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A COMEDY OF ERRORS: MISGUIDED POLICY, MIS-SOLD MORTGAGES, AND MORE

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Abstract

In Phishing for Phools, Akerlof and Shiller characterise the US subprime crisis as the insolvency that follows when highly-leveraged investment banks mis-sell derivative-style products to low-income US households. That rating agencies qualified many of the Mortgage Backed Securities as triple A was no proof of top quality; just further evidence of distorted incentives. Other observers, however, see it as a direct consequence of financial innovation; or as a liquidity crisis driven by the lack of transparency of Mortgage Backed Securities. To help weigh these views in the balance, three aspects of the situation are explored, using both theoretical models and the outcome of recent legal proceedings. First, we examine the role of pecuniary externalities using a partial equilibrium model of investment banking due to Adrian and Shin, where bank equity induces amplified responses to news on fundamentals. We find that the system may be 'catastrophic' in that the simple reversal of a 'good news' shock (which has been promptly 'marked to market') can lead to insolvency. To interpret these news shocks, we turn to a general equilibrium model of risky asset pricing with heterogeneous beliefs recently developed by Fostel and Geanakoplos. In their framework, a rise in optimism acts as a 'good news' shock which raises the price of risky assets; while 'bad news' may be attributed to financial innovation that allows for the shorting of risky assets. Finally, to help resolve the contentious issue of whether the striking collapse in the value of MBSs net of insurance costs was due to irrational panic or had its basis in poor fundamentals, we consider the nature of state support and, more especially, the findings of law courts. The need for unprecedented capital injections by the Treasury in 2008 and the substantial fines for mis-selling of MBSs subsequently imposed on the banks suggest that the collapse of confidence in subprime securities had its roots in reality, not unreasoning panic.

JEL Classification: D52, D53, G01, G12, G13

Keywords: financial stability, Financial crises, General Equilibrium, default

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A comedy of errors: misguided policy, mis-sold mortgages, and more[1]

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August 2016

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In *Phishing for Phools*, Akerlof and Shiller characterise the US subprime crisis as the insolvency that follows when highly-leveraged investment banks mis-sell derivative-style products to low-income US households. That rating agencies qualified many of the Mortgage Backed Securities as triple A was no proof of top quality; just further evidence of distorted incentives. Other observers, however, see it as a direct consequence of financial innovation; or as a liquidity crisis driven by the lack of transparency of Mortgage Backed Securities.

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[1] Acknowledgements: For their valuable comments, we are grateful to George Akerlof, Sacha Becker, Alistair Milne, Herakles Polemarchakis and Peter Spence.

1. Introduction

That the period of macroeconomic stability known as the Great Moderation should have ended in a financial cataclysm was a nasty shock – especially for those who believed in the inherent efficiency of financial markets! But how to account for the fact that the spark for the crisis came not from emerging markets but from within the United States itself, where monetary affairs had, for many years, been in the seemingly trustworthy hands of Mr Greenspan, doyen of central bankers?

Earlier financial shocks and external factors doubtless played a role, with US interest rates being cut after the high-tech bubble collapsed in 2000; and then kept low as funds flowed in from the 'savings glut' in East Asia. But here we focus on factors specific to US housing finance to see how subprime mortgage lending, sponsored by misguided policy, could be fanned to bursting point by febrile financial innovation.

The objective in revisiting these issues is not to allocate blame; rather to see how a repeat may be avoided. If the problem was essentially a panic, for example, as Gary Gorton (2009, 2014) and others maintain, the remedy would be ample provision of liquidity. But if, as Mian and Sufi (2014) contend, policy-makers were using the provision of cheap credit as an elixir to cure growing income inequality – and shadow banks 'joined the party' with sophisticated products that would only work when house prices were rising – the analysis and policy response needs to go far deeper. To start with, however, we must provide some institutional and policy background.

Housing finance: getting onto the housing ladder

The development of US banking in the late twentieth century, according to Calomiris and Haber (2014), involved a 'bargain' between banks and society: banks were permitted to merge and grow so long as they promoted home ownership for low-income mortgage applicants.

> Once branching limits were removed, bankers had ambitious plans for mergers. Their plans were, however, subject to a political constraint: they needed to be judged good citizens of the communities they served in order to gain approval from the Federal Reserve Board. Good citizenship came to be defined as being in compliance with the 1997 Community Reinvestment Act (CRA) ...For activist groups seeking to direct credit to their memberships and constituencies, the good-citizenship merger criterion was a powerful lever in negotiations with merging banks. The bankers and the activists forged a coalition that consolidated the American banking industry into a set of megabanks that were too big to fail. Calomiris and Haber (2014, p.208)

Such a deal had the apparent advantage of helping to offset the stagnation of median incomes and growing inequality as earnings at the top raced ahead. Instead of taxes and subsidies to redistribute income, the idea was that those on lower incomes would borrow to get on the housing ladder so – with time and house price appreciation – they could extract equity to increase consumption.

As Calomiris and Haber (2014, p.209) go on to point out, however:

> Other partners had to be drawn into the coalition in order to make it stable. Banks would not make unlimited commitments to their activist partners: CRA loans implied higher levels of risk

> for the bank than traditional mortgage loans. Thus, under pressure from activist groups, Congress began to place regulatory mandates on government-sponsored enterprises (GSEs) that purchased and securitised mortgages... Fanny Mae and Freddie Mac, in particular, were required to repurchase mortgage loans made to targeted groups (i.e. individuals who had low incomes or lived in urban locations that were defined as underserved). In order to meet these targets, Fannie and Freddie had to weaken their underwriting standards.

Under the Clinton and Bush administrations, the mandate for low income housing steadily increased, from 42% of assets in 1995 to 56% in 2004. Indeed, it has been estimated that:

> by 2008, the mortgage giants, the FHA and various other government programs were exposed to about $2.7trillion in subprime and Alt-A loans, approximately 59% of total loans in these categories. ... As money from the government-sponsored agencies flooded into financing or supporting low income housing, the private sector joined the party. ... Unfortunately, the private sector, aided and abetted by agency money, converted the good intentions behind the affordable housing mandate and the push towards an ownership society into a financial disaster. Rajan (2010, p.38, 9)

As discussed above, there had been substantial political pressure to extend home ownership by poorer households: but the subprime share of mortgage market remained around 10% until 2003. With the development of private label securitisation (PLS), however, the subprime experiment in 'dynamic credit enhancement' for low-income borrowers accelerated sharply. As can be seen from Fig. 1, the share of subprime mortgages rose rapidly to over 20% of all mortgage originations in 2006. But when the house price bubble burst, the share of subprime mortgages fell precipitously, with virtually none being securitized.

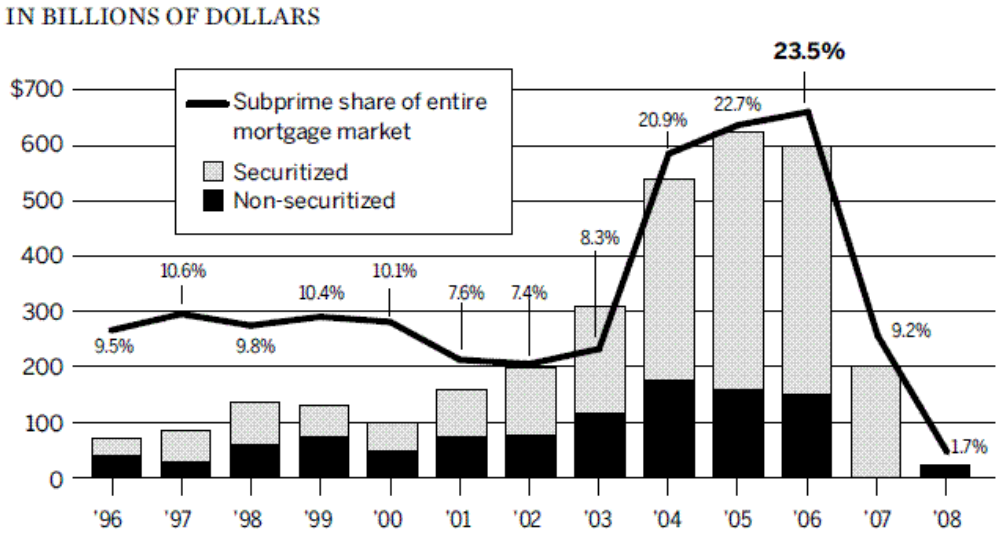


Figure 1 U.S. Subprime mortgage originations.

Source: Financial Crisis Inquiry Commission Report, p.70 Figure 5.2

Could policy makers and regulators not have stopped this vast expansion of subprime lending - by changing the mandates, for example, or by imposing higher prudential capital requirements on such loans? In the view of Calomiris and Haber (2014, p.281):

> they could ... but they chose not to do so. Instead, regulators stood by and watched: in essence they subcontracted regulation of banking to private firms that sold ratings and whose incentives were therefore aligned with those issuers and purchasers, who wanted to have inflated ratings.

If this is an accurate assessment of the policy and regulatory framework, then the onset of financial crisis seems as inevitable as the fate of Santiago Nasar in Marquez's *Chronicle of a death foretold.*

Financial innovation and asset prices

In his celebrated speech at Jackson Hole in 2005, Rajan raised the issue of whether financial innovation was making the world a riskier place. The focus of his concern was on leverage and asymmetric information. But recent theorising suggests that, even without asymmetric information, leverage and other financial innovations can have major effects on asset prices if markets are incomplete. According to Fostel and Geanakoplos (2012), the evolution of housing finance, and of house prices themselves, owed a great deal to the development of new financial products. In their view, the sequential introduction of these financial innovations was, in and of itself, enough to cause boom and bust.

In a general equilibrium model of competitive markets, where investors have heterogeneous beliefs, they show how leveraged lenders can raise the value of securitised assets (and of the properties being purchased); and how, particularly if the risky asset is 'tranched', this will lead to an asset bubble, where 'the asset price is higher than any agent in the economy thinks it is worth!' In their view, the innovation that can trigger collapse is the use of CDS contracts which allow for insurance against failure, so non-asset holders can 'short' investment in risk assets[2]. In their analysis, the availability of such CDS contracts is enough to burst the bubble.[3]

Structure of the paper

After this brief review of the evolution US housing finance and of recent theoretical analysis of the role of financial innovation, we proceed with a focus on two contrasting factors. First is an issue discussed well before the subprime crisis, namely the role of *pecuniary externalities* in investment banking, where value at risk (VaR) rules are used to ensure prudent lending. In Danielsson et al. (2001), Shin and colleagues at LSE gave early warning that the VaR rules of Basel II, designed to ensure prudential behaviour at the level of the individual bank, could lead to systemic instability by amplifying common, 'macro' shocks. Here we use the investment banking model of Shin (2010) to check on the robustness of US-style shadow banking in the face of such shocks. We ask: could the externalities prove sufficiently strong that the simple reversal of good news leads to widespread insolvency and banking collapse?

[2] So-called 'naked' CDS contracts do not require ownership of the assets being 'insured'.

[3] Their simulations show the effect of leverage and tranching could be sufficient to raise asset prices by about a third; but the ability to bet against the bubble could reduce prices by a similar fraction. Fostel and Geanakoplos (2012), Figure 11, R=0.5.

Whether *financial innovation* may be responsible for boom and bust is the theme of the second section of the paper. The stripped-down, general equilibrium model of Fostel and Geanakoplos (2012) is used to provide a wider perspective on subprime developments, and to motivate the macro shocks discussed earlier. Using this framework, the 'good news' shock can be interpreted as a rise in optimism about the prospects for investment in risky assets; and the 'bad news' shock as the introduction of derivatives that allowed investors to divest themselves of downside risk.

In contrast to such pessimism on market structure is the view that the subprime crisis owed its severity to the onset of a traditional *bank run*. This – the so-called 'confidence crisis' view – is the perspective explored recently by Gertler and Kiyotaki (2015). In their Rational Expectations model of banking, moral hazard problems call for equity buffers; and, as in the model of Shin, these lead to the amplification of macro shocks. But they do not lead to crisis and collapse: for that, a run on the banks is necessary. To see how likely a run on the shadow banks might be – and whether it was a matter of mindless panic or misguided product design – is the focus of section three, where we ask: could the switch from partnerships to limited liability investment banking in the US have helped to encourage reckless risk-taking, as argued by Akerlof and Shiller (2015)? Legal findings of mis-selling are a key element of the evidence reviewed.

Section four concludes.

Section 1 Pecuniary externalities and the risk of insolvency

In this section, the Investment Banking model of Shin (2010) and Adrian and Shin (2011) is used to confirm that VaR based regulation is no guarantee of systemic stability. We demonstrate specifically how the representative Investment Bank could become insolvent when a significant upgrade in risky asset quality is followed by a subsequent reversal. Why they might be willing to expose themselves to such risk is discussed at the end of this section.

1.1 Equilibrium with Value-at-Risk

In what we will refer to simply as the Shin model, there are two groups of investors; (1) risk averse agents with mean-variance preferences, who do not use leverage to finance investments such as pension funds and mutual funds; and (2) risk neutral investors, who can finance investments with leverage but are subject to a Value-at-Risk (VaR) constraint. For present purposes, we will treat the latter as homogenous and highly-leveraged investment banks. But, in reality, such active leveraged investors include hedge funds and foreign banks, as well as U.S. investment banks.

There are two assets: (1) a riskless bond with its rate of return normalized to 0; and (2) a risky asset with random payoff Q, uniformly distributed over [q − z, q + z] where q > 0, with moments denoted by:

$$E[Q] = q$$
$$Var(Q) = \frac{z^2}{3}$$

Both types of investors are endowed with initial equity equal to e. Investors' portfolio payoff (end of period wealth) is $W \equiv Qy + (e - py)$, where y represents quantity of the risky asset holdings and p is the price of the risky asset.

Passive investors

Risk averse investors are passive as they cannot leverage to finance their investments. Their 'mean-variance' preferences are described by

$$U(W) \equiv E(W) - \frac{1}{2\tau}\sigma_W^2$$

where τ represents risk tolerance and, since their portfolios comprise of only riskless bonds and risky asset, portfolio variance is $\sigma_W^2 = \frac{y^2 z^2}{3}$. Risk averse investor's optimization thus becomes:

$$\max_y \left(qy + (e - py) - \frac{y^2 z^2}{6\tau} \right)$$

The demand function of passive investors becomes:

$$y_P = \begin{cases} \frac{3\tau}{z^2}(q-p) & if \quad q > p \\ 0 & if \quad otherwise \end{cases} \tag{1}$$

Note that because of the assumption on mean-variance preferences, the demand for risky asset by the passive investors is independent of their wealth.[4]

Active investors: Investment Banks

Risk neutral investors are active as they use leverage to finance their investments subject to a VaR constraint. Specifically, investment banks' optimization is described by

$$\max_y E(W) \qquad s.t. \qquad VaR = (p - q + z)y \leq e$$

where $E(W) = (q-p)y + e$ and the VaR constraint implies the borrowing is no greater than the worst realized payoff on the risky asset, $py - e \leq (q - z)y$. Since $E(W)$ is linear in y, for q > p, the VaR constraint is binding and the demand for risky asset by investment banks becomes:

$$y_A = \begin{cases} \frac{e}{z-(q-p)} & if \quad q > p \\ 0 & otherwise \end{cases} \tag{2}$$

Market-clearing

For $q > p$ and assuming that aggregate supply of risky assets is fixed and equal to 1, the market clearing condition $y_P + y_A = 1$ gives the equilibrium price:

[4] In Shin's model, the specific formulation of VaR implies no default ex post as the distribution of q has bounded support. However, if q follows normal distribution, ex post default is possible; so the wealth of the passive investors may be affected. But with these mean-variance preferences, the determination of equilibrium asset prices is not affected.

$$p = q - \frac{z}{2}\left[\frac{z}{3\tau} + 1 - \sqrt{\left(\frac{z}{3\tau} - 1\right)^2 + \frac{4e}{3\tau}}\right] \quad (3)$$

In Fig.2 the demand by passive investors, measured from the right-hand axis, lies below the mean q with a slope reflecting their degree of risk aversion. The demand curve for active investors is measured from the left hand axis, where the kink reflects their initial equity e and the downward slope indicates, not risk aversion, but the effect of the VaR rule: a fall in price allows more assets to be held as there is less risk per asset $p - (q - z)$ to be covered by this equity. Given the parameter values indicated, market-clearing equilibrium is at A, where the schedules intersect. The equilibrium price lies 'within the band' between q and $q - z$ where initial equity can cover the maximum expected risk exposure on the balance sheet of the leveraged investors.

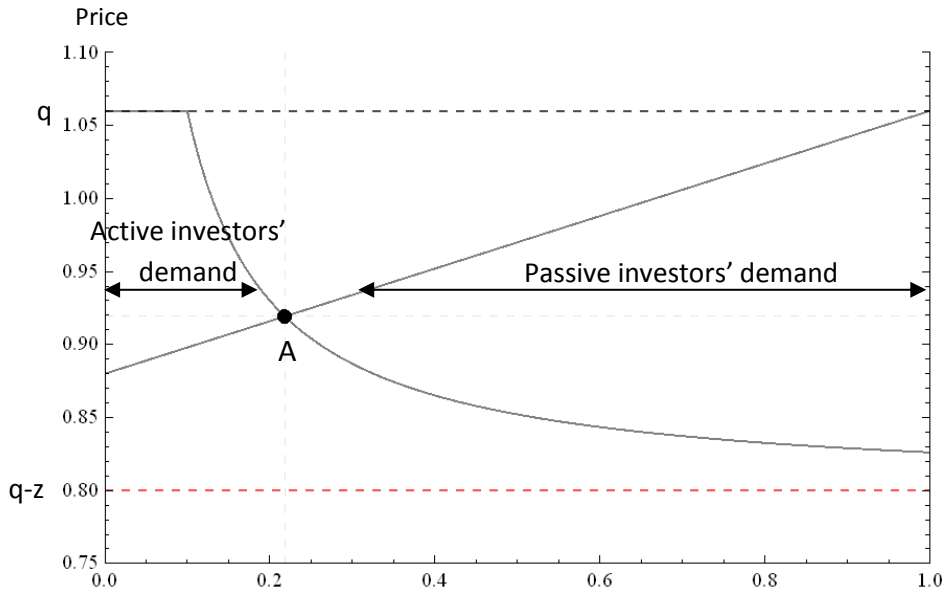


Figure 2. Market-clearing price of risky assets (q=1.06; z=0.26; τ=0.125; e=0.026)

Estimating how this equilibrium will shift if there are unanticipated shifts in expected return q or in the maximum downside risk the asset quality involves taking account of the impact of price changes on the equity of the leveraged investors. In this framework, the effect of such 'macro' shocks (i.e. those which affect every bank) will be amplified by pecuniary externalities. Each bank responds to the parametric shift, taking the price of risky assets as given: but this will change asset prices and, as asset prices are marked to market, the equity base of the banks. The system-wide responses to these price changes give the amplification.

Effect of exogenous shocks raising asset quality

How to determine the ultimate effect taking these externalities into account? To derive this formally, note first how, with mark-to-market gains following an improvement in asset quality, the previously binding VaR constraint is relaxed and the new equity level of active investors is given by:

$$e' = p'y - (q - z)y \quad (4)$$

where $p'y$ denotes assets revalued at new prices and $(q-z)y$ is pre-existing level of borrowing. The increased equity value allows active investors to take more risky assets onto their balance sheets. These expand until VaR constraint is again binding, so:

$$e' = p'y' - (q' - z')y' \tag{5}$$

where *y'* denotes the new optimal holdings of risky assets held by active investors, and the improved asset quality is indicated by $q' > q,\ z' < z$.

For the holding of risky assets by active portfolio managers, equations (4) and (5) imply the expanded level of asset holdings following such favourable shocks is:

$$y_A{}' = y_A\left(1 + \frac{(q'-q)-(z'-z)}{p'-q'+z'}\right)$$

or

$$y_A{}' - y_A = y_A\left(\frac{(q'-q)-(z'-z)}{z'-\frac{z'^2}{3\tau}(1-y_A{}')}\right) \tag{6}$$

given the market clearing condition, $y_P{}' + y_A{}' = 1$.

The effect of an improvement in the mean from q to q' with and without marking to market is discussed in Annex A: the effect of a contraction of downside risk as *z* falls to *z'* is considered next.

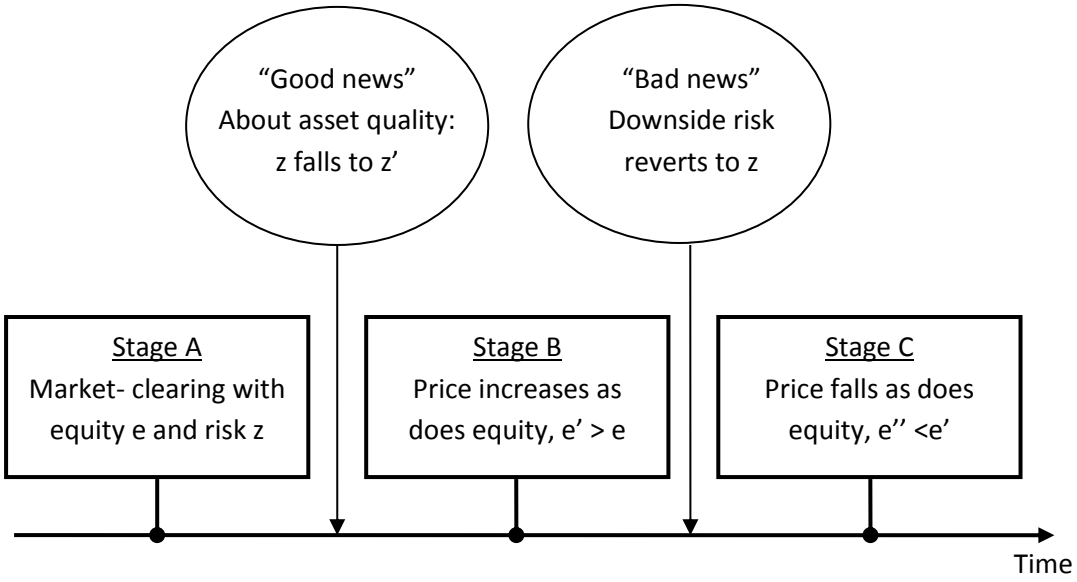
1.2 A test of robustness: a reduction in downside risk, later reversed

How to use this model to capture both the rapid expansion of risky assets held by the banks when subprime-related securities were given high ratings; and how they might respond to a negative shock, such as an increase in the cost of insuring risky assets against failure? (As discussed later, an index was introduced in Jan 2006, the (ABX-HE) index, which measured cost of insuring subprime assets, although the requirement that it be used for 'marking to market' under FAS 157 did not apply until November 2007).

Here, as in Carlin and Soskice (2015), we test the robustness of shadow banking by first introducing a significant reduction in perceived risk; and then, when the equity base has expanded, reversing this 'good news'. In reality, the *unexpected increase in asset quality* that results in perceived risk reduction[5] could correspond to the highly favourable pre-crisis ratings given by rating agencies: while the *reversal of this good news* could reflect the subsequent sharp rise in the cost of insurance signalled by the ABX-HE indices, discussed below. It is important to note that, although the good news turns out to be temporary, marking assets to market effectively treats it as permanent.

[5] Narrowing the 'downside', *z,* of risky asset's payoff, leaving the expected payoff unchanged at *q*.

To facilitate discussion of how two, successive exogenous changes in distribution may affect asset prices - and the equity of investment banks - we outline the timeline of events.



Timeline of events

There are, as illustrated, three stages. In the initial stage, labelled A, with the downside risk parameter z and investment bank equity e, the equilibrium price p is determined along with y, the share of the risky asset held by active investors, as shown at point A in Figures 2, 3a and 3b, for example. After markets have cleared on the assumption of an unchanging future distribution of asset returns, however, 'good news' on asset quality arrives: downside risk has fallen to $z' < z$.

This unanticipated but welcome development leads to an increase in the price of risky assets; and the holdings of active investors also increase. There are two reasons for this: their initial equity e can bear the downside risk on a larger volume assets; and with 'marking to market' there will be an increase in their equity as pre- existing stocks get marked up relative to the riskless liabilities that helped finance them. Conceptually, one could separate these two factors as is done in the Annex for the case of 'good news' on the mean q. In that case there is no expansion in active investors holdings if equity remains at e: all expansion is due to the 'pecuniary externality' of endogenous equity. This is not the case for news on downside risk, so we solve for both effects at one swoop using equation (6) above, with the outcome shown at point B in Figures 3a and 4a, for example (where the latter involves the greater narrowing of downside risk).

By marking assets to market at these higher prices, investors are effectively assuming no change in the future distribution of asset returns. They will be disappointed, however, if as indicated in the timeline, 'bad news' arrives to the effect that downside risk z' has reverted back to what it was in the first stage, namely z.

Given the original payoff distribution, but starting now from the higher equity base (e') achieved at stage B - with larger holdings financed by higher borrowing (p'y'-e') inherited from previous stage - the question is: how much will asset prices have to fall as active investors contract their balance sheets to meet the now-tighter VaR requirements; and will their equity be sufficient to take the hit? We provide two numerical examples of the Shin model responding to the events as outlined. First a small news shock where reversal does not lead to insolvency; then a larger shock where it does.

No bankruptcy

In the first case, using the parameters shown below Fig.3a, the good news shock takes the system from an initial equilibrium at A to the higher price equilibrium at B. Reversal of this positive news shock generates a new equilibrium at C without insolvency*;* though active investors end up holding less risky assets than at A (due to the asymmetry of the mark-to-market capital gains and losses).

Specifically, with 'good news' of a 20% reduction of *z,* shown as a 'narrowing of the band' of downside risk in the Figure[6], there is a shift from initial equilibrium at A (0.22, 0.92) to a new equilibrium at B (0.31, 0.98), with the price of the risky asset increasing by about 6%. Note that at B capital gains from this price increase have enabled Investment Banks to borrow more; and their holdings increase from about a quarter to almost third of all risky assets in the market (from 22% to 31%).

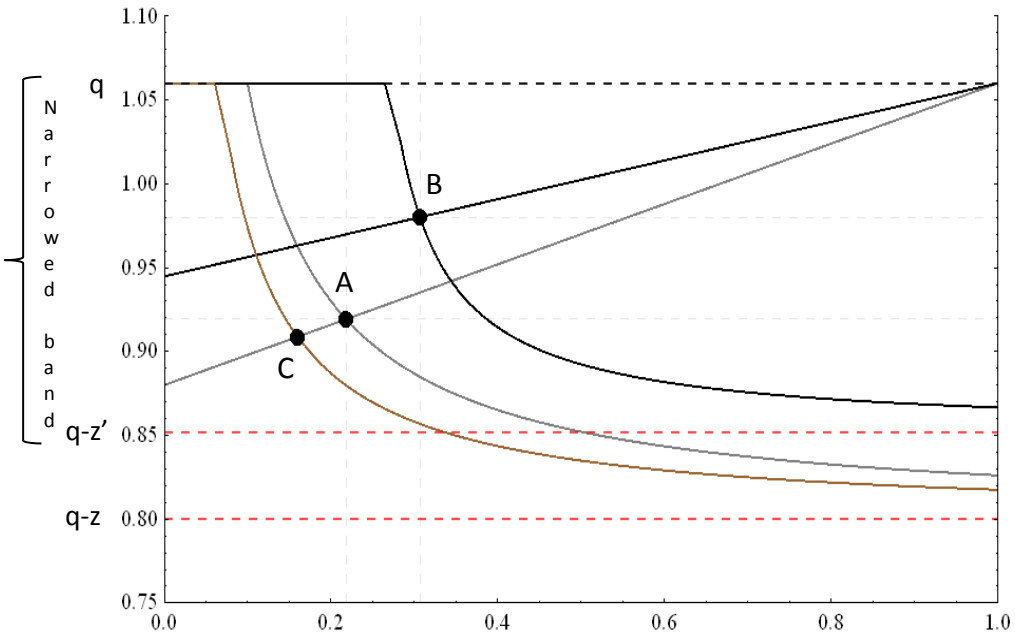


Figure 3a. Good news reversed without bankruptcy (q=1.06; z=0.26; τ=0.125; e=0.026; and z'=0.8z)

What happens if, *starting from point B*, perceived risk reverts back to its initial level (i.e. there is 'bad news')? The drop in risky asset prices will force active investors to cut down holdings of risky assets in order to satisfy the suddenly-tighter VaR constraint, while passive investors will demand a greater risk premium. Allowing for the exogenous shift in the downside risk (from narrow band back to wider band) and the endogenous impact on equity, equilibrium moves to C (0.16, 0.91), where the asset price is a little lower than its initial level at A. Because A lies inside the 'narrow band', however,

[6] from [q, q-z] to [q, q-z']

the equity e' of active investors at B will be sufficient to cover the fall in price (though their holdings shrink to about one sixth of the market,16%).

Insolvency

The reversal of good news can cause insolvency, however. The most straightforward case to consider, as in Carlin and Soskice (2015, pp. 203-210), would be where *the 'narrowing of the band' of downside risk is sufficiently pronounced as to exclude the initial equilibrium price* p_0 (i.e. $q - z' > p_0$); as, for example, if the band narrowed by a half in the numerical case considered above. With the asymmetry of mark-to-market gains and losses noted above, one expects the equilibrium price to fall a little below the initial price on the reversal of the good news. But if the solvency band has narrowed so substantially, such an outcome would take equilibrium 'outside the band' involving losses larger than the maximum sustainable ; so the entire equity of the banks will be wiped out by the bad news.

In the context of a model with uniformly-distributed risk, this would be classified as a 'zero probability' event, an outcome that takes prices lower than the worst they could expect given the downside risk as perceived at B[7]. But the second numerical example to be considered here shows that, *even where a return to the initial equilibrium price would be sustainable* (i.e. where $p_0 > q - z'$), the asymmetry of capital gains and losses may trigger insolvency nonetheless.

Fig.3b shows such a case. We start with the same initial equilibrium as in Fig 3a, but the 'good news' is taken to be a bigger reduction of z, by 40% rather than 20%. Note that although the 'narrowing of the band' is greater than in Figure 3a, the initial equilibrium A still lies *within* the new band. The equilibrium price shifts much more decisively to point B, with the risky asset price increasing by about 10% (from 0.92 to 1.02) and the resulting capital gains allowing active investors to virtually double their market share (from 22% to 41%).

When the upgrade is reversed (i.e. the bad news arrives) and asset values fall, however, the capital losses incurred, as applied to these increased holdings, will lead to insolvency[8]. With active investors leaving the market, passive investors will be left holding all the risky assets (at a price of 0.88).

[7] With normally distributed risk, however, this will have positive - but very low probability - as discussed further below.

[8] Technically, the initial equilibrium price at A is so close to *q-z'* that, when allowance is made for capital losses, no equilibrium is possible with *p'>q-z'*.

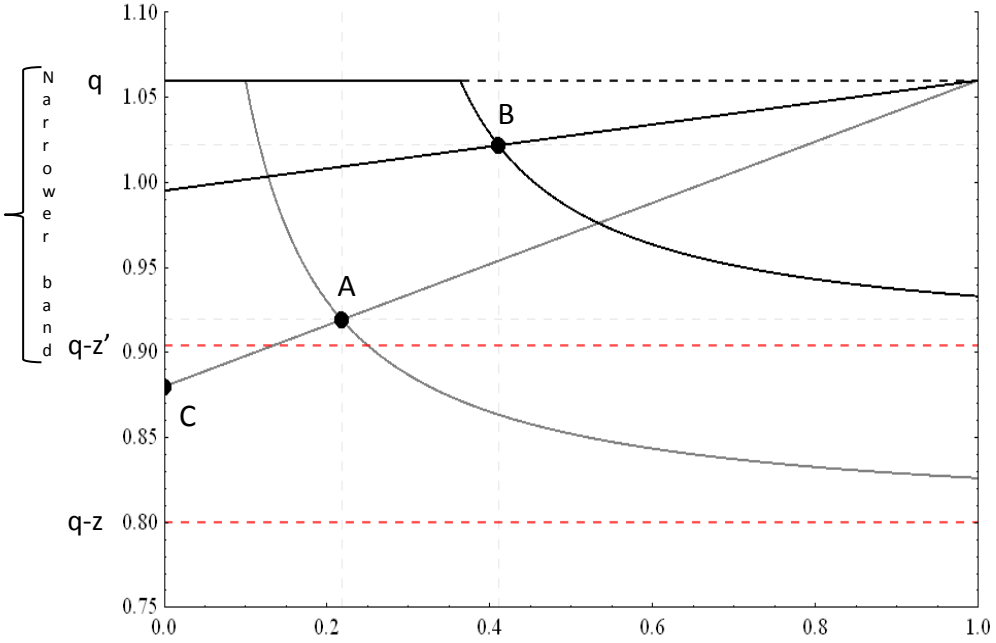


Figure 3b. Good news reversal, with bankruptcy (q=1.06; z=0.26; τ=0.125; e=0.026; and z'=0.6z)

Since the initial equilibrium lies within the new, narrower band, Investment Bankers may be excused for thinking that a reversal of the news would leave them solvent. But with 'mark to market' accounting, implementation of VaR rules does not prevent banking collapse. The asymmetry of gains and losses means that the reversal of good news will take the system 'outside the solvency band' as bad news, amplified by pecuniary externalities on the downside, destroys the equity of highly leveraged investment banks.

Catastrophic behaviour

As just indicated, the tendency of the system to head for a lower equilibrium after a quality upgrade is reversed can be traced to the 'pecuniary externality' that operates when asset prices are 'marked to market'. This accounting practice makes endogenous the level risk-taking by firms which keep their balance sheets at the limits set by VaR. But it operates asymmetrically. While the good news (that the rating agencies have reduced their estimate of the downside risk, for example) has a positive amplification effectapplied to the *initial* level of equity at A, the rescinding of this good news (by a daunting increase in the cost of insuring risk assets against loss, for example) has a negative amplification effect applied to the equity level at B, *boosted by the earlier good news*.[9]

Clearly the effect of rules of accounting can have a marked effect on the dynamic response of the system to exogenous shocks; and, for large enough shocks, it appears that the price of risky assets can exhibit what Zeeman (1974) and Arnold (1984) refer to as 'catastrophic' behaviour – highly asymmetric responses to symmetric movements in exogenous forces.

In the paper we reference, Christopher Zeeman sought to explain the gradual rise in equity prices in a boom followed by the sharp fall in the subsequent crash by the difference in behaviour between 'bulls and bears' – a psychological explanation that Arnold criticizes as rather ad hoc. In the case we

[9] If assets were not marked to market, however, the effects would be symmetric.

are discussing, however, the dynamics are derived explicitly from the 'rules of the game' – VaR rules sanctioned by Basel II to check moral hazard on the one hand; and market accounting regulations (FAS 157 in particular) designed to ensure fair asset pricing on the other.

Distorted incentives?

In their monograph on *Phishing for Phools*, George Akerlof and Robert Shiller (2015) discuss how, with asymmetric information, markets may misallocate risk and resources. Instead of promoting efficient allocation, indeed, markets may be used to generate income transfers – from the less-well-informed to the market-makers to be sure.

They claim that structural flaws in US Investment Banking industry, and in the agencies that provided ratings for the products it acquired, are a case in point. The switch from partnerships to limited liability, prior to the subprime crisis, gave the banks much greater willingness to take risks, they argue. But the degree of risk involved was grossly understated, as rating agencies – skilled in assessing repayment prospects for the debt of corporations and sovereigns – were paid by the banks to give favourable ratings to complex financial products whose properties defied conventional analysis.

The results, they argue, were predictably dire. 'The mortgage-backed securities may have been rated very highly; but they were largely backed by subprime loans with a high chance of default. When it was discovered that these loans were worth a lot less than previously thought, the investment banks were bankrupt' (Akerlof and Shiller, 2014, p.36). This view is also that of David Stockman (2013, p.543), who asserts bluntly that, in the absence of Fed intervention: " Every single investment bank, including Goldman, Morgan Stanley, and the embedded hedge funds at J P Morgan, Citibank and Bank of America would have been rendered instantly insolvent and dismembered under court and FDIC protection."[10]

Financial developments over the course of 2008 seem to support this perspective. For, as summarized succinctly in Sorkin (2009, p.529) and indicated in Table 1 below: 'Each of the former Big Five investment banks failed, was sold, or was converted into a bank holding company. Two mortgage giants and the world's largest insurer were placed under government control. And in early October, with the stroke of the president's pen, the Treasury – and by extension, American taxpayers – became part-owners in what were once the nation's proudest financial institutions.'

Our analysis of the Investment Banking model of Shin (2010) is consistent with such an insolvency view. The model is highly simplified, of course; and the way in which capital gains and losses are calculated may *overstate* the threat to solvency. For it is assumed that capital gains following a positive shock only accrue on the initial holdings of risky assets: all others are purchased at the new equilibrium price. Likewise, for capital losses it is assumed that all the (expanded) holdings suffer capital losses to the full extent of fall in prices: effectively no assets are sold before then. Allowing for trading at intermediate prices would narrow the gap between the gains and losses.

[10] This is something that he advocates as he believes that the outcome would not have affected Main Street.

On the other hand, the simplified model may *understate* the risk of insolvency because, by assuming a uniform distribution, 'tail risk' is omitted. By contrast, with an assumed normal distribution of risk for example, VaR rules do allow for some residual risk to be retained, i.e. insolvency is a (low probability) possibility for each bank. But if a shock in the tail affects all the banks, i.e. the individual shocks are correlated, then pecuniary externalities will lead to amplification, with the initial shock amplified by the associated price effect. If outcomes in the lower tail of the distribution generate pecuniary externalities, then implementing a VaR rule may not prevent systemic crisis – possibly involving widespread insolvency

Section 2 Sourcing the shocks : financial innovation and investor beliefs

In the previous section we have looked at how the price of risky assets, and their allocation between active and passive investors, might respond to industry-wide shocks in the form of good and bad news. Fostel and Geanakoplos (2012p. 190), hereafter F&G, 'propose the possibility that the mortgage boom and bust crisis of 2007-2009 might have been caused by financial innovation. We suggest that the astounding rise in subprime and Alt A leverage ... together with the remarkable growth of securitization and tranching... raised the prices of underlying assets such as houses and mortgage bonds ... [and] that the introduction of Credit Default Swaps (CDS) in 2005, and 2006 brought those prices crashing down.' In this section we use the heterogeneous beliefs approach they develop to provide a general equilibrium perspective, in which the 'good news' corresponds to an increase in optimism; and the 'bad news' to the introduction of CDS swaps which allow for shorting of risk.

F&G assume an endowment economy populated by risk-neutral agents with heterogeneous beliefs, who can trade their initial equal holdings of a safe and a risky asset (whose payoffs in the 'up' state and 'down' state are specified as (1,1) and (1,R<1), respectively) in a competitive general equilibrium. Their focus is on how financial innovations which affect trading possibilities will alter the price of the risky asset.

Given their heterogeneous prior beliefs about the probability *q* of the good outcome for the risky asset, participants can be ordered in terms of increasing optimism, where $0 \leq h \leq 1$ denotes the 'height' of optimism; so q = h, for example; or perhaps $q = 1 - (1-h)^2$.

Without leverage, the solution for the market clearing price, p, of the risky asset *conditional on any given degree of optimism* is given by equating the revenue from sales of the asset to the aggregate expenditure by the more optimistic agents:

$p = (1-h)(1+p)$ so $p = (1-h)/h$

as shown by the schedule NN in Figure 4a. The reason that the market-clearing price is negatively related with *h* comes from the fact that only agents to the right of the NN schedule hold the risky asset; so the same amount of risk assets have be held by a smaller fraction of the population as h increases.

The assumed heterogeneity of beliefs implies a positive relation between the beliefs of the marginal investor and the market price, however. Specifically, assuming that the market price of the risky

asset, p = q+(1-q)R, reflects the beliefs of the marginal investor, this defines the schedule labelled Marginal Buyers Valuation in the Figure. If, for example, q = h, then the schedule is simply

$$p = (1 - h) + hR$$

as shown in Figure 4a. The intersection of this schedule with NN at E_N identifies the marginal holder of the risky asset and determines the equilibrium price for the no-leverage economy.

If agents can borrow, optimists can command a greater share of risky assets. So, with leverage, 'expenditure' on the risky asset by the more optimistic agents only has to cover the downside risk so the market-clearing equation becomes:

$$p - R = (1 - h)(1 + p)$$

This increases the price conditional on any given degree of optimism, as indicated by the schedule LL; and in the new equilibrium E_L the price of the risky assets will increase as a smaller number of optimists will be able to hold them all.

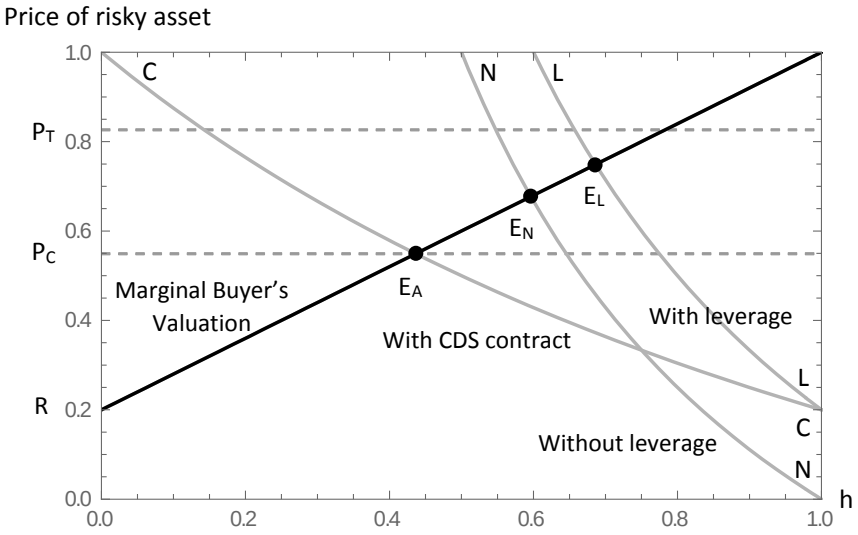


Figure 4a Four equilibria in F&G model, assuming q = h

F&G go on to determine the impact that 'tranching' the risky asset will have. They argue that giving holders of the risky asset the ability to sell the 'down tranche' effectively gives the most optimistic participants access to an Arrow security for the 'up' state (where risk assets have high return); while the pessimists who buy it gain access to an Arrow security for the 'down state' (where risky assets have low return R) [11]. The effect is to raise the price of the risky asset to p_T as shown by the upper dashed line in the figure. Tranching, they argue, enriches the set of securities on offer; but with access tied to asset ownership, it distorts the asset price.

By way of contrast, the price of Arrow securities themselves, assumed to freely available and enforceable without collateral, imply the much lower 'complete markets' price p_C for the risky asset,

[11] Note that for F&G 'tranching' refers to the ex ante creation of Arrow securities, while in normal parlance 'tranching of MBS' (into senior junior etc.) refers to the ex post allocation of losses. The equivalent of a 'senior tranche' which delivers consumption in both states, would require holding both Arrow securities.

indicated by the lower dashed line in the figure[12]. Indeed – and this is the nub of their argument – F&G argue that, where tranching is already available, introducing CDS contracts (which can be used to insure against losses when the risky asset 'fails') has the effect of completing the market.[13] The curve CC in Fig.4a shows market clearing for the down tranches *plus* CDS contracts issued by the optimists and purchased by pessimists. In the resulting Arrow/Debreu equilibrium at E_A, risky assets are held by a larger fraction of the population; and the price falls to E_C to reflect the lower valuation of the marginal buyer.

This model provides a neat way of modelling the sort of 'news' shocks discussed in the previous section. Good news could be treated as an increase in optimism which lifts the marginal buyer's valuation. Take for example a shift in the mapping from *h* to *q*: if, instead of *q = h*, one assumes $q = 1 - (1-h)^2$ this pulls the marginal buyer's valuation upwards for *h* between zero and one. This will give higher equilibrium prices as shown in Figure 4b.

One could interpret the 'bad news' shock as the impact of introducing CDS contracts, which has a marked downward shift on the equilibrium price. For R=0.2, for example, F and G calculate a fall of about a third as between p_T and p_C. Indeed, this is the account of the collapse in the price of MBS that F&G are advocating: that, from artificially high levels prevailing in incomplete markets, they fell to a 'complete market' level.

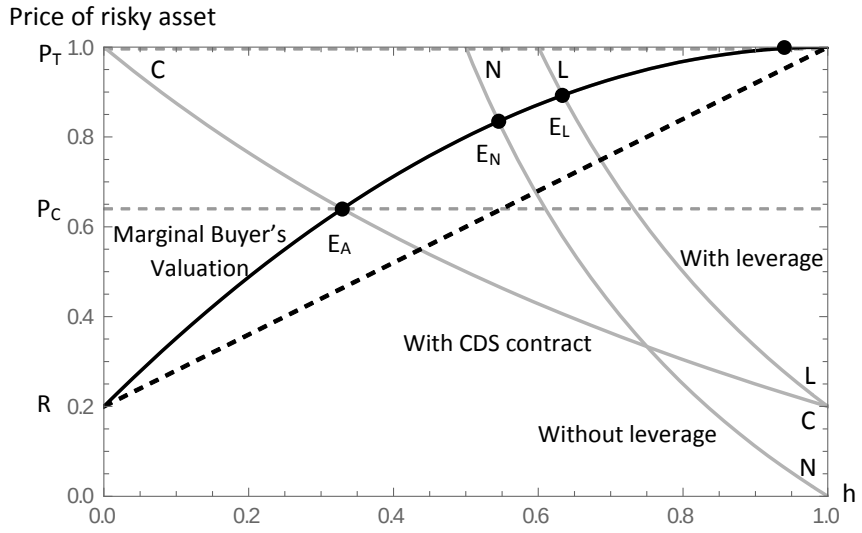


Figure 4b 'Good news' as increased optimism: 'bad news' as shorting

In reality, however, the fall in the value on MBSs, net of insurance against failure, was far greater than one third (as we discuss further below). So, while F&G's ingenious analysis provides interesting insights, particularly on the role of heterogeneous beliefs, its application comes with several caveats.

Most strikingly, there is no bankruptcy in the GE model. This is partly due to technical assumptions at odds with what actually occurred in the subprime crisis. Thus for F&G, all 'naked' CDS contracts

[12] Razin (2014, Chapter 7) provides further discussion of this 'complete markets' outcome.
[13] It is as if the full complement of Arrow securities were available for purchase in quantities desired with all contracts fully collateralised.

are assumed to be *fully collateralised* (i.e. with liquid reserves available to cover all losses): this would be surprising for unregulated OTC contracts-and the spectacular failure of AIG, for example, seems to contradict the assumption[14]. Likewise, despite the failure of Lehman Brothers, all borrowing and sale of down tranches by owners of the risky asset are assumed to be fully covered by downside payoffs. In addition, they do not explore the possible consequences of good news followed by bad news which, 'with mark to market accounting', could lead to insolvency, as noted in the previous section.

In passing, the authors mention the idea that CDS give 'investors the incentive to manipulate markets'; but they assumed that the distribution of beliefs that play a key role is determined ex-ante, i.e. beliefs are *not subject to market manipulation*. But if it's the optimists who go into debt to buy risky assets and drive up their price, would the less optimistic lenders not want to feed this optimism to increase their profits? Is there not a temptation here to 'phish for phools'? Mian and Sufi (2014, p. 149) suggest this was the case: ' home owners mistakenly believed that house prices would rise forever. Perhaps this was a silly belief, but the image of a sophisticated home owner gaming lenders and the government is wrong. If anything, sophisticated lenders may have taken advantage of naïve home owners by convincing them that house prices would continue to rise.'

The behavioural phenomenon which Gennaioli et al. (2012) have dubbed 'neglected risk' – the tendency of investors to ignore certain possible outcomes – also supports such a 'phishing' perspective.

> The key insight is that bankers will create securities that are vulnerable only to those neglected risks. ... For, example, if investors convince themselves that house prices throughout the country cannot fall by 10 percent or more, then bankers will create securities that retain their value in every scenario except when house prices throughout the country fall by 10 percent or more. Because these securities look riskless to investors, they will be produced in abundance. This large expansion in the supply of securities that look riskless will fuel an asset bubble by allowing optimists to buy even more expensive homes. When house prices do in fact fall by more than 10 per cent, the result is catastrophic. Mian and Sufi (2014, p.113,4)

In the next section we look more closely at the marketing of subprime securities, with particular attention to legal decisions on charges subsequently laid for mis-selling.

Section 3 Illiquidity: mindless panic or realistic reassessment?

The 'insolvency' view discussed in Section 1 focuses on the poor quality of bank assets and the excessive leverage and risk-taking involved; the 'financial innovation' perspective, by contrast, focuses on tranching and the introduction of CDS securities as major factors. There is, in addition, a 'liquidity crisis' view, which emphasizes

> excessive reliance on short-term borrowing and the resulting maturity mismatch, the weakness of 'mark to market' accounting rules...and the panic withdrawal of short-term funding that created wide-spread market illiquidity, resulting in undervaluation of assets and the dislocation of money markets where banks normally borrow short term. In short this is a

[14] As the authors acknowledge in their discussion of the CDS market, Fostel and Geanakoplos (2012,p. 193).

> crisis of confidence in the banks, whose assets are not as bad as many suppose, but who are no longer able to borrow short- or long -term and so are forced to cut back sharply on lending. Alistair Milne (2009, pp.18,19).

Following the failure of Lehman Brothers in September 2008, it is argued, ' the crisis mutated from a loss of confidence in institutions pursuing aggressive and high risk business models into a loss of confidence in all banks, with little regard to their actual exposure to potential credit losses. This was a run on the entire banking system of many countries. ...Wholesale funds were withdrawn from banks on a huge scale, and central banks vastly increased their balance sheets as they loaned banks money to replace these lost wholesale deposits.' Milne (2009, p.285)

What banks in general suffered in 2008, it is suggested, is what the investment banks had faced the year before – namely a liquidity crisis. Indeed Gary Gorton (2009, 2014), one of the leading proponents of this view, chose 'The Panic of 2007' as the title of the paper on the subprime crisis that he presented to central bankers and academics at Jackson Hole.[15]

The principal piece of evidence Gorton refers to is the cost of insuring against losses on subprime mortgages, as measured by the ABX-HE indices. From January 2006 onwards these ABX-HE indices were constructed to price traded insurance contracts, each contract providing cover on repayments of a bundle of Mortgage Backed Securities for a period of five years. [16] Figure 5 shows the movements in the BBB and AA versions of this ABX index, reflecting the cost of purchasing investment-grade tranches of twenty major MBS deals.

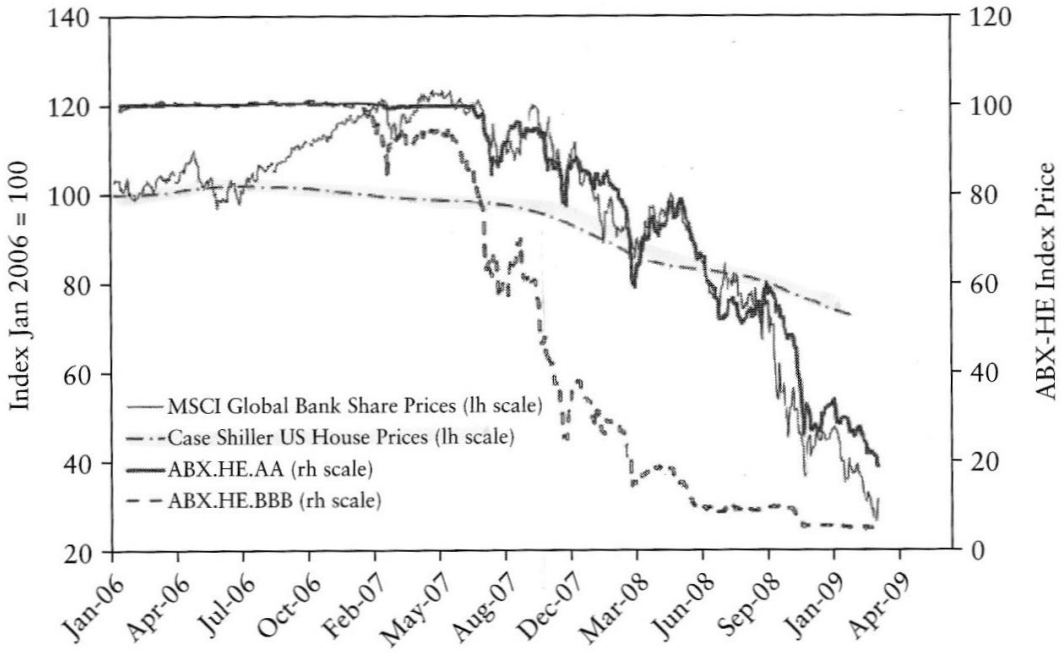


Figure 5 US House prices, ABX indices, and share prices of Global Banks. Source: A. Milne (2009, p. 201)

[15] Later incorporated in his monograph on the subprime market Gorton (2014).

[16] Thus a price of 80 for a particular AAA contract on a given date means that the protection buyer must pay 20% of the par value of the AAA index to get protection for the next five years.

While both the indices shown initially stood at par, the relatively riskier ABX-BBB index began to fall at the beginning of 2007; and *both indices began to fall sharply after August 2007* - the date the Panic began, according to Gorton. Continued precipitous decline took the BBB down to about 5c in late 2008; by which time even the less risky ABX-AA index was down to 20c, implying up-front insurance costs of 80c in the dollar.

Reasons for panic: opacity or product design?

For Gorton (2009, p.199) the main culprit for panic was the 'loss of information' involved in securitisation and the consequent 'opacity' of MBS securities in terms of their asset backing (he states specifically that 'House price declines and foreclosures do not explain the Panic'). But, in commenting on Gorton's paper, Bengt Holmstrom (2009, p. 267) argued that opacity was not the key issue.

> The problem with sub-prime related securities was not the lack of transparency as such... the real problem was the sensitivity of the MBSs to a fall in the average house price. ... *The dynamic credit enhancement model only worked as long as house prices were rising*, a point that seems obvious in retrospect. (Italics added)

For there was a catch to the 'dynamic credit enhancement' on offer: the finance provided when house prices were rising would cease when house prices stopped rising, or began to fall. When those who had been lent the funds found no refinancing was available, they would be unable to avoid the scheduled step-up in rates (possibly doubling); and, if house prices were falling, they would need to post more collateral or pay down the loan: otherwise, they could become homeless as their homes were repossessed.

In circumstances when house prices were already high by historical standards (and Gorton (2009, p. 202) concedes 'it was widely understood that house prices were likely a 'bubble''), aggressive marketing of such loans looks to have two undesirable consequences (a) to push house prices yet higher; (b) to leave as homeless those who were unaware of how and when the finance would effectively be withdrawn when the bubble burst[17].

As the Case-Shiller index of House Prices plotted in Figure 5 above indicates, property prices in main US cities did in fact peak in the third quarter of 2006, and went on to decline by about 30% over the next two and a half years. This – the timing of house price declines – supports Holmstrom's analysis.

The evolution of house prices in the US over the long run also supports the idea that house prices had, in any case, been experiencing a 'bubble' in the years when subprime lending had widened access to house purchase (with Private Label Securitisation lowering credit standards). Figure 6 shows the index constructed by Robert Shiller giving U.S. house prices in real terms since 1880,

[17] Both aspects analysed in considerable detail in Mian and Sufi (2014).

where the spike that developed in the early years of this century is clearly visible (and the other series shown suggest that it was not related to underlying fundamentals).

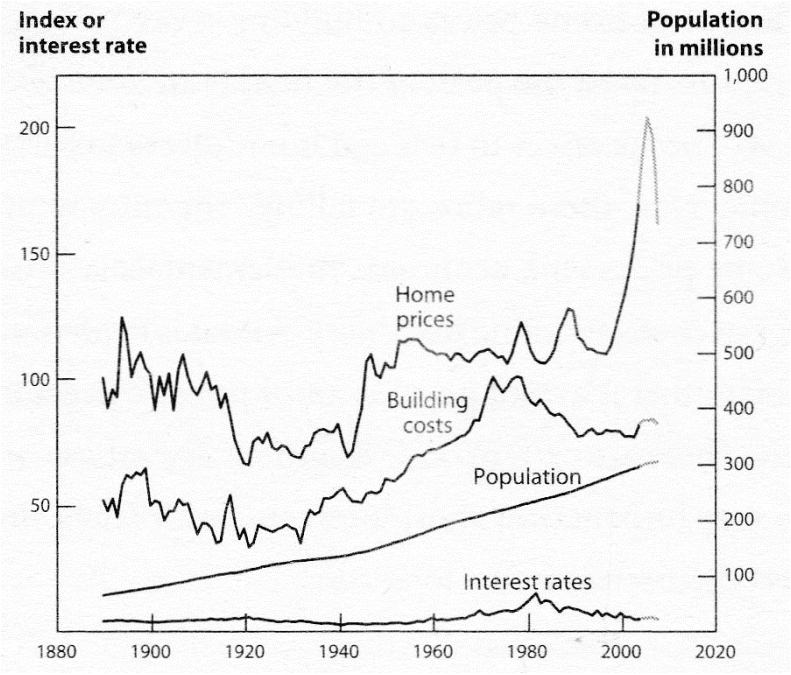


Figure 6 U.S. Real home prices in the long run. Source: R. Shiller (2008, p. 33)

Legal evidence of mis-selling

The ABX indices indicate a 'loss of confidence' in 2007. Was this unreasoning panic; or did it reflect a realisation of failing fundamentals? Strong evidence for the latter has subsequently emerged from the US law courts, in a series of cases on the mis-selling of MBS in particular. The fines levied on investment banks and on the big commercial banks such as Bank of America, J P Morgan and Citigroup amount to $45b, as shown in Table 1 below (of which $8b were levied on the two surviving investment banks, $20b on the big banks that took over Bear Sterns and Merill Lynch.)

The largest fines – and some of the most chilling evidence – comes from the case against Bank of America which, in addition to acquiring Merill Lynch, had earlier taken over Countrywide Financial, the largest lender of subprime mortgages in the US. At a press conference where the settlement against Bank of America was announced, Eric Holder, the U.S. attorney general, is on record as saying:

> These financial institutions knowingly, routinely, falsely, and fraudulently marked and sold these loans as sound and reliable investments. Worse still, on multiple occasions – when confronted with concerns about their reckless practices – bankers at these institutions continued to mislead investors about their own standards and to securitize loans with fundamental credit, compliance, and legal defects.

The 'Big Five' US Investment Banks (as of early 2008)	Size, Assets end 2007	Fate after crisis	'Big Eight' Banks (Current Survivors)	Credit losses and write downs 2007-8	Capital injections October 2008	Subsequent fines for Mis-selling of MBS
Goldman Sachs	$1,120b (26)	Became Bank H Co	Goldman Sachs	$10b (0.7)**	$10b	$5b
Morgan Stanley	$1,045b (33)	Became Bank H Co	Morgan Stanley	$19b (2.1)	$10b	$3b
Merrill Lynch	$1,020 (32)	T/O by Bank of America, Sep, 2008	Bank of America	ML: $73b (7.5) BoA: $57b (1.8)	$25b	$17b (+$37b set aside)
Lehman Bros	$691b (31)	Liquidation, Sep 2008	_	$30b (5.0)	_	_
Bear Sterns	$396b (33)	T/O by J P Morgan, Mar 2008	J P Morgan	$41b (2.8)	$25b	$13b
			Citigroup	$114b (4.0)	$25b	$7b
Totals	$4,272b IBs only			$344b	$95b	$45b

Notes:*Figure in brackets is leverage, Assets / Equity

** Figure in brackets shows ratio of losses and write downs to 2006 pre-tax earnings

Sources: Losses: Milne(2009, p.249); Injections: Sorkin (2009, p.524); Fines: (DoJ web reports)

Table 1 Big Five Investment banks and survivors of the Big Eight: losses, capital injection, fines

Evidence obtained by government investigators suggests that well before the crisis Countrywide was aware of what unsophisticated borrowers were not – that the loans were likely to fail when the real estate market 'deflated'. As a co-founder of Countrywide explained in 2005:

> when the loan resets in five years there will be enormous payment shock and the borrower is not sufficiently sophisticated to truly understand the consequences, then the bank will be dealing with foreclosure in potentially a deflated real-estate market. This would be both a financial and reputational catastrophe. (Email from Angelo Mozilo, to other Countrywide

bank executives, dated August 1, 2005)

Many of the fines were for misleading investors as to the quality of the mortgages that had been securitised and sold on. But what about the homeowners who had been persuaded to take out loans which might well fail? In the case of Bank of America 'part of the settlement requires Bank of America to pay down mortgages for certain home owners; reduce tax payments for others; and pay to demolish abandoned homes in certain neighborhoods to reduce urban blight'. In addition, it appears, 'the bank has also set aside $37.3 billion to buy back bad mortgages from investors'.[18] (Guardian newspaper report)

Capital injections: official purchase of preference shares

Alongside losses and write-downs totalling $344b incurred in 2007/8, the table provides details of the principal capital injections[19] made by the US Treasury in late 2008, running to a total of almost $100b for the banks in the table. For a liquidity crisis, where the investments of the banks are not in question, such capital support is not necessary. But in this case, when house prices were already falling, subprime insurance had become prohibitive, and the MBS market had essentially closed down, and losses amounted to a third of a trillion dollars, solvency support was considered essential.

Does the fact that these capital subventions have subsequently been repaid prove that all was well – that the investments were, after all, well-judged? On the contrary, the string of prosecutions provides evidence that there had been mis-selling on an industrial scale: and the banks that were fined are the same as those getting support from the Treasury.

The 'loss of confidence' reassessed

There is no question that there was a 'loss of confidence' in the business of subprime mortgage lending, starting in 2007. The nation-wide policy of helping low income households by getting them to take highly-levered positions in housing at prices at or near peak levels was surely misguided. But there was, it seems, widespread connivance in a policy which commanded political support when house prices were rising. With the lowering of lending standards and the widespread mis-selling of mortgages, however, the highly-levered poor were first in line to lose their homes when the bubble burst [20].

If, as is widely agreed, the rating agencies had been offering ratings that were misleading as to the nature of risk involved in subprime lending, one would expect adverse market signals to lead to some correction. Indeed, as soon as house prices stopped rising, CDS contracts provided negative signals as to the quality of MBS. This is not to deny that the coming-into-force of the new "mark to market" accounting regulation (FAS 157) in late 2007 led to an exaggerated response, with risk being

[18] It would be interesting to see how these redress procedures compare with those set by the Financial Conduct Authority for UK banks who had mis-sold interest rate swaps to small and medium enterprises, as described on www.the-fca.org.uk/consumers/interest-rate-hedging-products

[19] Enforced purchases of preference shares.

[20] As Mian and Sufi (2014) point out, the rise in home ownership achieved through this policy was reversed when prices fell.

greatly over-priced. As Razin (2014, p. 200) describes it, “Lending institutions were abruptly required to write their illiquid mortgage asset down to rapidly falling current values, forcing them to sell securities to raise capital and generating a vicious downward credit spiral”.

Gorton talks of a collective ‘loss of confidence’ hitting the banks when the bubble burst; but the legal evidence and the fines imposed indicate that the investments did not deserve confidence that they had enjoyed! They had been involved in selling derivative-style products to low-income households without explaining the downside risk, and mis-selling the resulting mortgages to other financial institutions.

If the banks were able to profit from mis-selling derivative-type products as the housing bubble grew, it is something of an irony that that introduction of CDS contracts should have brought things to a head. The ABX index not only revealed how risky the loans might be; it also allowed for betting against the bubble. As the saying goes: those who live by the sword die by the sword.

Contagion

Holders of the ‘liquidity crisis’ view argue that, by retaining only super- senior tranches on their books, investment banks were immune from insolvency risks. But, as Shin (2010, Chapter 8) points out, the prevalence of interbank lending and borrowing provides a channel for contagion: the liquidity shock suffered by a bank with good assets may be the consequence of withdrawals by another bank suffering equity losses from poor asset quality (causing it to reduce its balance sheet). In other words, one bank’s liquidity shock could be another’s solvency shock.

Section 4 Conclusion: innovation, illiquidity – or mis-selling?

Using an ingenious GE model including financial derivatives, F&G claim that the historical sequence of financial innovation in the U.S. was the key factor driving boom and bust in the subprime crisis. In the light of cumulative legal evidence, however, we have argued that the real culprits were mis-information and mis-selling.[21] We have also shown how, given mark to market accounting and the usual VaR conventions, highly leveraged investment banks [22]could face insolvency due solely to changes in fundamentals: a simple reversal of good news on the perceived quality of risky assets could be sufficient.

Given their defensive strategy of acquiring senior tranches of MBSs, however, it can and has been argued that investment banks were well protected from insolvency. But, as Holmstrom put it, the blunt fact of sub-prime financing is that ‘ the dynamic credit enhancement model only worked as long as house prices were rising’. So when the housing bubble burst it was almost inevitable that banks heavily invested in such products would be in serious trouble – either because they held as assets which were call-option style products collapsing in value; or because of a roll-over crisis. Even banks holding senior tranches of MBSs were subject to contagion from roll-over failures by others holding lower grade tranches.

[21] Accompanied by a ‘silent bank run’ – i.e. the rollover crisis which occurred when the true quality of ‘fundamentals’ became apparent.

[22] Table 1 gives figures for leverage in 2007. i

Interestingly enough, a recent proposal by Mian and Sufi (2014, Chapter 12) is that *appropriate* financial innovation may be the key to preventing a recurrence. They argue that standard mortgage contract, which 'forces the borrower to bear the full burden of a decline in house prices until his equity is completely wiped out, be replaced by Shared-Responsibility Mortgages (SRM). An SRM has two important differences: (1) the lender offers downside protection to the borrower; and (2) the borrower gives up 5 percent capital gain to the lender on the upside'. The risk sharing involved in such contracts keeps the loan to value ratio stable even when house prices fall: it should also make lenders more cautious about lending into the boom – and so limit house price volatility.

Insofar as the subprime experiment was designed to give marginal borrowers access to housing, it must be judged a spectacular failure. Far better to provide explicit subsidies; e.g. government matching of down-payments by new homebuyers as Calomiris (2009, p. 29) suggests; or promoting the introduction of SRM contracts as Mian and Sufi recommend.

One moral of the subprime tale is that financial innovations are peculiarly prone to mis-selling. Against those who say it is all past history, and tomorrow is another day, there is the warning of Santayana – that ignoring the lessons of the past is to invite a repeat performance.

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Annex A

How price changes amplify common shocks: effect of a quality upgrade

The case of a perceived improvement in asset quality which affects the mean of the distribution neatly indicates the impact of marking to market as a pecuniary externality . So, as in Shin (2010, p.33), let the *mean* of the risky asset payoff increase from q to q’ without any change to the *downside risk* of the uniform distribution, which remains at z. Without marking to market, this will lead to an upward shift in the demand for both active and passive and investors; as illustrated by the shift from A to B in Fig A1. The price of risky assets will rise in response to the good news on quality, without any trading: so there is no change in the holdings of the active investors.

When prices are marked-to-market by the leveraged institutions, however, the rise in their equity will allow them to expand their holdings. The effect in equilibrium is captured by shifting the demand by the banks further to the right. Allowing for the pecuniary externality, equilibrium shifts from A to C, with risky asset holdings by the active investors expanding by $y_A' - y_A$, as described in equation (6).

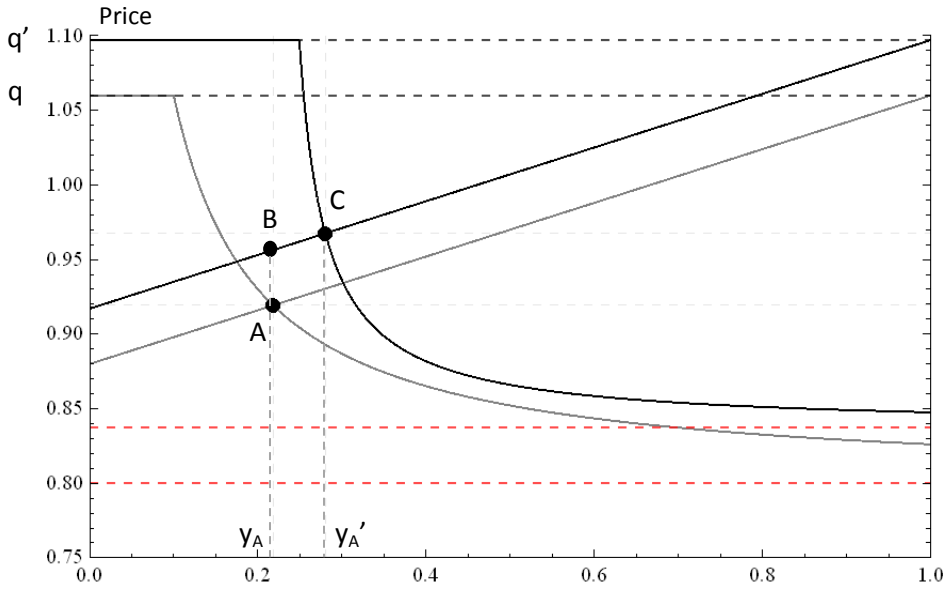

Figure A1. Increased market share of active investors with 'good news' on mean return