Lessons Not Learnt: From the Collapse of Long-Term Capital Management to the Subprime Crisis

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Abstract The subprime crisis was largely unanticipated as the efficient market hypothesis held sway and the Gaussian techniques used to rate Collateralised Debt Obligations were assumed to have diversified risk and reduced systemic risk. However, as this paper argues, many of the shortcomings stemming from these assumptions, together with the consequent economic policy of 'light regulation', were clearly revealed by the collapse of Long-Term Capital Management in 1998. This nearly brought about the collapse of the US banking system and gave a clear practical demonstration that the economy is non-ergodic. The paper discusses the collapse of Long-Term Capital Management and shows how the lessons derived from that crisis were not learnt. It also highlights the dangers of assuming that uncertainty can simply be treated as risk, as the Post-Keynesians have long argued. Furthermore, it argues, following Akerlof (2007), that case studies can be just as, or indeed more revealing than, econometric testing.

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Introduction

Reinhart and Rogoff (2009) entitled their authoritative analysis of eight centuries of financial crashes *This Time is Different.* It reflects their conclusion that, until an often relatively small incident triggers the collapse of a speculative financial or housing bubble, there is little realisation that it is imminent, or indeed, likely to occur at all. The experience of past bubbles can be discounted as ‘things have changed’, or so many policy-makers and financiers believe. Financial markets, the argument continues, have become progressively more sophisticated with innovations in financial instruments to manage risk more effectively and the presumption that a rapid rise in the price of assets merely reflects changes in the underlying economic fundamentals. The subprime crisis of 2007 was, in this respect, no exception. The IMF in its *World Economic Outlook* (2007) saw, only five months before the collapse, “global economic risks as having *declined* since our last issue in September 2006” (p. xii, emphasis in the original). Bezemer (2009), for example, could find only ten economists who forecast the likelihood of a crash on the scale that actually occurred, although he restricted the list to those who used an explicit economic model.[1]

But at least in one respect this time *was* different. While previous post-war financial crises in the OECD countries have been associated with downturns in economic activity (*World Economic Outlook*, 2003 and Reinhart and Rogoff, 2009) none, with the exception of the Nordic countries at the beginning of the 1990s, had carried with it the risk of a complete collapse of the banking system. Certainly few economists, prior to the subprime crisis, predicted that the world’s most advanced country with the leading innovative financial system would teeter on the brink of a banking crisis.[2]

It is shown that the fundamental cause of the collapse was the uncritical acceptance of the efficient markets hypothesis (EMH) by the most influential US policy-makers, including

[1] These included Roubini (see Roubini and Mihm, 2010) and Godley, (2007a and b). The latter used a Post-Keynesian flow-of-funds analysis that explicitly includes the interrelationship of the financial and real sectors, unlike the mainstream dynamic stochastic general equilibrium model which consequently could shed no light on the subprime crisis.

[2] One exception was Rajan (2005) who based his analysis on an extensive knowledge of changes in the operation of, and incentives within, the banking and financial sector which, he concluded, could lead to substantial financial problems and even the freezing of the inter-bank market. Rajan was Chief Economist at the IMF. Not only were his warnings ignored, but when he presented his paper at the 2005 meeting of Central Bankers at Jackson Hole, Wyoming, his views were described as “luddite” by Summers (Ferguson, 2010).

the then chairman of the Federal Reserve Bank of New York (Federal Reserve), Greenspan and the consequent 'light' regulation of the financial markets that effectively started in the late 1990s and continued to the present time. The EMH by then had turned into an axiom, or at least a Kuhnian paradigmatic pseudo-assumption that was untestable by fiat.[3] (See McCombie and Pike, 2010, for a discussion of Kuhn's concept). Keynes's emphasis on the pervasive nature of Knightian 'uncertainty' rather than 'risk', especially in the financial markets and in the work of Post-Keynesian economists that emphasised the non-ergodicity of capitalist economies (Davidson, 1982-83, 1991, 2008a, 2008b, 2009a and 2009b) were implicitly seen as irrelevant.[4] New financial techniques and instruments arising from the work of, *inter alios,* Merton (1973) and Black and Scholes (1973) had by the 1990s putatively enabled risk to be hedged and the possibility of extreme adverse events to be nullified (for a review see Jarrow, 1999). The watchword was that financial markets needed only light, or perhaps no, regulation at all.

However, in this paper, it is argued that the warnings about the developing and inherent fragility of the US financial system were there to be seen. (This is a companion paper to Allington *et al*., 2011). The most notable warning was provided by the collapse of the hedge fund Long-Term Capital Management (LTCM) in 1998 and this is examined here as a case study. It is a particularly important episode, because Scholes and Merton (winners of the Memorial Nobel Prize in Economics in 1997) were partners (with nine others) in LTCM and its likely bankruptcy was viewed by the Federal Reserve at the time as endangering the already precarious US banking system. Yet the lessons went unheeded. There was no major change in the regulation of hedge funds or similar financial institutions despite the recommendations of the Report of the President's Working Group on Financial Markets (RPWGFM, 1999). Nor did the collapse have any major influence on the continuing development of increasingly sophisticated and ever more complex financial instruments. The faith of influential policy-makers in the EMH remained unshaken. The securitisation that rapidly developed in financial markets after the collapse of LTCM, far from diversifying 'risk' as the conventional wisdom held, actually increased the overall degree of 'uncertainty' inherent in the valuation of these

[3] Strictly speaking, the EMH can only be tested as part of the joint hypothesis that markets are efficient and there is an equilibrium in expected returns, i.e., the asset-pricing model holds (Fama, 1991). While there have been a large number of attempts to test this joint hypothesis (with, for example, numerous disputes over the correct econometric specification), in some quarters the EMH has reached a stage where it is assumed to be incontrovertibility correct, especially in policy discussions. For Fama's dogmatic views based on the EMH, see Cassidy (2010).
[4] The ergodic hypothesis is a classic example of Hume's (1888) principle of the 'fallacy of induction'.

securities. Thus the lessons that were not learnt from the collapse of LTCM and how this neglect led almost inevitably to the subprime crisis are the key issues examined here.

One of the important methodological lessons for macroeconomics that emerges from this analysis is the need for a detailed understanding of the underlying institutional framework. This reflects the concerns articulated by Akerlof (2007, p.28) when he wrote that "in contrast to reliance on statistical testing, disciplines other than economics typically put much greater weight on a naturalistic approach. This approach involves detailed case studies. Such observation of the small has often been a key to the understanding of the large". Sometimes, a case study sheds more light than any number of regressions. See Summers (1991) for a sceptical view of the power of econometric testing to change preconceived ideas and Leamer (2010) for a more recent critique of the usefulness of econometrics.

The structure of the article is as follows. The next section charts the rise and fall of LTCM to illuminate the failures of the EMH. LTCM's strategy and its failure are then examined in the following section. Next, the EMH and its inability to deal with extreme events is appraised with subsequent sections examining the policy reaction and the implications of securitisation and measures of uncertainty in the build-up to the subprime crisis. Finally, how Value at Risk is measured is shown to be faulty and some conclusions are drawn that may help to frame regulatory policy in the wake of the subprime crisis.

The Rise and Fall of Long-Term Capital Management[5]

The deficiencies and limitations of the EMH were fully exposed in a practical manner by the factors surrounding the collapse of LTCM in 1998.[6] In this section the history of LTCM is outlined.

LTCM was initially a small hedge fund that was founded in early 1994 with relatively little equity of $1.3bn, most of which came from financial institutions and wealthy individuals connected with the industry. The hedge fund incorporated a Delaware limited

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[5] This discussion draws on Edwards (1999), Lowenstein (2001), RPWGFM (1999) and the Financial Crisis Inquiry Report (2011).
[6] There has, of course, been considerable academic criticism of the EMH (Shiller, 2000, chapter 9) although this had not shaken confidence in the concept in much of the financial economics literature.

partnership LTCM, LP., but the Fund, LTC Portfolio, LP., was a Caymans Island entity. By 1997 the equity had risen to $7bn, but by the beginning of 1998 this had fallen to $4.8bn ($2.7bn or 36 percent of its capital having been returned to investors in 1997, to reduce its position relative to the market, without any corresponding adjustment in its investment stance). It had assets of $129bn with a borrowing of a further $124.5bn implying a leverage ratio of 25:1 and the asset base was four times that of the next largest hedge fund.[7] For a few years LTCM offered investors spectacular returns (after hefty fees of 2 percent for administration plus an incentive fee of 25 percent) of 20 percent (in 1994); 43 percent (1995); 41 percent (1996) and 17 percent (1997) before the fund collapsed in the aftermath of the 1997 Asian Financial Crisis and the Russian sovereign debt default a year later.[8] By August 1998, following more losses, the asset base had shrunk to $2.3bn and as its equity base eroded further in September 1998 to $600m, the leverage ratio reached an extraordinary 250:1. At that time the gross value of LTCM's contracts on the futures exchanges exceeded $500bn with a further $750bn on swaps contracts and over the counter derivatives in excess of $150bn (RPWGFM, 1999, p.12). The fund ceased operations in early 2000: it was "effectively liquidated" (Scholes, 2000, p.17) .

The importance of this episode is that there were fears at the time that if LTCM had not been rescued, it could have brought the US financial system to the point of collapse and severely damaged an already fragile world economy, rocked by the Asian and Russian financial crises. Consequently, there was a desperate last minute, but ultimately successful, bailout 'coordinated' by the Federal Reserve, involving the fourteen primary couterparties and creditors who were most exposed in a default scenario (with the conspicuous exception of its prime brokerage firm, Bear Stearns, already highly exposed to LTCM).[9] This amounted to an injection of $3.6bn in new equity reducing the original partner's stake to 10 percent with the consortium taking the remaining 90 percent and assuming operational control. The Federal Reserve was particularly concerned with the contagion effect that bankruptcy of LTCM could inflict, bringing with it the collapse of a substantial number of other US financial institutions. The problem was that normally in cases of bankruptcy, the bankruptcy law prevents the creditors immediately selling any of

[7] At that time a financial institution having a leverage ratio of over 10:1 was unprecedented.
[8] From 1997 to 1994 LTCM's average returns were 30.2% compared with 23.8% from shares on the S&P 500 index.
[9] LTCM estimated that its 17 major counterparties stood to lose between $3bn and $5bn in aggregate.

the firm's assets under their control. In the case of derivatives, however, the counterparties could immediately liquidate *any* assets of the defaulting firm under their control. Edwards (1999, p.201) noted "in the scenario of wholesale liquidation, the fallout from LTCM might have directly threatened the solvency of some major banks and securities firms". However, this might not have been the case with LTCM because the partnership was incorporated in the Cayman Islands and any bankruptcy proceedings would probably have occurred there. The Cayman's receiver could then apply for a Section 304 Injunction prohibiting, even if only temporarily, the liquidation of any collateral in the US pledged by LTCM to its counterparties. Such a delay would have had equally serious financial consequences for the counterparties necessitating a financial rescue.

Although at subsequent inquiries the Federal Reserve was at pains to emphasise that there was no direct government bailout, there is little doubt that the Federal Reserve's intervention had been crucial. Some critics such as Dowd (1999) have seized on this as a major factor that increased the degree of moral hazard (also created by the sharp drop in interest rates that followed the crisis (Haubrich, 2007 and BIS, 1999)), with subsequent adverse effects on the level of risk-taking by financial institutions in the succeeding decade.[10] Indeed, there is more than a grain of truth in this (Kho *et al.*, 200 and Furfine, 2006). But viewed from the Federal Reserves' perspective it was not that LTCM (rather like AIG in the current financial crisis) was 'too big to fail', but rather 'too interconnected to fail'. But the irony is that both the high (and opaque) leverage and the low equity base were major contributory factors to the eventual collapse of LTCM. And yet as the subprime crisis demonstrates, the lessons were not learnt. By 2008, in fact, leverage ratios of 30:1 amongst many financial institutions and not just hedge funds, were commonplace and the potential dangers illustrated earlier by LTCM were ignored.[11]

Long-Term Capital Management's Strategy and its Failure

The EMH assumes that stock prices reflect all the relevant information about those assets, and hence these will only change as a result of new information. As this 'news' is

[10] Bankruptcy counsel for Lehman Brothers, Harvey Miller, argued that hedge funds "expected the Fed to save Lehman's based on the Fed's involvement in LTCM's rescue. That's what history has taught them" (FCIR, 2011, p.58).
[11] Leverage, of course, greatly increases the potential profits. If LTCM had only invested its own capital, its rate of return would have been only 2.45% (Lowenstein, 2001, p.78).

assumed to be random, stock prices will follow a random walk. The hypothesis requires the assumption of rational expectations and, as such, suffers from all the limitations that this engenders (Davidson, 1991). The watershed in finance came in 1973 with the development of the well-known Black-Scholes formula for option pricing. Before then valuation had been based merely on conjectures and rules of thumb. Given the assumption of ergodicity in the determination of stock prices, option prices could, therefore, be derived from the current price and the average volatility. This is in spite of the fact that the options price is contingent upon the future prices of that stock. Using options the dynamic hedging of risk could, it was thought, be effectively eliminated, although at some financial cost.

The basic logic underneath the investment strategy of LTCM is conceptually simple, although not the implementation and, strictly speaking, it was at variance with the EMH. But the method and assumptions used were within the Black-Scholes framework. It is best illustrated through a simple example. Assume two bonds A and B that are initially priced at P_0^A and P_0^B . (For expositional ease the financial returns due to interest on the bonds are ignored.) The price of bond A is expected to rise and so a 'long' position is taken; it is bought at time 0 for P_0^A and sold at time *t* for P_t^A . The price of bond B on the other hand is expected to fall, so a 'short' position is taken; it is sold at the price P_0^B for delivery at time *t* when the price will be P_t^B . A profit will be made as long as

$$P_0^B - P_0^A > P_t^B - P_t^A \qquad (1)$$

Namely, if the prices of the two bonds converge over time. Note that this profit does not depend upon the *overall* performance of the bond market as that risk has been hedged away. Rather, all that matters is that the inequality in equation (1) is satisfied. By selecting this pair of trades, the overall performance of the markets has been hedged, in other words, immunising the outcome from general market movements. In fact, as the price of the bond is inversely related to the interest rate, these could be bonds issued by different governments where the interest rates differ. Thus the method, in effect, is a bet that interest rates will converge over time as markets become efficient or better integrated.

Clearly, if markets were fully efficient, arbitrage would have removed any possibility of making net gains. There is, thus, a certain paradox that the sophisticated mathematical models used by LTCM were based on the EMH and the assumption that prices followed a random walk. This is because the LTCM strategy was based on the assumption that there still remained very small gains to be made as financial markets became progressively deregulated and international capital markets progressively more integrated. These could yield substantial absolute gains if the number and total value of trades were large enough. Also, there were some predictable inefficiencies that could be exploited.[12] Consequently, LTCM's strategy was based on the assumption that substantial profits could be made on very small margins using a high degree of leverage. It was implicitly assumed that over time financial markets would become even more efficient so that the relative prices of different international bonds and other assets would ultimately converge (adjusting for exchange rate changes), leading to substantial total profits.

The 'quants' at LTCM employed powerful Gaussian statistical techniques using past financial data to estimate the most profitable trades and the associated risk. It was assumed that there is always a ready market for the traded assets which could be converted costlessly into cash at an instant. In other words, prices would change in continuous time in small increments, at which time as many trades as the market desired could be made. The probability of a *large* instantaneous change in prices was ruled out *ab initio*, as was the fact that the price of the asset may fall so fast that nobody would be willing to purchase it. Effectively, the possibility of a financial crash where these events inevitably occur was assumed away. (See Davidson, 2008a.)

Underlying the whole approach was the assumption that asset prices are essentially ergodic, in other words they follow a Bachelier-Wiener stochastic process.[13] This

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[12] As one example of this, LTCM exploited the difference in yields between "on-the-run" and "off-the-run" Treasury Bonds. The yield on a newly issued "on-the-run" 30 year Treasury Bond should be the same as a 29½ year Treasury Bond, but in fact the yield on the former was some twelve basis points higher. The reason seems to be the fact that some financial institutions were either so risk averse or bureaucratic that they only wished to hold "on-the-run" Treasury Bills. LTCM therefore expected, correctly, that the yields would converge over time and so purchased $2bn's worth of 29½ Treasury Bonds and shorted an equal value of 30 year Bonds. Thus, the trade was fully hedged so that it did not matter whether the yields moved uniformly up or down. The outcome was LTCM initially made $25m profits on $12m of its own capital (having borrowed the rest of the capital).

[13] This is a Markov process where a small change in a variable is equal to a random drawing from a standardised normal distribution multiplied by the square root of a small time interval. Crucially small changes in the variable are serially independent of each other and follow a random walk. The

assumption allowed precise estimates to be made of the *risk* of the fund losing money. For example, in the first shareholders' report the probability that the fund would lose 5 percent of its value in a typical year was given as 12 percent; losses of 10 percent and 15 percent or more, were given a correspondingly smaller probability. Other columns of probabilities were presented for less typical years and presented with misleading precision. The probability of the fund losing 85 percent of its value in five months, as in fact, it did in 1998, was not reported but, according to the underlying data generating functions used in the financial modelling, would have been once in the life of several universes.

The key to LTCM's modelling was knowledge of the historic volatility of bond prices from tens of thousands of bond prices and it was assumed that the degree of risk could be calculated precisely from these data. As with most financial trades, risk was simply 'volatility around the mean' and, crucially, the volatility was assumed to be constant over time so that it could be estimated from past data. In other words, the data are stationary, which is a necessary, but not a sufficient, condition for ergodicity. The problem was not that this approach was completely wrong. On the contrary, for several months it gave remarkably accurate predictions and earned LTCM high rates of return. The difficulty was not that LTCM used the wrong underlying distribution when markets were normal, but that it could not model the probability of extreme events.[14] This is not to say that it was not known that financial crashes had occurred regularly in the past in both the advanced and the developing countries. While the existence of fat-tail distributions was widely known and debated in LTCM, the problem of these was effectively discounted as LTCM based their trades on its statistical models which effectively ignored the four sigma events.

What caused its downfall was that while behind LTCM's strategy of thousands of trades was the prediction of convergence in sovereign bond; in 1998 precisely the opposite occurred. The 1997 Asian financial crisis that was (mostly) unpredicted, even by institutions such as the IMF, led to financial markets being in a fragile state. But the

financial formulae were drawn from Brownian motion in physics where, without the problem of human agency, the molecules can be assumed to follow a random walk.

[14] For a compelling popularisation of these problems that polemically challenges the Gaussian techniques, see Taleb (2007) and, more importantly, the technical appendix to his book. In particular, Taleb (pp.281-287) sees the failure of specifically LTCM as an "unexpected vindication" of his views.

straw that broke the camel's back occurred in August 1998 when Russia devalued the rouble and declared a moratorium on repaying its Treasury debt. Russian banks which had provided hedging against this event failed to honour their contracts (as they were entitled to do in the face of a systemic failure). Given this unexpected crisis, there was a 'flight to quality' and also to liquidity, as investors unloaded high-risk assets or junk bonds in all the national financial markets with the result that the market for these quickly became illiquid. This panic caused spreads to *widen* which was the converse of LTCM's expectations.

There was a panic in that risk premia in all emerging markets rose rapidly, including those that had little connection with the Russian situation. This led to a herd effect that was boundedly rational on the part of investors. As Keynes pointed out, and is discussed further below, in these situations an individual's judgement is heavily influenced by the actions of others (and expectations are 'conventional').

Even the spread between "on-the-run" and "off-the-run" Treasury Bonds widened as there was a rush to liquidity, even though "off-the-run" Treasury Bonds were regarded as one of the most liquid of bonds. The resulting crisis caused a rapid reduction in LTCM's equity base and the company was unable to borrow more, leading to its collapse, subsequent take-over and restructuring by other banks. Ironically, after the rescue, LTCM made a profit of $700m and the original partners were reported to have received fees of $50m (Pacelle, 1998).

The Efficient Market Hypotheses and the Probability of Extreme Events

The failure of LTCM's strategy was therefore based on the fact that its statistical models could not capture the probability of extreme events, in this case the flight to liquidity following the Russian crisis. It is interesting that Fama (1965), while finding some strong evidence that the return on stocks over the estimation period behaved as a random walk, concluded that the normal distribution was not the best description "….under the Gaussian hypothesis for any given stock an observation more than five standard deviations should be observed about once every 7,000 years. In fact, such observations seem to occur about once every three to four years (pp.49-50)".[15] Nevertheless,

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[15] The econometric tests are not nearly as favourable as some of the proponents of the EMH suggest. See, for example, the discussion in Frydman and Goldberg (2010, pp.16-19).

Lowenstein (2001, p.74) recounts, "curiously, Fama devoted the rest of his career to justifying the EMH. He argued that Black Monday had been a rational adjustment to a (one-day?) change in the underlying corporate values".[16]

The problem of past extreme events was well documented and the simultaneous collapse of international stock markets over the postwar period could hardly be considered as independent stochastic events. And unlike molecules, investors have memories which do affect stock prices. The disadvantage of LTCM's investment strategy was that it functioned as if it was in an ergodic world, where the large data sets on financial assets could, through sophisticated statistical programmes, measure volatility and hence risk. But as Keynes, Knight, Hayek, Shackle and Davidson have all stressed, over an eighty year period there is a crucial distinction between risk and uncertainty. This will be well-known to readers of this journal so only a brief account is necessary here (Davidson, 1982-83 and 1991, Lawson, 1985 and Gillies, 2006).

Risk is based on the assumption of the existence of a well-defined and constant objective probability distribution which is assumed to be known subjectively. Under uncertainty, however, this is not the case. As Keynes (1937, p.214 our italics) noted, in matters of true uncertainty, "…. there is no scientific basis on which to form any calculable probability whatever. *We simply do not know*".

One such matter was the probability in 1996 of a devaluation of the Russian Rouble in 1998 and the probability distribution of the subsequent change in the price of financial assets in the immediate aftermath. The problem is that the mathematical models based on the Gaussian distribution gave good predictions of *relative* asset prices for the environment over which they were estimated, or more strictly, for the time period when the assumptions held. But once a crisis starts, the prospect of substantial losses occurs and uncertainty increases so that this prospect dominates investors' calculations. (A corollary of this is that most econometric tests of the EMH give good in-sample predictions, but very poor out-of-sample predictions.) As Keynes (1937) presciently argued:

> "Knowing that our individual judgement is worthless, we endeavour to fall back on the rest of the world which is better informed. That is, we endeavour to conform with the behaviour of the majority or the average. The psychology of a society of individuals each of whom is endeavouring to copy the others leads to

[16] He made the same argument with respect to the subprime crisis (Cassidy, 2010).

> what we may strictly term a *conventional* judgement. Now a practical theory of the future … has certain marked characteristics. In particular, being based on so flimsy a foundation, it is subject to sudden and violent changes … The forces of disillusion may suddenly impose a *new conventional basis of valuation*. All these pretty, polite techniques, made for a well-panelled Board Room and a nicely regulated market, are likely to collapse" (pp.214-5 our italics).

In other words, Keynes is intimating that the underlying subjective probability distribution that was held by the individual investor collapses, so no well-defined probability distribution now exists. And, Keynes's mechanisms by which judgements are made in the presence of uncertainty have received a good deal of support from recent studies in behavioural finance. Behavioural economics examines how emotion, cognition and a combination of social and psychological factors can have an impact on financial decision-making. Here the EMH does not hold and decision-making more often than not depends on 'rules of thumb' and the psychic costs of non-conformity. See Barberis and Thaler (2003) and Avgouleas, (2009).

Keynes's discussion of uncertainty raises an important question highlighted by Terzi (2010) and Davidson (2010) on the difference between Knight's epistemological and Keynes's ontological uncertainty. In the former, the problem is that there are simply insufficient past observations to derive a probability density distribution that accurately includes the probability of extreme events. However, in Keynes's interpretation of uncertainty *no amount of data* from the past can accomplish this. Knight is postulating that there are deep structural parameters *à la* Lucas and that the omnipotent Laplacian mathematician could theoretically derive the underlying function.[17] In other words, there is a true underlying ergodic structure to the world, which in principle, although not in practice, could be discovered.[18]

However, people's attitudes, expectations and hence actions are endogenous; they are a function of (and also determine) existing institutions which themselves undergo substantial change over time. Consequently, no amount of past data can determine a

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[17] An analogy can be drawn from chaos theory. While chaotic observations are generated by a deterministic relationship, after a short period of time it is impossible to determine what this function is from consideration of the data.

[18] Terzi (2010) suggests that the two interpretations have very different policy implications. For Taleb, the answer is to have robust systems dominated by the survival of the fittest (so there should be no bail outs, etc). However, under Keynesian ontological uncertainty, there is no guarantee that the Darwinian mechanism is the best. "Here, the challenge is to cope with the uncertainty–driven demand for financial assets and the resulting lack of demand in an entrepreneurial economy (p.564).

subjective probability distribution that is a function of changes that occur in the future. In the words of Popper (1957, p.xii) "no society can predict scientifically its own future states of knowledge". The proximate factors causing the banking crisis in the Great Depression were different from those that applied in the subprime crisis and while the macroeconomic effects may have been similar (bank collapses, falling stock markets and the occurrence of a severe recession), the occurrence of the former has no bearing on the subjective probability of the latter occurring. Each time is indeed qualitatively different. The world is non-ergodic, but this does not mean financial crises are a thing of the past. This leads to a crucial criticism of the EMH and the rational expectations hypothesis (REH). The EMH states that the actions of market participants (which must be the representative agent to avoid different forecasting strategies)[18] ensure that asset "prices always 'fully reflect' all the available information" (Fama, 1965).[19] Thus, prices fluctuate around their fundamental or intrinsic values randomly. And both Fama (2009) and Lucas (2010) use the fact that the subprime crisis was largely unexpected as a vindication of the EMH. It was an unforeseen random shock. While Lucas may be correct that the timing and severity of the crisis could not have been predicted, this is not the same thing as saying that the high probability (without being able to assign a numerical value to 'high probability') of a crisis could not have been foreseen. Indeed, it was foreseen by Rajan (2005) and others with a detailed knowledge of the legal and institutional changes that occurred within the banking system and the progressive effects of deregulation.

Moreover, given the above analysis, these were endogenous, not exogenous, contextual changes driven by the increasing acceptance by policy-makers of the EMH and the REH which had been refuted by the evidence. The argument is driven to the tautological position that part of the 'available information' assimilated by (many) market participants, is that the EMH holds. Yet, even if the possible effects of the institutional changes had been more widely known, it is difficult to see how the quantitative change in asset prices from such qualitative contextual changes could have been accurately forecast. Related to this is the argument of Frydman and Goldberg (2010) that with an inherently wide diversity of information, there are likely to be numerous forecasting strategies which will affect the way the available information is fully reflected in asset prices.

[18] See Hartley (1997) and Kirman (1992) for critiques of the representative agent model.
[19] In the strong version of the EMH 'all the available information' means past information, current information and future information, both public and private.

The Keynesian notion of radical uncertainty and the way individuals counteract it is not a retreat to nihilism. Animal spirits do not lead to *random* changes in expectations, but are explicable, albeit at a qualitative level. Radical uncertainty helps explain why certain events have happened, even though in its simplest form it cannot predict them and in this it is at variance with Friedman's (1953) symmetry thesis.

Frydman and Goldberg (2007, 2008 and 2010) have attempted to provide an alternative approach to the REH, based on a microeconomic (or individualistic) approach to macroeconomics. They call this the Conditional Expectations Hypothesis (CEH) and while not citing any of the Post-Keynesian work on uncertainty, they provide a critique of the REH that is very much in this tradition. Furthermore, without using the term ergodic, it is clear they have this in mind when discussing the REH. Thus, "as with the rest of the structure of contemporary (neoclassical) models, the probability distribution of the causal variables (the exogenous shocks) or new information are usually assumed to be time-invariant" (Frydman and Goldberg, 2001, p.8). Even when the REH allows the probability generating function to change over time, the exact form of the new probability generating function is assumed to be known – in other words it assumes a deterministic probability function. Models incorporating REH use an 'overarching probability function' that has a 'sharp prediction' or a unique prediction. But under what they term "imperfect knowledge economics", the formation of forecasts or expectations is subject to learning and is contextual and subject to change. Instead they develop a theory where learning occurs and there are qualitative constraints, so that there is no unique set of expectations. For example, bulls and bears can be modelled so that their expectations about the possibility of a price change move in different directions. (There is not space to discuss this approach further, but it is one possible way of developing a formalisation of Keynesian expectations.)

The Policy Reaction to the Collapse of LTCM

It is a central tenet of this paper that, in many ways, the collapse of LTCM was a forerunner of the subprime crisis and although the context was different, a major cause of both collapses, namely the failure of the mathematical modelling of risk (essentially based on the Gaussian distribution), was virtually the same. While the LTCM debâcle undoubtedly led to an acceleration in the use of the technique of Value at Risk (VaR) and stress-testing, these proved to be totally inadequate in anticipating the next major crash, the subprime crisis. They were still based on the Gaussian distribution. There was very little change in the effective degree of overall financial regulation as a result of LTCM collapsing. See Haubrich (2007) for a critique as to whether or not the Federal Reserve should have intervened and whether the subsequent restructuring of LTCM was the best approach. In particular, the Financial Economists Roundtable Statement (1999) of thirty-one economists responding to the publication of the PWGFM. They record that "given the extraordinary events surrounding the LTCM episode, it is important that government regulators and especially the Federal Reserve, make it crystal clear that hedge fund investors and creditors will have to bear the full costs of their mistakes or misjudgements. Hedge fund losses should be borne by hedge fund investors and creditors and not by other market participants or taxpayers, either directly or indirectly" (p.20).

In fact, quite the opposite occurred.[20] There was the inevitable post-mortem, notably the Hearing on Hedge Funds Operations held before the US House of Representatives, (1998). Here, Federal Reserve chairman, Greenspan justified the strategy taken by LTCM in terms that bordered on hyperbole: "it is [a] really exceptionally and increasingly sophisticated pricing system which is one of the reasons why the use of capital in this country is so efficient. It is why productivity is the highest in the world, why our standards of living, without question, are the highest in the world. I am not saying that the cause of this great prosperity is the consequence of hedge funds… What I am saying is that there is an economic value here which we should not merely dismiss" (US House of Representatives, 1998, pp.93-4). Thus, it would appear that LTCM was caught out by an extreme financial event that was dismissed as unlikely to occur again (ignoring the fact that financial crises occurred in the US and the other advanced countries on roughly a decennial basis).

Spurred on by the good economic performance of the OECD economies during the next decade (the Great Moderation as it was called in the US or the NICE - Non-Inflationary Continuous Expansion - years in the UK) and buttressed by the theoretical arguments of the EMH and REH, the call was for lighter financial regulation. Financial markets worked efficiently, it was argued, without the need for excessive regulation and the

[20] The Hedge Fund Disclosure Act (HR 2924) passed into law in 2000 with an aim to inject more transparency into the workings of hedge funds, but nothing was done to regulate the hedge funds, or similar institutions.

development of ever more complex financial instruments was to be welcomed as they allowed investors with different aversions to risk to be accommodated. Securitisation of assets into different tranches with different putatively known risks, discussed below, could now be constructed using recent developments in financial risk analysis. This, it was held, allowed assets with different risks attached to be held by a wider selection of investors and hence (erroneously as it turned out) reduced the probability of systemic failure.

For example, Greenspan in a speech in 2005 to the National Association of Business stated that, "these increasingly complex financial instruments have contributed to the development of a far more flexible, efficient and hence resilient financial system than the one that existed just a quarter-century ago". Gordon Brown, then the UK Chancellor, at the Confederation of British Industry (CBI) conference in the same year argued that the "risk based approach" to regulation required "not just a light touch, but a limited touch. …. And more than that, we should not only apply the concept of risk to the enforcement of regulation, but also to the design and indeed to the decision as to whether to regulate at all."

Having had a nasty scare in 1998, the financial authorities in the US and the financial institutions promptly forgot the lessons of LTCM, only to be brutally reminded a decade later. In fact, it was only one year later (in 1999) that the Glass-Steagall Act (1933) was repealed at a time when Summers, an absolutist advocate of the EMH was Treasury Secretary.[21] Glass-Steagall had required the separation of depository banks from investment banks and their merger over the next decade undoubtedly exacerbated the severity of the subprime crisis and extended the compass of Federal Reserve guarantees. And just two years after the collapse of LTCM the Commodities Futures Modernisation Act (2001) was passed which effectively prevented any regulatory oversight of the derivatives markets which was a move Summers supported: the justification advanced relied on the EMH.

Nearly a decade after the collapse of LTCM came the subprime crisis which led to the deepest economic recession since the Great Depression. There had, of course, been numerous financial crises in the past. In the advanced countries this was usually the result

[21] This is notwithstanding that Lowenstein (2001, p.74) reports immediately after the crash that Summers told the *Wall Street Journal* "the efficient market hypothesis is the most remarkable error in the history of economic theory".

of the collapse of an asset bubble, most notably a house price bubble or a bubble in equities.[22]

For monetary policy, asset bubbles are a fact of life and there has been a detailed discussion as to whether monetary policy should be used to prick the bubble before it becomes too large (Allington and McCombie, 2005). The consensus of opinion that coalesced around Greenspan's two terms at the Federal Reserve is that it should not. This is partly because of the difficulty in determining, *ex ante*, when a marked rise in asset prices is a bubble and also because the use of monetary policy (in this case the interest rate) is a very crude instrument in this context. It could have undesirable effects on the real side of the economy (a result of the Tinbergen problem of there being fewer instruments than targets). Consequently, in the past the approach has been for monetary policy to deal with the consequences of the bursting of the bubble when it occurs. The collapse of asset prices in the past generally led to a downturn in economic activity although the effects were short-lived and not particularly serious.

This time, however, *was* different. The collapse of the housing market and the way its financing had changed over the previous fifteen years or so, threatened the whole stability of the Western banking system. This was the first time the consequences had been so extreme since the Great Depression and its banking collapses.

This Time it *was* Different: Securitization, Uncertainty and the Subprime Crisis

It is now clear that there were two policy lessons and one theoretical lesson that were ignored following the collapse of LCTM. On policy, the first was the danger of excessive leverage and the second was extensive use of sophisticated computer models that relied on relatively recent historical data and reliance on the assumption of ergodicity. The theoretical lesson was that the EMH is subject to severe shortcomings and the implication that financial markets needed only light, or no regulation, was uncompelling.

[22] Bubbles pose something of a problem for the REH, which has led to some of them being explained as merely changes in fundamentals. For example, it has been seriously argued that 'tulip mania' of 1636/7 in the Netherlands and the South Sea Bubble of 1720 in the UK could not be irrational bubbles (Garber, 1989 and 1990). This is clearly contradicted by any plausible reading of the historical evidence, including contemporary accounts (Baddeley and McCombie, 2001).

The dangers of these omissions were compounded by two further factors. The first was the marked increase in the securitisation of income streams such as mortgage payments. The second was the extensive use of the relatively new technique of Value at Risk (VaR) to calculate the riskiness of a portfolio of asset holdings or the balance sheet of banks and corporations. Both these used statistical techniques based on the ergodic hypothesis and short time spans of historical data. They both failed to give any reliable risk assessment for the impact of a major asset bubble crash such as the house price bubble collapse. And the VaR had been assessed by the institutions themselves rather than an independent authority such as the central bank.

Securitization and Structured Finance

The last decade saw the rapid rise of structured finance where relatively illiquid assets such as mortgage repayments were capitalised into liquid bonds, which can then be sold on by the originator.[23] Consequently, the banks moved from their traditional position where they financed mortgage loans and received interest payments (‘originate and hold’) to one of ‘originate and distribute’ (securitise). This meant that they had less incentive to vet the quality of the loans as the purchasers of the resulting securities would bear all the risk. The assessment of the degree of risk was devolved to the credit rating agencies (CRAs) who did this on the basis of past default rates without the use of any individual assessment of the creditworthiness of the mortgagees. The resulting residential-backed mortgage securities (RBMS) were then used to construct portfolios of collateralised debt obligations (CDOs), which included corporate bonds and other fixed income assets. An additional advantage was that these instruments could be held off the balance sheet, thereby reducing the amount of capital banks needed to hold under Basel II, but where the risk remained essentially unchanged. This is a deficiency within Basel II now recognised in the deliberations that will eventually produce Basel III.

What was seen as the great advantage of these CDOs was that they were composed of tranches, normally ‘junior’, ‘mezzanine’ and ‘senior’ tranches, with different risks attached to each: the junior had the greatest risk associated with them. This arrangement

[23] While the subprime mortgages have attracted most attention, because of the collapse of the housing bubble and the subsequent defaults that triggered the crisis, it should be remembered that many other income streams were securitised. These included credit card debt, student and automobile loans, aircraft leases as well as state and local government revenues (Roubini and Mihm, 2010, p.65).

for diversifying risk, so that investors with different attitudes towards risk could choose between the various tranches, was seen as increasing the efficiency of resource allocation. Although, as is now well established, the CDOs actually had the opposite effect (see below).

To understand why these securities proved to carry far more risk than the CRAs originally indicated, it is necessary to explain the way risk was diversified.[24] Following Coval *et al.* (2009) assume that an income stream of mortgages and, on the basis of these payments, a bond is issued which pays £1 unless there is a default, the probability of which is 10 percent, in which case it pays nothing. Suppose that there is a second bond with the same characteristics. These two bonds are pooled and, for example, two new tranches issued forming a CDO. The high risk or 'junior' tranche bears the first risk of default and pays nothing if there is a default on one, or both, of the original bonds. The risk of this occurring is 19 percent *if the probability of default of the two bonds is uncorrelated.* The 'senior' tranche only suffers a loss after the capital of the junior tranche has been exhausted. In other words, it pays nothing only if there is a default on both bonds. This will occur with a probability of 1 percent, again assuming that there is no correlation between the probabilities of default on both bonds. Thus there is a very risky junior tranche, which sells for a lower price to give a higher risk-unadjusted yield and, say, an AAA senior tranche with an appropriately lower rate of return.

The process of securitisation can be carried a step further if the process is repeated with, for example, two high-risk 'junior' tranches. The resulting senior tranche from this new CDO which is constructed from the two existing CDOs (hence the obligation is called a CDO^2) has a probability of default of 3.6 percent, again greatly below the default risk of the underlying bonds.

Thus, to estimate the riskiness of the CDO, it is necessary to calculate the probability of default on the individual bonds and the covariance of the defaults. Given the complexity of the various transactions underlying the CDOs, noted above, recourse was had to statistical analysis which, of course, relies on the assumption that measures of future risk can be inferred from historical data. Covall *et al.*, (2009) have shown that small errors in parameter estimates here can have significant effects on the calculation of the estimated outcomes, especially on the senior tranches.

[24] For a detailed discussion of securitisation see Ashcraft and Schuermann (2008).

The data used in constructing these ratings only went back a few years, when the house price boom was well underway and the ratings were therefore based on the assumption that house prices would continue to rise. Consequently, while over this period there were defaults on mortgage payments, they were due to individual factors and were not regionally correlated. But once the housing bubble burst and the downturn occurred, the defaults on the bonds became highly correlated and were largely unanticipated by the CRAs. With the bursting of the housing bubble, the correlation of defaults of the various underlying bonds approached unity. And if the correlation is unity, the risk of default on the senior tranche becomes the same as that on the junior tranche, although of course the probability of default on *all* the bonds is likely to increase. (It should be noted that the probability of default on the junior tranche falls relative to the senior tranche.)

The ratings of the senior (and junior) tranches were thus severely downgraded and as many portfolios of CDOs were based on the instruction that a certain, large, proportion of them had to have an AAA credit rating, they were automatically sold with predictable results. Thus there was a complete loss of confidence in the ratings and the market for these securitises collapsed and rapidly became illiquid. Consequently, with mark-to-market valuation, the asset base of the banks which had been forced to take back on to their balance sheets their off-balance sheet CDOs, also plunged in value making the banks first illiquid and later insolvent. The rest of the story is well-known. With increasing Keynesian uncertainty about the value of the banks' assets, the inter-bank money market became totally illiquid and the spread on Credit Default Swaps (CDSs) widened considerably.

Anecdotal evidence in Coval *et al.* shows that the CRAs became very aware of this problem. In particular, they considerably underestimated the probability of systemic collapse.[25] Indeed the structured financial instruments became very complex with CDOs of CDOs (the so-called CDO^2). The use of historical data led to some dangerous and unwarranted assumptions. Coval *et al.* report that Fitch, one of the three CRAs, based its ratings on the assumption that house prices would rise continuously at around 2 to 5 percent per annum as they had done for the last hundred years. When asked what would

[25] There were added problems that the unregulated CRAs were paid by the issuer of the securities and they helped construct securitisation so that the tranches just crept into, say, the AAA band raising acute problems of conflict of interest (see for example Coffee, 2009 and Utzig, 2010). For a discussion of why the CRAs failed to warn of the impending crisis see Eihorn (2008).

happen if "home prices were to decline 1 percent to 2 percent for an extended period of time?", the reply was that Fitch's risk assessment models "would break down completely". The justification of this assumption could be that the downturns in US house prices were largely regional with no US-wide downturn observed during the postwar period, apart from a small decline between 1990 and 1994.

So a collapse in house prices was not unprecedented. However, there was a marked acceleration in house prices from about the year 2000 as interest rates plunged (from 6.54 percent in August 2000 to 1.82 percent in December 2001) and there was plenty of evidence that this was a speculative bubble driven by the change in the cost and availability of housing finance. "Between 1996 and 2006 (the year when prices peaked), the cumulative real price increase was about 92 percent – more than three times the 27 percent cumulative increase from 1890 to 1996!" (Reinhart and Rogoff, 2009, p.207). But the conventional wisdom was that this was no cause for alarm; it merely reflected the lower level of risk that the new financial instruments brought with them.

The Failure of the Value-at-Risk Technique

The second failure that explains why the possibility of a banking collapse arose was from the VaR technique of assessing the riskiness of portfolios. VaR was accepted not only as the industry standard, but it was also used by the regulators (where it became institutionalised) for calculating risk and therefore the required capitalisation of the banks (Jackson and Perraudin, 2001 and *Turner Review*, 2009).

The VaR uses past patterns of price movements to generate a probability density function of potential loses on the asset base over a short, often one-day or a one month, trading period. If the VaR has the probability of 0.05, for say £10m, it implies that the portfolio has a one in twenty chance of losing this amount *or more*. Alternatively, it says 95 times out of a 100, the maximum loss with be £10m *or less*. The VaR depends on there being a well-defined stable underlying probability distribution, i.e., it is ergodic. If it assumes a quasi-Gaussian distribution (where there are fatter tails than with the normal distribution) the risk imposed by the tail is still likely to be very small. Yet as Taleb (2011, p.2) has argued, "knowledge degrades very quickly in the tails of the distributions, making tail risks non-measurable (or, rather, impossible to estimate – 'measure' conveys the wrong impression)". And in a footnote (2010, p.2 ftn.1), "data shows that methods meant to improve the standard VaR, like ‘expected shortfall’ or ‘conditional VaR’ are equally defective with economic variables – past losses do not predict future losses. Stress-testing is also suspicious because of the subjective nature of ‘reasonable stress number’ – we tend to underestimate the magnitude of outliers. ‘Jumps’ are not predictable from past jumps” (i.e., the world is non-ergodic).

The other problem that arises from Taleb’s comments was that the calculations involving the VaR were based on “relatively short periods of historical observation (e.g. 12 months)” and that this “introduced dangerous procyclicality into the assessment of trading book risk” (*Turner Review*, 2009, p.22). If over a twelve-month period the VaR reflects high volatility following a fall in confidence, future liquidity may dry up and hence may increase the volatility in this particular market: a self-reinforcing effect.

Moreover, even if the risk increased, the VaR can lead to it being ignored. Suppose in the previous example, it can be reliably estimated there is a one percent probability of a £100m loss, which will bankrupt the firm. This is outside the 95 percent level which, if it is the decision level, would result in this possibility being ignored. In actual fact £100m was the *least* that could be lost one percent of the time. Furthermore, the VaR could be ‘gamed’ once financial institutions started to report them as a measure of risk. Employees were rewarded not just for the profits they made, but for large profits accompanied by low risk. Thus, they were incentivised to manipulate the VaR by taking asymmetric risk positions, with contracts like CDSs that generate small gains, but rarely sustain losses. But any losses turn out to be very large indeed, although the VaR measure appeared to be low – a small probability of a large loss. The gains from selling CDSs were modest, but regular and there was the presumption that there would never be an insurance pay-out. In this case it was outside the 99 percent probability and outside the VaR. The catastrophe hidden in the one percent did not appear anywhere in the assessment: VaR does not measure the probability of extreme events (like black swans). Rather than minimising risk, therefore, VaR actually increases the propensity of financial institutions to take risks. Particularly when most of the institutions are pursuing the same strategy. As Keynes (1931, pp.176-77) accurately remarked “a sound banker, alas! is not one who foresees danger and avoids it, but one who, when he is ruined, is ruined in a conventional and orthodox way along with his fellows, so that no one can really blame him.”

But the use of VaR carries more problems than this. It gives a false sense of security. It has been argued above that the real world is not Gaussian and extreme events that carry substantial losses cannot be easily given a subjective probability. This is especially true if contagion effects set in and markets are not 'normal', as was the case in the various stock market crashes. The VaR is not designed for and certainly is not able to deal with these, not all that rare, occurrences. In addition and quite crucially in the context of the subprime crisis, VaR did not measure liquidity risk or take into account in a satisfactory way the leverage occurring with the use of options in particular.

Why did the risk management fail? This issue has been addressed by Haldane (2009). He summarised three failures in the stress-testing and risk management. The first he designates as *disaster myopia.* This refers to the behavioural characteristics of agents who attribute a progressively lower subjective probability to an event the further ago it happened. Eventually, the event is given zero probability. Haldane (pp.6-7) suggests that perhaps a decade is "the threshold heuristic for risk managers", given the systemic crashes of 1987, 1998 and the present credit crunch. What is instructive is that the variability (the probability density estimates) of many macroeconomic variables such as growth of GDP, inflation, unemployment, the UK base rate and house price inflation were very much narrower with slimmer tails in the NICE decade than in the full sample stretching back to the nineteenth century. Hence, the view that 'this time it is different'. The problem is that the tails of these distributions, in what are essentially small samples, are much smaller than over the full sample. "If we assumed that the Golden Era (the NICE years) distribution was the true one, the three worst monthly returns in history - the bursting of the South Sea Bubble in September and October 1720 and Black Monday in October 1987 - would have been respectively 12.7, 6.9 and 6.5-sigma events. All three would have appeared to be once in a lifetime - of the universe - events" (Haldane, 2009, p.8). This was precisely the problem with LTCM's financial models, even though the problem of extreme events was well-known.

The second was the problem of *network externalities.* This is where it is necessary to estimate not just the counterparty's risk of failure, but the counterparties of the counterparty and so on. This contagion risk that gives rise to systemic failure is very difficult to calculate. Finally, there are *misaligned incentives.* Within the banks, when risks were perceived to be low, the risk mangers are generally marginalised. A principal–agent problem also arose between the banks and the regulatory authorities. In the NICE years the stress tests were very cursory simply because it was assumed that there was little point to them. If there was a severe shock, all these individuals would lose their bonuses and possibly their jobs and, secondly, the authorities would always step in to save any bank which was assumed to be ‘too big to fail’ or ‘too integrated to fail’. Moreover, investors within the banks had their bonuses, which could exceed their basic salaries, tied to the above-average profits they made, but in bad years they did not have to pay any of these bonuses back. Hence, this asymmetry led to greater risk-taking that in turn led to higher rewards.

In 2009, the *Turner Review* of the UK banking crisis in its section on “Fundamental Theoretical Issues” (pp.39-49) raises serious criticisms of the EMH on which the whole regulatory framework of the UK (and US) banking industry has been based. It noted that efficient markets can be irrational, citing the work of Mandelbrot (2004), Taleb (2007), Soros (2008), the behavioural economists Kahneman *et al.*, (1982) and Shiller (2000). It also concludes, albeit with only a brief discussion, that there was “misplaced reliance on sophisticated maths”, including “short observation periods”, “non-normal distributions”, “systemic versus idiosyncratic risk” and “non-independence of future events, distinguishing risk from uncertainty”. But the writing on the wall had been there from at least 1998, if not before, but it could not be read through the lens of the EMH that dominated the thinking of a few influential policy-makers in the US and the UK.

The resultant meltdown of financial markets has been extensively studied. Overviews are provided by Brunnermeir (2009) and Roubini and Mihm (2010). The problem was that confidence in the rating values of the various CDOs plummeted and given this uncertainty, the market collapsed. With mark-to-market valuation, the valuation of these assets fell sharply, possibly below their intrinsic value, although nobody knew this for certain. But the banks had also bought a lot of these assets and borrowed short to finance their purchases. When the collapse came, they found that given the extreme nature of the financial crisis, there was a reluctance to roll-over this lending. Banks, as a result cut back in turn on their own lending including that to credit-worthy firms. The subprime crisis rapidly became a credit crunch.

Conclusions

In this paper it has been shown that the subprime crisis should have been predictable for anyone with a detailed knowledge of financial markets and the LTCM crisis in particular; all the warning signals were there. Inflation targeting, which is ultimately based on the New Neoclassical Census and rational expectations, assumes that complex financial systems and their relationships can be adequately described through a number of simple regression equations. It was not that inflation targeting necessarily entailed the wrong policy advice, rather it was just that any policy advice it could give was irrelevant and woefully inadequate given the causes of the crisis. The crisis and the capacity of the standard Neoclassical models to deal with it, gave rise at times to a vitriolic debate not just in the academic journals, but also in the broadsheets and on the internet blogs (McCombie and Pike, 2010). For a time, it looked as if there might be a fundamental reshaping of macroeconomics away from the 'toy models' towards an approach that required a detailed understanding of the financial institutions and the impact they have on the macro economy. However, at the time of writing, this hope is rapidly diminishing. The financial history of the last decade has shown the need for policy-makers and regulators to adopt a radical new approach to monetary policy. As the old adage of the philosopher Edmund Burke says "those who do not know history are destined to repeat it." It happened in 1998 and again in 2007 and it is probable it will happen again, in a decade or so, unless the lessons are finally learnt.

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