C_1^*(R,\lambda) + C_1(R,\varsigma) = 2 \tag{8}$$

Using the properties of $C_1(R,\tau)$ and $C_1^*(R,\lambda)$ above, the equilibrium condition (8) implies the following comparative statics for the global interest rate:

$$\frac{\partial R}{\partial\lambda} = -\frac{\partial C_1^*(R,\lambda)/\partial\lambda}{\partial C_1^*(R,\lambda)/\partial R + \partial C_1(R,\tau)/\partial R + \tau_R \partial C_1(R,\tau)/\partial\tau} > 0 \tag{9}$$

$$\frac{\partial R}{\partial k} = -\frac{\tau_k \partial C_1(R,\tau)/\partial\tau}{\partial C_1^*(R,\lambda)/\partial R + \partial C_1(R,\tau)/\partial R + \tau_R \partial C_1(R,\tau)/\partial\tau} < 0 \tag{10}$$

How excessive leverage and risk concentration can affect the pattern of consumption and global interest rates is illustrated with the aid of Figure 3, where the horizontal axis measures period 1 consumption and the vertical the global real interest rates. (Note that Home's consumption is measured from point O_H and that of the Foreign country measured from O_F.) In the absence of asset price bubble ($\tau = 1$) and the risk concentration ($\lambda = 1$), the equilibrium is at point A where the two demand schedules of the Home and the Foreign intersect. Note that allocation at point A is only constrained efficient because the global asset markets are incomplete: full efficiency would require Arrow securities or GDP linked bonds.

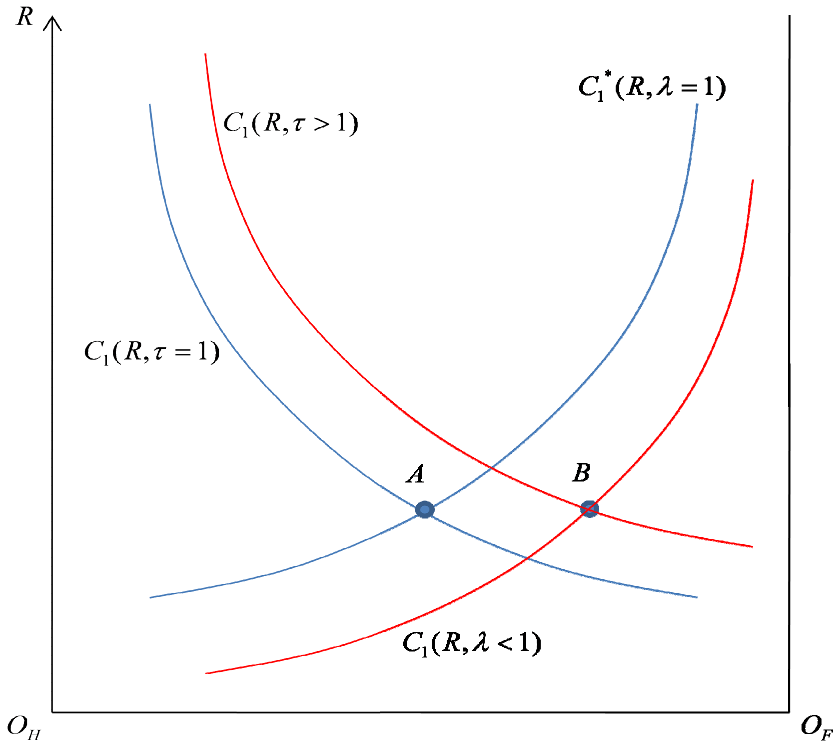


Figure 3. Risk concentration, excessive leverage and global imbalances

Limited liability, weak regulation and excessive leverage leading to an asset bubble shift Home's demand schedule up to $C_1(R,\tau>1)$ reflecting the increased wealth perceived by Home consumers, as in Laibson and Mollerstrom (2010). The presence of risk concentration, on the other hand, shifts Foreign's demand schedule down to $C_1^*(R,\lambda>1)$ due to precautionary savings. Global market-clearing equilibrium with risk concentration and excessive leverage is given by point B where the two revised demand schedules intersect. With appropriate choice of τ and λ, substantial global imbalances will emerge with little changes of real interest rates.

By assumption, both externalities and missing markets play a role in defining this equilibrium -- a situation of excessive, bubble-driven consumption in one country and high precautionary savings in the other. Welfare-improving policy interventions would involve tightening regulation in the Home country (increasing k) and providing a social safety net in the Foreign country (increasing λ). With and k above the critical value shown in (3) above, equilibrium would be at A. (Welfare improvement from A would require completing the global asset market, e.g. by the issuance of GDP bonds.)

3. Network externalities, contagion and circuit breakers

Liquidity and solvency problems have been studied in previous sections without considering the pattern of interconnectedness between agents, i.e. by assuming, so to say, a representative bank. This could be defended from a reductionist perspective – why look at structure unless you have to? It has been found however, that industry structure is key for contagion: research at the Bank of England and the FRBNY using stochastic network theory shows that different structures can lead to very different propagation mechanisms.

This is what we study in this section, which begins with a discussion of the special nature of banks - how it arises from asymmetric information and missing markets; and how it leads to institutional arrangements that call for a structural analysis. This is followed by a simplified model of the banking industry where risk-pooling encourages individual banks to consolidate into banking groups, but the risk of contagion inside any group sets a limit to efficient group size. If the activities that generate contagion can be hived off outside the banking industry, however group size can expand indefinitely. This could be interpreted as an argument for Glass-Steagall type of separation of commercial and investment banking. It may also provide a rationale for the partial separation recommended by the Vickers Commission where investment and commercial banking activities can remain within the same corporate entity but are separated by a "ring-fence".

Liquidity Provision

Taking the Diamond and Dybvig (1983) model as a bench mark, the problem facing agents wishing to invest long term subject to random liquidity need is there are imperfect markets for liquidity insurance. The tension between long term investment and need for cash can be reduced by trading in the non-contingent spot markets – what Allen and Gale call the market solution. But, as they show, banks can, achieve Pareto improvement by pooling of liquidity risks using the law of large numbers. This banking solution is however, subject to a coordination problem in that fears of depositor flight can lead to a bank run. Even without Bank runs, there is an obvious risk that the law of large numbers --- while it applies across banks --- does not apply to any individual bank or those in a region. Hence the emergence of interbank markets to pool liquidity.

But, as the sub-prime crisis has made clear, the interbank markets - where short term lending is not collateralized - are themselves prone to seizure when fear of counterparty insolvency stalks the streets. In the recent case, interbank lending effectively gravitated onto the balance sheet of central banks: following the collapse of Lehman Brothers, the liabilities of US Federal Reserve promptly doubled while the balance-sheet of the Bank of England expanded three and half times.

So banks that pool liquidity risk among their customers and interbank markets which economize on system wide liquidity are both prone to collapse. Network gains are subject to coordination failure.

Contagious insolvency

Similar issues arise with respect to insolvency. In their stochastic network model of UK banks Gai and Kapadia (2010) and Gai et al (2010) find that an interconnected financial system of a large number of banks can fail if and when a shock hits affects a super-spreader and is then dissipated widely around the system.

Modelling the way the network structure can amplify shocks may be relevant for the analysis of the financial crisis, but in the view of Jon Danielsson (2010) of LSE a realistic 'endogenous risk model is beyond our abilities'. In these circumstances, he argues that supervisors should focus their attention on where the risk is created (rather than trying to measure it); and that the most important factor is Resolution – i.e. the closure of systematically important financial institutions which have gambled and face failure.

Another approach, as in Stiglitz (2011), is to simplify the structure sufficiently so as to achieve analytical tractability. Using an electricity grid system as a metaphor, Stiglitz's analysis involves production uncertainty where the risk of productivity shocks is insured by sharing of costs between all the players. The result is a stylised model of endogenous risk, where the gains of connectivity have to be balanced against the risk of propagating large shocks around the system. By analogy with the electricity grid, the principal policy recommendation is the implementation of circuit breakers, designed to limit the propagation of large shocks.

To throw light on structural measures currently being taken to reduce the vulnerability of banking - both in terms of resolution procedures and of the 'ring-fencing' – a simplified version of the Stiglitz model is provided in the Annex B, with a trade off between sharing small risks and avoiding large ones. Forming an interconnected group allows for risk-pooling, but it exposes group members to contagion from a large shock hitting any group member, so there is a limit to optimal group size. Given a ‘circuit breaker’ which prevents any contagion from a large shock, however, there is no limit to the size of the group.

Stiglitz (2011) suggests that such circuit breakers could be interpreted as restrictions on capital flows. Here we suggest that a circuit breaker be interpreted as a metaphor for structural changes designed to limit the damage an insolvent Systemically Important Financial Institution (SIFI) can impose on the wider banking system. This could include both resolution procedures, and ‘ring-fencing’ proposals.. In the UK, for example, the Banking Act 2009 created a Special Resolution Regime (SRR)[10], giving the authorities a framework for dealing promptly with distressed banks and building societies; and the Government currently proposes to ‘ringfence’ the retail banking operations of big universal banks so that it will be possible to let the riskier investment banking arms to fail without imperilling household savings and small business lending.

Conclusion

What is being done to check the impact of externalities in the financial sector since the crisis of 2008/10? The steps being taken involve first the regulation of individual bank portfolios in the form of rules governing capital adequacy and liquidity holdings; second changes to the structure of the industry; and finally macro-prudential interventions across the industry which varies with the business cycle.

A compact summary of the current state of play is provided by Barrell and Davis (2011)::

> On Capital:
> The new regulations, which are basically complete, will raise common equity from the previous **minimum** of 1 per cent of risk-weighted assets to at least 4.5 per cent, and Tier 1 as a whole to 6 per cent. **A conservation buffer** of 2.5 per cent of risk-weighted assets must also be built up with common equity, and if this is exhausted in a crisis then the bank will be wound up. A minimum ratio of capital to total (unadjusted) assets of 3 per cent must be held.
>
> There is provision for a **countercyclical capital buffer** of up to 2.5 per cent of risk-weighted assets, which is to be imposed at the discretion of the regulators. The regulation of subsidiaries and capital market activities has been substantially tightened,

[10] By, for example, transferring all or part of a bank to a private sector purchaser, or to a ‘bridge bank’ subsidiary of the Bank of England, or into temporary public ownership; or sending it to be wound up.

including the introduction of stress-related benchmarks for trading book capital and counterparty credit risk.

Calibration of the Capital Framework
Capital requirements and buffers (all numbers in per cent)

	Common equity (after deductions)	Tier 1 capital	Total capital
Minimum	4.5	6.0	8.0
Conservation buffer	2.5		
Minimum + conservation buffer	7.0	8.5	10.5
Countercyclical buffer range	0–2.5		

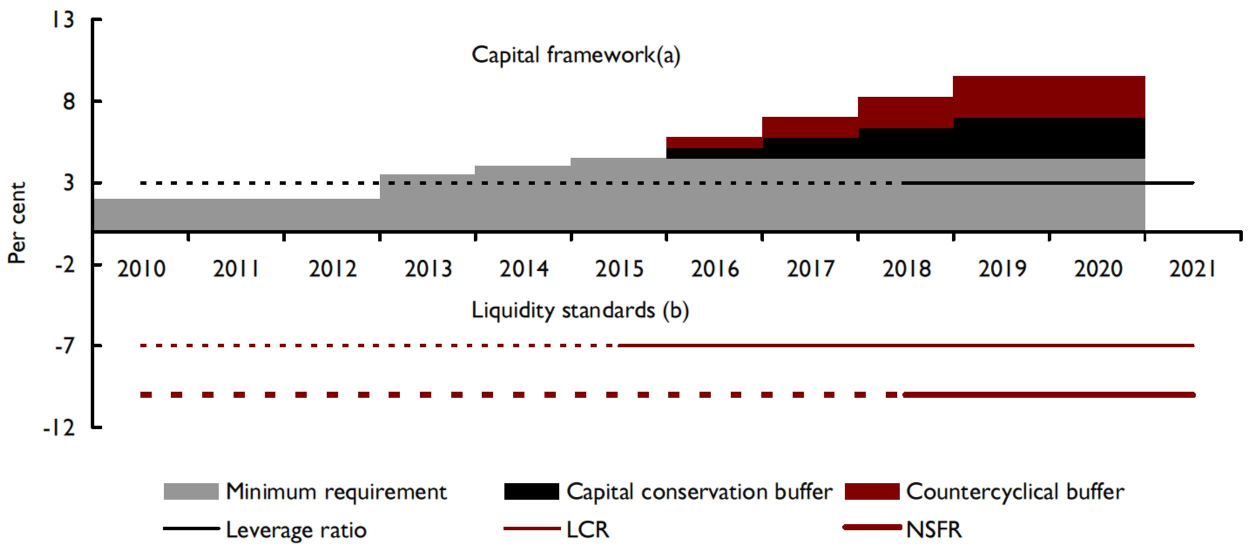
Source: Barrel and Davis (2011, p. F5).

On Liquidity
Two new regulations for liquidity risk are being introduced: first, a liquidity coverage ratio (LCR) enforcing sufficient liquid assets to offset net cash outflows during a 30-day period of stress; second, a net stable funding ratio (NSFR) which seeks to ensure a degree of maturity matching over a one-year horizon, including allowance for off-balance sheet commitments.

The Timetable

Given the virulence of the crisis, plans for implementation of these reforms are extraordinarily protracted. As can be seen from the graphic of Cechetti et al. (2011), the build- up of the equity and the implementation of the liquidity standards is spread over a decade!

Figure 4. Timeline for the implementation of Basel III



Source: BCBS (2010b).

Notes: (a) Shaded areas indicate common equity requirements as a percentage of risk-weighted assets; additional requirements exist for Tier 1 and total capital. (b) Dashed lines indicate observation periods, solid lines represent the introduction of the minimum standard. The countercyclical buffer is defined as a range of 0–2.5 per cent, according to national circumstances. It will be phased in in parallel with the capital conservation buffer. The new leverage ratio of 3 per cent (Tier 1 capital over total exposure) will be subject to supervisory monitoring in 2011–12, before the parallel run (dashed line) and its eventual migration to Pillar 1 treatment (solid line).

Source: Cechetti et al. (2011, p. R35)

Effects on bank leverage

Academic economists see the need for much tougher regulation than do the guardians of financial stability housed in Basel, as may be seen from the following table.

The minimum capital requirements shown range from the 7% baseline ratio of equity to risk weighted assets (RWA) of Basel III to the ratio of 15% on total assets recommended by Admati et al (2010) in their evidence to the ICB. As shown in column 3, with risk weighted assets at half the balance sheet, the leverage for banks at the Basel III minimum could rise alarmingly close to 30; but it would fall to single figures under the proposal of Admati et al (2010).

	Minimum	**Capital**	**Requirement**	**Liquidity**	**Other**
	% RWA	***% Total Assets***	***Leverage (assuming 50% RWA)***		
Basel III	***4.5 +2.5 = 7 + Cyclical Buffer***	3.5	28	***LCR, SFR***	***Resolution***
ICB Interim Report (Retail banking)*	***10***	*5*	*20*		***Ring- fencing***
"Double Basel" Barrell & Davis(2011)	***14***	7	*14*		
Miles et al.(2010)	***19***	*9.5*	*11*		
Admati et al.(2010)	**n. a.**	***15***	**4**		
Memo item					
Hedge Funds(		***30***	***3.33***		

Table 1. Regulatory measures for capital, liquidity and structural separation

* In addition for systemically important banks the ICB recommended that they "should have an equity ratio of at least 10% [of risk weighted assets] provided that they also have genuinely loss-absorbing debt" (CoCos), arrangements which should be agreed internationally.

Of great importance for the regulation of banking in the UK are the proposals of the ICB Interim Report, recently endorsed by the government. As indicated in line 2, these consist of both capital adequacy requirements and structural separation, with a "ring-fence" around the country's retail banking operations to help protect them from financial crisis. With such a firewall, especially with improved resolution procedures, "the investment arm could, in extreme circumstance, be liquidated efficiently and at no public expense while preserving the retail activities uninfected by bad investment banking assets" (ICB, 2010, para 4.21).

In the absence of such structural separation, the ICB warned that capital requirements higher than 10% (on RWA) across the board might well be called for (Vickers, 2011). The figures shown in line 3 calculated by Barrel et al (2011) to reduce banking risk to acceptable levels are double Basel requirements, and this may be what the ICB had in mind.

Given the pernicious externalities considered above -- and the accumulating evidence that they matter greatly in practice -- the plans under Basel III look seriously inadequate - especially when compared with the decisive steps taken by the Roosevelt Administration in the 1930s.

In *Whither Socialism,* Joseph Stiglitz suggested that Communist planning could not succeed because the information required for the top-down allocation of resources was simply not available. Could information issues prove the Achilles heel of market liberalism in the West? What if banks use opaque financial products and limited liability to take on excessive risk - collecting the upside and shifting the downside to the taxpayer via bail-outs in times of crisis? Again and again!

It will surely take more than Basel III to 'save Western capitalism from the capitalists'. In its *Final Report,* ICB (2011), the Vickers Commission recommends the 'ring fencing' of commercial bank operations (to separate them from investment banking, possibly within the same bank holding company), subjecting the retail arm to much higher capital adequacy requirements and prohibiting the holding of many risk assets so as to 'get the taxpayer off the hook'. Could this type of structural separation for UK banking work as an update of Glass-Steagall for our times?

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APPENDIX

Optimal risk sharing network with systemic risks

Consider a very simple case of financial network formation. The motivation for connecting each node to an existing component is to insure against small idiosyncratic shocks. The whole network however, may be hit by some 'macro shock' which leads to the failure of large fraction of nodes. The interaction between these two effects may limit the extent of connectivity. In what follows, we first show the existence of such limit and then illustrate how by isolating the node hit by the large shock can increase the connectivity.

As shown by Gai and Kapadia (2010), whether solvency shocks on a small fraction of nodes can lead to systemic risk depends on (1) where the shocks hit and (2) the network structure (degree distribution). To make the problem analytically tractable, we assume a very simple network structure: that there are a fraction of nodes which are completely connected, and the rest are isolated (as shown in Figure 1). If a solvency shock (a macro shock) hits an isolated node, only that node fails. If the solvency shock hits on a node in the component, the whole component fails.

Assume N *ex-ante* identical nodes, each faced with two types of shock:

(a) $x_i = \varepsilon_i$, small shock, could be shared by the network.
(b) A large shock T occurs with probability p. So an individual node will get hit with probability p/N.

The shocks, ε_i, are iid random variables with bounded support and $E\varepsilon_i = 0$. The type of shock (b) is the solvency shock described above. To have clear-cut results, **we further assume that shocks (a) and (b) are independent.**

To look at the incentive to form connections, we compare the expected utility for two types of typical nodes: isolated and in a component.

1. An isolated node

The expected utility at the node is given by:

$$U_I = (1-p)Eu(\varepsilon_i) + p\left\{\frac{N-1}{N}Eu(\varepsilon_i) + \frac{1}{N}u(T)\right\} = \left(1 - p + \frac{N-1}{N}p\right)Eu(\varepsilon_i) + \frac{P}{N}u(T) \quad (1)$$

where u(.) is a standard increasing and strictly concave utility function, and E is an expectation operator. Here, we assume that $Eu(\varepsilon_i) > u(T)$.

II. A node in a component

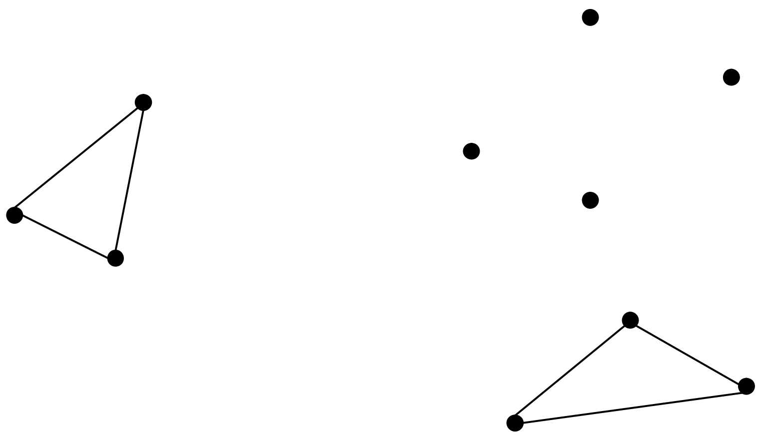

Figure 1. A partially connected network

In a partially connected network, consider an completely connected component of size n. The expected utility of a node in the component is:

$$U_C(n) = (1-p)uE\left(\frac{\sum \varepsilon_i}{n}\right) + p\left\{\frac{N-n}{N} Eu\left(\frac{\sum \varepsilon_i}{n}\right) + \frac{n}{N}U(T)\right\}$$
$$= \left(1 - p + \frac{N-n}{N}p\right) Eu\left(\frac{\sum \varepsilon_i}{n}\right) + \frac{np}{N}u(T)$$
$$= \left(1 - \frac{np}{N}\right) Eu\left(\frac{\sum \varepsilon_i}{n}\right) + \frac{np}{N}u(T)$$

(2)

In the completely connected component of size n, the idiosyncratic shocks are evenly shared. (It is clear that if n=1 the above becomes (1), the unconnected case.)

Differentiating the above expected utility w.r.t. n yields

$$\frac{\partial U_C(n)}{\partial n} = \frac{p}{N}\left[u(T) - Eu\left(\frac{\sum \varepsilon_i}{n}\right)\right] + \left(1 - \frac{np}{N}\right)\left(-\frac{1}{n}\right) E\left\{u'\left(\frac{\sum \varepsilon_i}{n}\right)\left(\frac{\sum \varepsilon_i}{n}\right)\right\} \quad (3)$$

The first term on the RHS of (3) represents the adverse effect of solvency shock on the component: the larger is the component, the more severe will be this adverse effect. The second term represents the positive effect of smoothing the idiosyncratic shock: this effect declines with the increase in n because of the concavity of the utility function. A trivial case is when $Eu(\varepsilon_i) \gg u(T)$: the negative effect dominates, no connection is formed.

For some reasonable utility functions (or $u(T)$ $not\ too\ small$), it could be that the positive effect dominates if n is small while the negative effect dominates if n is large. In this case, the optimal network would be the one which maximises (2), as illustrated in Figure 2, so there is a limit to the optimal size of a group.

Note that in a naturally formed network, an isolated node can make connections and a connected node can break its connections, so the network will have isolated components of size n*. *In this case, the probability of systemic risk is* $n^{*}p/N$.

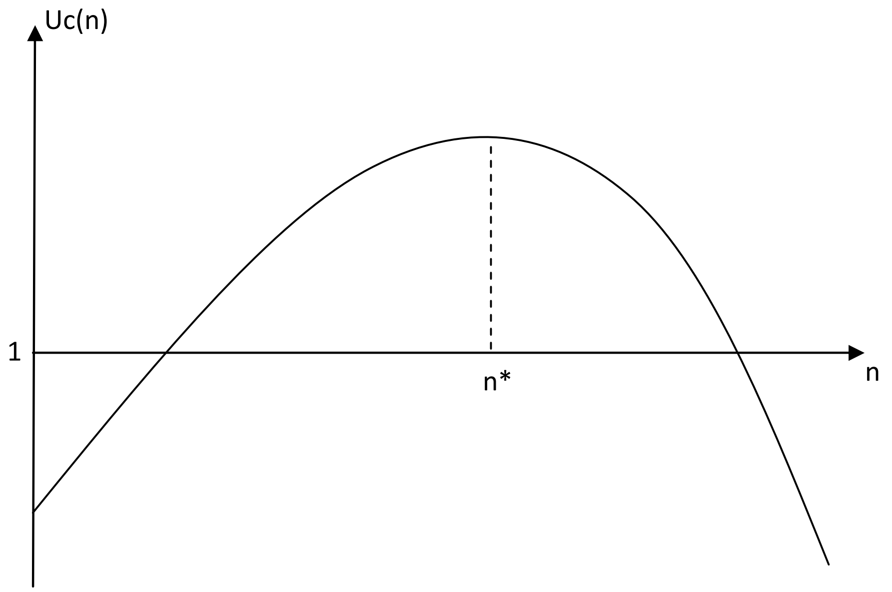

Figure 2. Optimal network

III. Circuit Breaker (withdrawal of node)

In Gai and Kapadia (2010), the policy of isolating the node hit by a large shock was not examined, maybe because of difficulties associated with substantial cross-holdings of assets among banks. Side-stepping such issues, let us assume that the large shock is clearly identifiable. Assume that if a connected node is hit by the large shock, its connections to other nodes in a component are severed; then the expected utility of a member in an n-group with such kind of "circuit breaker" is:

$$U_b(n) = (1-p)Eu\left(\frac{\sum \varepsilon_i}{n}\right) + p\left\{\frac{N-n}{N}Eu\left(\frac{\sum \varepsilon_i}{n}\right) + \frac{n-1}{N}Eu\left(\frac{\sum \varepsilon_i}{n-1}\right) + \frac{1}{N}U(T)\right\}$$
$$\approx \left(1 - p + \frac{N-n}{N}p + \frac{n-1}{N}p\right)Eu\left(\frac{\sum \varepsilon_i}{n}\right) + \frac{p}{N}u(T)$$
$$= (1 - p/N)Eu\left(\frac{\sum \varepsilon_i}{n}\right) + \frac{p}{N}u(T)$$

(4)

The above is an increasing function of n, **so the optimal size of a group is N.**

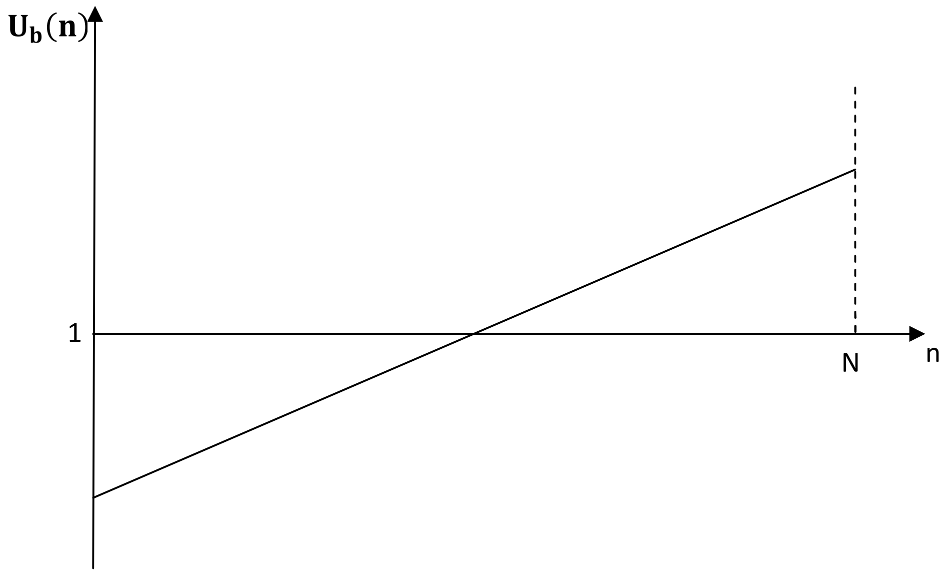

Figure 3. Expected utility of a node with circuit breaker

The idea that by separating systemically important nodes could allow the network to benefit fully its risk sharing function is intuitive with the aid of simple structure considered. The real financial networks are rarely completely connected: they usually exhibit small world properties with fat-tail degree distribution and high clustering coefficient. These imply that there are some important financial hubs which are highly inter-connected – the so-called “super-spreaders”. Haldane (2009) and Haldane and May (2011) have argued that it is crucial to identify such “super-spreaders” and to impose appropriate regulatory measures (such as higher capital buffers) to reduce their adverse effect on the stability of the whole financial system. In the similar vein, Stiglitz (2011) suggested, in the context of global financial integration, the use of “circuit breaker” (through, e.g., the use of capital control) to separate the infected component from the rest of the system. The Independent Commission on

Banking, in *Final Report* (2011), advocates a structural approach to banking regulation: by "ring-fencing" commercial banks from their investment arms, and subjecting them to limits on risk assets and different capital adequacy requirements. The "circuit breaker" used in the simple model above is may be used as a metaphor for such structural separation.