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Keywords
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Understanding the Global Financial Crisis

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Understanding the Global Financial Crisis

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ABSTRACT

The financial meltdown 2007-08 was a vast and complex event that many analysts are still trying to decipher. The purpose of this paper is to impart an understanding of the global financial crisis with a sharp focus on informed conjectures. To this end, the paper first provides a picture in the large of the financial turmoil 2007-08, and then, singles out contributing factors to the crisis (such as sub-prime mortgages, excessive risk-taking and securitization) which taken in isolation could not possibly explain the collapse of the financial system. The main claims of this paper are the following two. First, no complete understanding of the financial crisis 2007-08 is possible without a thorough comprehension of the interactions among three mutually reinforcing financial innovations, namely: sub-prime mortgage, securitization and re-securitization. Second, the catastrophic financial collapse in October 2008 happened because re-securitization engendered pervasive Knightian uncertainty.

1. INTRODUCTION

The global financial crisis originated in the US financial system (arguably the most sophisticated financial centre in the world), quickly spread beyond America to other countries, and provoked worldwide panic at the end of 2008. By early 2009, the central focus of economic policy was to prevent another 1930s style-slump.

If there is a point of unanimity concerning the financial crisis, it is that the phenomenon in question displayed stupefying complexity. The process of understanding a complex event starts by describing the phenomenon that we wish to comprehend. After the phenomenon has been broadly characterized, it is necessary to reduce the vagueness of the description and discard the inessentials. To this end, we need to employ hard-won notions and results developed by researchers and practitioners that enable us to approach the subject matter in a coherent way and get down to the nitty-gritty. Finally, we identify plausible causes for the phenomenon to occur.

Although I use insights stemming from developments on the formal theoretical front, the explanation of the financial crisis provided in this paper is largely at the level of verbal theorizing or appreciative theory. Specifically, I use elementary empirical evidence based on 'event studies' in parallel with basic theoretical reasoning to explain in the simplest possible terms the financial crisis 2007-08.

Somewhat roughly, the anatomy of the recent financial crisis can be described as follows: an excess of world saving –a *global saving glut*– combined with *monetary excesses* (central banks mistakes leading to excess liquidity) led to a double (housing and credit) bubble, and eventually to a financial collapse.[1]

The classic first step to understand real-world financial crises is to focus on excesses which lead to a financial bubble and an inevitable bust. The second step is much less obvious. Each financial crisis is unique in terms of its causes and the types of financial innovations that it engulfs.

The main claims of this paper are the following two. First, no complete understanding of the financial crisis 2007-08 is possible without a thorough comprehension of the interactions among three mutually reinforcing financial innovations, namely: sub-prime mortgage, securitization and re-securitization. Second, the catastrophic financial collapse in October 2008 happened because re-securitization engendered pervasive Knightian uncertainty. These claims can be condensed in pictorial description (see Diagram 1) that gives a visual sense of the intricacies underlying the recent crisis.

DIAGRAM 1 HERE

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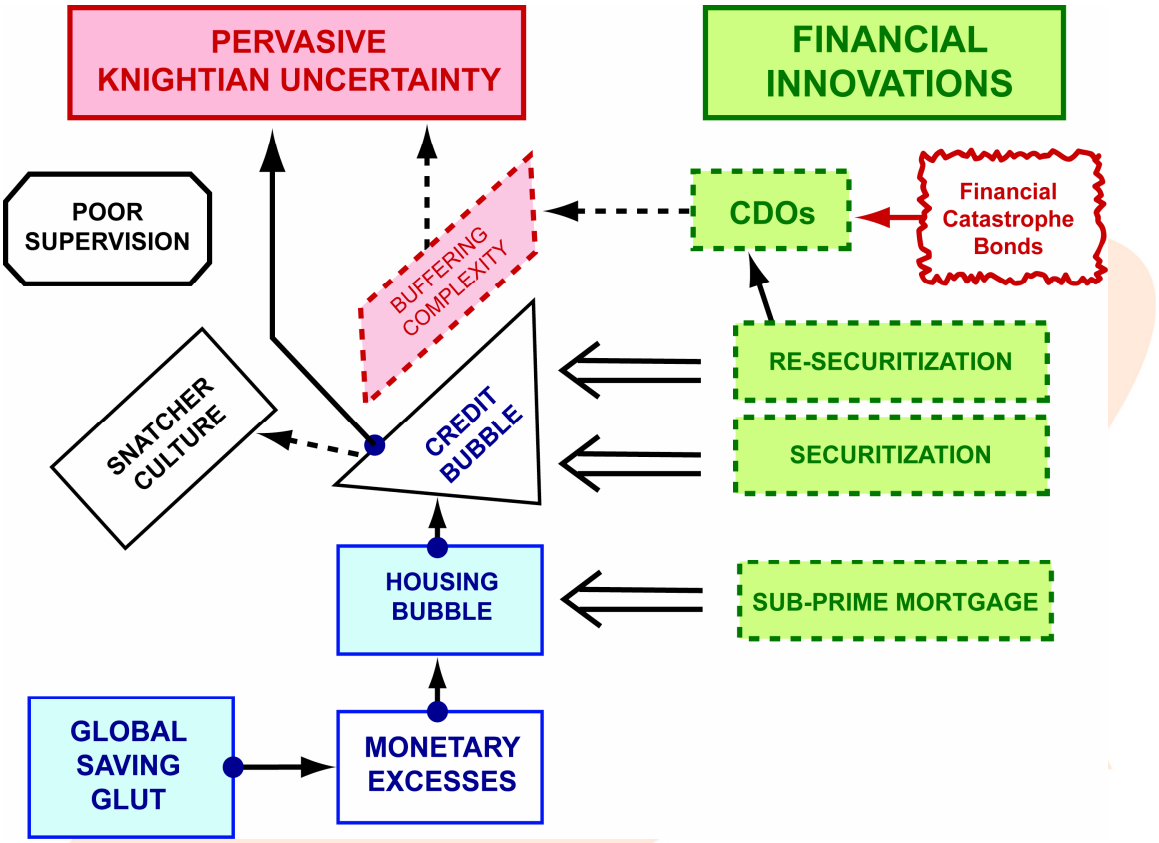

Diagram 1, Anatomy of the financial crisis

The organization of the paper is as follows. Section 2 provides a succinct event logbook with particular regard to the chronological manifestations of the financial turmoil 2007-08. Section 3 sets out specific financial innovation nomenclature (essentially, a triad of definitions) that is useful for organizing thinking about the crisis. Section 4 describes three factors conducive to short-run profit maximization through excessive risk-taking. Section 5 explains the reasons for the incessant increase in Knightian uncertainty. Section 6 briefly discusses the notions of 'shadow banking system' and 'systemic runs.' Section 7 presents a slice of the financial crisis termed 'debt bubble sequence.' The final section offers concluding remarks.

2. AS IT HAPPENED: THE FINANCIAL MELTDOWN 2007-08

The complexity and intensity of the recent crisis in financial markets has surprised nearly everyone. It is the worst financial crisis since the 1930s. As will become apparent, there are a number of factors explaining the financial collapse, including problems stemming from financial innovations such as sub-prime mortgage, securitization and re-securitization.

The origins of the financial meltdown 2007-08 go back at least to the beginning of the new millennium when the surplus of savings generated in one part of the global economy were absorbed by deficits in the developed countries. Initially, these savings expanded investment particularly in information technology. However, following the burst of the Internet bubble investment was cut back drastically.[2] Loose monetary policy by the world's central banks avoided a sharp downturn. In particular, the US Federal Reserve made clear its willingness to pump in liquidity and cut interest rates in case of a deep recession.[3]

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Innovations in the US mortgage market laid the groundwork for the 2001-08 debt bubble. For example, sub-prime mortgage lending rose significantly after the bust of the Internet bubble reaching 20% of total mortgage originations in 2005 and 2006. As sub-prime markets grew, they gave lenders greater access to funding through securitization and re-securitization. In particular, the practice of securitization was one important source of the decline of underwriting standards during the recent past.

Financial institutions were able to make quick profits from changes in investor sentiment. Money market funds demand for AAA-rated bonds for reasons beyond the basic economics of payoffs was fuelled by monetary excesses (loose monetary policy reduces risk-free rates and may induce investors to overpay for higher yielding securities perhaps ignoring the magnitude of the risk factor). Furthermore, financial institutions operating outside the regulated banking system built up financial positions by borrowing short-term and lending long-term. They became vulnerable to non-bank runs, that is, they could fail if markets lost confidence and refused to extend or roll over short-term credit as it happened with Bear Stearns.

The chief financial instruments use to provide the AAA-rated bonds were the *Collateralized Debt Obligations (CDOs).* As reported by The Economist, Mr. John Paulson, a hedge fund superstar, did a sagacious evaluation of the CDOs and found that "It was obvious that a lot of that stuff [CDOs] was practically worthless at the time of issuance." Paulson bet against sub-prime mortgages and personally earnt $US3.7 billion. The Economist (2009b)As will become apparent in section 5, the CDOs were 'catastrophe financial bonds.'[4]

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Liquid markets created tremendous opportunities for profit-seeking financial agents and induced them to maximize profits in the shortest run, irrespective of the high uncertainty underlying the untested financial products. Just a few weeks before the onset of the financial crisis, the then chairman of Citigroup, Chuck Prince, told the Financial Times:

> When the music stops, in terms of liquidity, things will be complicated. But as long as the music is playing, you've got to get up and dance. We are still dancing."
>
> *Financial Times* (9 July, 2007).

The legendary Chapter 12 of the *General Theory*, entitled "The State of Long-term Expectation," reminds us that this sort of mentality resembling a 'musical chairs' approach to business is not new:

> (…) For it is, so to speak, a game of Snap, of Old Maid, of Musical Chairs –a pastime which he is victor who says *Snap* neither too soon nor too late, who passes the Old Maid to his neighbour before the game is over, who secures a chair for himself when the music stops. These games can be played with zest and enjoyment, though all players know that it is the Old Maid that is circulating, or that when the music stops some of the players will find themselves unseated.
>
> Keynes (1936, esp. pp. 155-156)

The money markets difficulties began in July 2007, when two Bear Stearns hedge funds revealed the damage done to their portfolios by sub-prime mortgages. Bear Stearns

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was rescued by the US government and central banks intervened to keep money markets functioning with a series of schemes.[5]

The *Credit Default Swap (CDS)* innovation –due to Blythe Masters of J.P. Morgan– was introduced in 1995.[6] The market for CDS was meant to insure against systemic risk, but instead brought the system to its knees. In fact, the eruption of the sub-prime crisis in July 2007 caused the value of the CDOs to plunge and this, in turn, caused buyers of CDSs on such securities to demand the corresponding payment. These financial instruments are the derivatives that Warren Buffet termed 'financial weapons of mass destruction' in his famous 2002 warning.

The financial crisis became acute on 9-10 August, 2008, when money market interest rates rose significantly. This was seen by the authorities as liquidity problems. On September 6, 2008, the Bush administration took over mortgage lending giants Fannie Mae and Freddie Mac. Nine days later Merrill Lynch agreed to a take over by Bank of America, but on the same day (15 September, 2008) the Federal Reserve and the US Treasury refused to bail out the investment bank Lehman Brothers. Following the collapse of the Wall Street bank Lehman, the financial crisis took a dramatic turn for the worse.

The collapse of the sub-prime mortgage market in the US contaminated the entire financial system due to the existence of a huge amount of CDOs. Financial instruments (or firms) of any type whose failure would pose a systemic risk put fear in the hearts of both investors and regulators.[7] For example, the global insurance giant American International Group (AIG) was taken over by the American government one day after the

collapse of Lehman because it was 'too big to fail'. Through its division AIG Financial Products, AIG took colossal risks as holder of CDSs that could not afford.[8]

The US Treasury Secretary Henry Paulson was the architect of a bailout plan involving $US700 billion to reverse the damaging effects of the credit crunch and avoid a deepening of the financial crisis. Paulson's plan was rejected by the US House of Representatives on September 29, 2008, sending markets into a tailspin and highlighting strong public opposition.

After a series of concessions, the US Senate backed a revised version of Paulson's plan. On 3 October, 2008, the House of Representatives voted in favour of the rescue plan (263-171) and President George W. Bush signed the Emergency Economic Stabilization Act 2008, creating a $US700 billion *Troubled Assets Relief Program (TARP)* to purchase failing bank assets.

The governments by themselves cannot by edict restore confidence. House Speaker Nancy Pelosi described the legislation as 'only the beginning' of the legislative response to the market failure. The biggest problems where: which assets to buy; how to buy these assets; and whom to buy assets from. The most important remedial measures, namely: Washington's $US700 billion rescue package; widespread interest rates cuts; and the US Federal Reserve's move to lend directly (without security) to US businesses, failed to restore investor confidence. The normal channels for connecting savers with borrowers sized up and the panic reached new depths.

On Friday, 10 October, 2008, share markets around the world suffered their worst falls since the 1987 crash. The main reasons for the initial failure to restore confidence were that (a) no one knew who was broken (who deserved support and why?), and (b)

there was no co-ordinated global action (apparently, investors needed a guarantee that governments around the world will stand behind their financial institutions).

In the original TARP it was envisaged that authorities could offer to buy illiquid assets through auctions and allocate them to a federal entity. On 13 November, 2008, Henry Paulson said he would spend some of the $US700 billion TARP on buying securitized consumer debt from banks –such as car loans, credit cards and student loans– abandoning the earlier plan to make direct purchases of impaired assets (sub-prime mortgages and related assets). This backflip on a plan to buy toxic mortgage debt from troubled US banks cast doubts over the credibility of the US government attempts to restore confidence in the financial system and once again ignited a rout on global share markets.

The financial services giant Citigroup was also considered 'too big to fail.' In mid-November 2008, Citigroup and the US government identified $US306 billion in troubled assets. Citigroup shares fell astronomically (60% in just one week). There was a joint rescue by the US Treasury, the US Federal Reserve and the Federal Deposit Insurance Commission. The rescue came into two parts: $US40 billion in fresh capital and capital relief, and it rang-fence $US306 billion of illiquid assets on Citigroup's $US2 trillion balance sheet.[9]

By the end of 2008, securitization was virtually inexistent, rating agency revenues from asset backed securities disappeared and Wall Street banks were force to incur pervasive write-downs. The year ended with a spiral of uncertainty and gloom gripping investors, producers and consumers around the world.

3. REAL, NOMINAL AND TOXIC FINANCIAL INNOVATIONS

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The importance of finance and financial innovation is widely recognized. For example, financial innovation laid the ground for the expansion of the credit market that has taken place over the last 15 years or so. The essential function of finance is to channel funds from savers to individuals and firms with productive opportunities. Any new idea applicable to the essential function of finance is termed a *financial innovation*.

Beyond any doubt, financial innovations such as credit cards, Automatic Teller Machines (ATMs) and automated underwriting systems helped open new possibilities for many consumers. But financial innovation cannot be axiomatically qualified as desirable. The recent crisis has shown that there are economically deleterious financial innovations.

To some extent, this point was recently recognized by the US Federal Reserve chairman Ben Bernanke in his prepared speech delivered in Washington DC on 17 April, 2009. After praising financial innovation for helping "at least some underserved consumers more fully enter the financial mainstream," he said:

> Yet with hindsight, we can see that something went wrong in recent years as evidenced by the currently high rates of mortgage delinquency and foreclosure, especially in minority and lower-income neighbourhoods. Indeed, we have come almost full circle, with credit availability increasingly restricted for low- and moderate-income borrowers. And the damage from this turn in the credit cycle –in terms of lost wealth, lost homes, and blemished credit histories– is likely to be long-lasting. One would be forgiving for concluding that the assumed benefits of financial innovation are not all they were cracked up to be.

Bernanke (2009)

It should be emphasized that not all financial innovations are economically desirable. Mason (2008) distinguishes 'real' from 'nominal' financial innovations. A financial innovation that provides economically valuable benefits constitutes a *real* financial innovation. *Nominal* financial innovations are financial instruments that increase compensation without providing lasting economic benefits.[10]

Providing mortgage finance to low income and minority households is a social goal in many rich countries. The main issue to be confronted in lending to this group is that the borrowers are riskier because of two issues: (a) insufficient funds (they do not have enough funds for the down payment on the house); and (b) credit issues (they have either no credit history or prior problems repaying debts). A financial innovation was necessary to answer the following daunting question: how can a mortgage loan be designed to make lending to riskier borrowers potentially profitable. 'Sub-prime mortgages' were a profit-seeking financial innovation aimed at answering this question. The new idea associated with the sub-prime mortgage is as follows: the borrower and the lender can take advantage of the house *appreciation* over short horizons.

A representative sub-prime mortgage can be described in four steps. First, a subprime mortgage starts with a fixed interest rate ('teaser' rate, say 7% per year) and incorporates a variable interest rate ('reset' rate or 'step-up rate, say LIBOR plus 8%) after an initial period of time of two or three years. Second, the appreciation of the house is the basis for refinancing every two or three years. Third, the lender makes the choice to refinance or not at the end of the initial period and the borrower may be rolled into

another sub-prime mortgage. Finally, another important feature of a subprime mortgage is the prevalence of prepayment penalties.

The US housing boom period started in 2001 and ended in 2006: US housing prices reached a peak in 2006 exceeding replacement costs by as much as 100% and fell 50% from this peak in 2006-2007. The high housing prices of 2001-2006 were a short-run response to high demand. Expectations were not rational because individuals assumed that housing prices will keep on rising forever, while elementary economic logic predicts that housing prices will revert back to replacement costs.

Securitization is the hallmark of the new financial system. Indeed, the transit from traditional to modern banking happened with the introduction of a financial innovation: *Securitization*. This innovation is a financial engineering procedure by which financial companies pool assets (from mortgages to car loans) and sell the repackaged assets. The archetypal example of securitization is a mortgage-backed security (MBS) which is a particular case of an asset-backed security (ABS).[11] Securitization can be of two types: *pass-through* securitization and *tranched* securitization. As will become apparent, 'collateralized debt obligations' are inextricably linked to tranched securitization.

Two observations involving securitization are in order. First, a recent contribution on the theoretical front strongly points to the fact that securitization is a critical source of financial *instability*. Shleifer and Vishny (2009). These authors have developed a formal theory of financial intermediaries operating in markets influenced by investor sentiment and shown that when banks participate in financial markets by securitizing loans and using leverage, bank instability and financial instability reinforce each other.

Second, securitization fits nicely into the notion of 'disruptive innovation' introduced by the Harvard Professor Clayton M. Christensen. He classifies innovations in general –not necessarily financial innovations– into two categories: innovations that improve the performance of established products (*sustaining innovations*) and innovations that represent an important shift from everything that has come before (*disruptive innovations*). Christensen (1997). The financial innovation represented by 'collateralized debt obligations' is a sustaining innovation emerging from securitization.[12]

The dichotomy real/nominal innovation suggests a possible definition of 'toxic' (or economically malignant) financial innovation that may be useful for analytical purposes. A *toxic* financial innovation is a nominal innovation which singly or jointly with other financial innovations provokes a financial crisis. The existence of toxic financial innovations presupposes not only loose monetary policy but also poor supervision.

It is generally agreed that the sub-prime mortgage innovation in combination with securitization and Credit Default Swaps led to the financial crisis 2007-08. Thus the sub-prime mortgage may be considered as an example of toxic financial innovation. In the US sub-prime lending was relatively a small proportion of the mortgage market which, in turn, was just a part of America's financial markets. The cascade of failing credit spread throughout the financial system. The original loss of several hundred billion dollars in the mortgage market amplified into a full blown financial crisis.[13]

Ben Bernanke (2009) made the case for encouraging continuous financial innovation while admitting the risk in allowing it. In particular, he pointed to the need to manage financial innovation's risks properly (but he did not explicitly say how). In

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essence, he argued that increased regulation would be a better response than eliminating innovation. Bernanke's conclusion merits quoting at length:

> (…) Regulation should not prevent innovation, rather it should ensure that innovations are sufficiently transparent and understandable to allow consumer choice to drive good market outcomes. We should be wary of complexity whose principal effect is to make the product or service more difficult to understand by its intended audience. Other questions about proposed innovations should be raised. For instance, how will the innovative product or practice perform under stressed financial conditions? What effects will the innovation have on the ability and willingness of the lender to make loans that are well underwritten and serve the needs of the borrower? These questions about innovation are relevant for safety-and-soundness supervision as well as consumer protection.
>
> Bernanke (2009)

It appears that Bernanke considers that all financial innovations are desirable by definition, provided they are transparent. In financial markets, 'transparency' is nearly always equated with information disclosure. To be sure, transparency of financial innovations is of absolutely fundamental importance. That said, the possibility of transparent financial innovations enhancing systemic risk to the point of collapse should not be overlooked. Transparency does not necessarily imply comprehension.[14]

The notion of toxic financial innovation is consistent with a clear understanding of the new idea involved in the financial product in question. The fact that a relatively modest innovation (sub-prime mortgage) led to a full-blown financial crisis cannot solely be attributed to a lack of transparency. If we are willing to accept that there may be toxic financial innovations, independent scrutiny seems to be necessary before the commercialization of the new financial idea is allowed.[15] As for those who argue that transparent financial innovations cannot do harm, we may leave to them the task of proving their case.

4. RISK-TAKING: STICKER VERSUS SNATCHER

Quite obviously, irrationality should be defined to consist in decision patterns which make it more difficult to attain one's own ends. The choice of objectives cannot be considered rational or irrational. Pressure on top management to originate quick profits may induce a company to maximize profits in the short-run irrespective of the long-run implications of this objective. Flawed internal compensation may also be conducive to profit-maximization in the shortest run with complete disregard of the relatively distant future. For example, if traders are allowed to boost their bonuses by buying untested securities it is likely that they will ignore the default risk associated with these products and force financial institutions to maximize profits in the shortest run.

Many years ago John R. Hicks (1954) introduced the insight that companies may seek a balance between short-run and long-run profit-maximization. Hicks suggested that we should think of a decision maker as maximizing a convex combination of the rates of short-period profit g and long-period profit G, defined as ag + bG, where a and b are

weights. He also suggested that "The weights a,b may then be taken to be governed by such things as the lengths of time for which the close (short) and open (long) periods are expected to last, the rate of time-preference, and the willingness to bear risks. Such subjective factors (and capital-market factors) may well on occasion, be of great importance" and introduced the compelling –but often forgotten– dichotomy 'Sticker-Snatcher.' Hicks (1954, p. 45)

In the context of financial markets the Hicksian dichotomy can be paraphrased as follows. A financier who is interested in maximizing long-term value (high b relative to a) may be called *Sticker*, while a financial executive interested in seizing a quick profit can be called *Snatcher* (high a relative to b). For example, a venture capitalist tends to be a Sticker while hedge funds managers resemble Snatchers. In financial markets populated by Snatchers, the following business attitude governs investor psychology: it is irrational to play safely while everyone else is a core gambler.

The culture of excessive risk-taking observed during the double (housing and credit) bubble 2001-08 seemed to be consistent with a gradually increasing value of l converging to a = one (perfect Snatcher). To see this, we need to look at the endogenous determination of the value of a relative to b. Recent research shows that there were at least three mutually reinforcing factors conducive to a high a relative to b, namely: two factors internal to the bank's organization (incentives to the top and flawed internal compensation and control) and the impact of investor sentiment on the bank's behaviour.

The first two factors were singled out by Diamond and Rajan (2009, pp. 5-6). Top managers may not seek to maximize long-term bank value because they prefer to increase their stock prices and enhance their personal reputations. Even if top managers seek to

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maximize G (perfect Sticker, b = 1), it may be difficult to control traders working for the bank. To quote Diamond and Rajan at length:

> Even if top management wants to maximize long-term value, it may find it difficult to create incentives and control systems that steer subordinates in this direction. Given the competition for talent, traders have to be paid generously based on performance. This gave traders an incentive to take risks that were not recognized by the system, so they could generate income that appeared to stem from their superior abilities, even though it was in fact only a market-risk premium. The classic case of such behaviour is to write insurance on infrequent events such as defaults, taking on what is termed "tail" risk. If a trader is allowed to boost her bonus by treating the entire insurance premium as income, instead of setting aside a significant fraction as a reserve for an eventual payout, she will have an excessive incentive to engage in this sort of trade. Indeed, traders who bought AAA MBS were essentially getting the additional spread on these instruments relative to corporate AAA securities (the spread being the insurance premium) while ignoring the additional default risk entailed in these untested securities. Diamond and Rajan (2009, p. 6)

Investor sentiment is the third factor conducive to Snatcher behaviour. The model of financial instability developed by Shleifer and Vishny (2009) to analyze the role played

by banks in transmitting changes in investor sentiment into the real economy shows with logical compulsion that

> investor sentiment, through securitization, infects banking and leads to cyclicality of profits, of investment, and at least of the market value of the balance sheet. Banks used up all their capitals in booms knowing full well that a crisis will come and that they will suffer (at least book) losses. But they realize that there is so much money to be made during booms that they should nonetheless extend themselves fully. Shleifer and Vishny (2009, p. 20)

President Barack Obama' speech unveiling his proposed new financial architecture (17 June, 2009) described the problem of financial excess quite clearly: Wall Street developed a "culture of irresponsibility," the president said. Lenders did not hold on their loans, but instead sold them off to be repackaged into securities, which in turn were sold to investors who did not understand what they were buying. "Meanwhile," Obama said, "executive compensation –unmoored from long-term performance or even reality– rewarded recklessness rather than responsibility."

5. ENGENDERING KNIGHTIAN UNCERTAINTY

At the core of the financial meltdown 2007-08 was a process of transformation of risk into uncertainty in the strict sense: investment banks turned trillions of dollars of risky assets into financial instruments involving many forms of bundled debts and this, in turn, created a black box that could not be penetrated by investors to determine the size and location of the risks.

5. 1. The Dichotomy Risk/Uncertainty

Before going into the process of endogenous creation of pervasive uncertainty, it is important to revisit the familiar distinction risk/uncertainty because this dichotomy enlightens the sudden stop of the interbank credit market in particular, and the 2008 global financial collapse in general.

Frank Knight (1921, esp. pp. 19-20) made the distinction between two types of randomness: *risk* (calculable probability) and *uncertainty* (incalculable probability). Beyond any doubt, the insight underlying these notions, namely: it is not always possible to compute probability distributions describing real-world phenomena, is extremely valuable.

Two distinct set of reasons conducive –in practice– to uncertainty in the strict sense should be emphasized. First, the fact that there are many widely-used software packages for statistical analyses enabling speedy 'number crunching' does not of itself prove that we have risk in Knight's sense. The compelling constraint –obvious, but often forgotten– is that the existence of Knightian risk depends on the availability of appropriate data to compute the relevant probability distribution. If the empirical data to compute the occurrence probability of a particular event do *not* exist, it follows at once that there is uncertainty, not risk.

Second, Knight's characterization of the dichotomy risk/uncertainty works well as a first approximation, but not as a second because we may find a well-specified probability distribution that exhibits extreme sensitivity to modest changes in the parameter estimates. After all, we should be suspicious of a model to appreciate a real-life situation if the model behaves very differently by including arbitrarily small

perturbations, since in practice we can only measure within some non-zero margin of error.

Consequently, 'calculable probability' should mean that the probability distribution is at least *structurally stable* in that small perturbations of the parameter estimates do not provoke drastic changes of the probability distribution. For example, if a small perturbation in a parameter estimate drastically changes the probability of default of a security rated AAA, there is uncertainty not risk.

The foregoing enables us to distinguish between *strong* Knightian uncertainty (incalculable probability distribution) and *weak* Knightian uncertainty (the probability distribution cannot be computed or it is structurally unstable). The expressions 'Knight's uncertainty' and 'uncertainty in the strict sense' will be used interchangeably on the understanding that we are using the weak definition of uncertainty.

5.2 Financial Alchemy: CDOs

The prototypical structured finance was a financial innovation derived from securitization known as *Collateralized Debt Obligation (CDO)*. This financial instrument entailed a manipulation of the risks associated with a collection of assets such as mortgages, credit cards and student loans. In fact, the initial collection was partitioned into sub-collections ordered by degree of risk. This automatically implied the generation of two polar cases: one sub-collection would display negligible risk ('risk-free' case) and the other would contain extremely risky assets that bear all the expected losses in the original collection ('toxic waste' case). Quite obviously, for the manipulation of risks to be financially meaningful the issuer of a CDO should have beeen able to compute the default probabilities corresponding to each sub-collection of assets.

While the first CDOs were introduce in the 1980s, their quantitative importance remained low (under $US100 billion annually) until 1998.[16] As early as 2001, *The Economist* warned about the opacity of the CDOs:

> The chairman of American Express, was man enough to admit last week that his outfit "did not fully comprehend" the risk underlying a portfolio of whizz-bang investment known as CDOs.
>
> The Economist (2001, p. 68)

Paradoxically, American Express Financial Advisor (AEFA), an arm of American Express also created CDOs:

> CDOs sales rose to $US80 billion in 1998, and to about $US140 billion a year thereafter. Yet despite eager buyers for the higher tranches, the creators of CDOs have, since 1998, often been unable to sell the bottom tranche, forcing them to hold onto it themselves. Some of the bottom tranches that American Express holds are toxic from its own deals for AEFA also creates CDOs, despite the admission that American Express *did not fully comprehend the risk.*
>
> The Economist (2001, p. 69) [*Italics added*]

The lack of understanding of the CDOs risk was not an impediment for the expansion of the CDO sector: between 2002 and 2008 CDOs were the fastest growing sector of the asset-backed securities market. One of the reasons for this expansion was that firms issuing CDOs generated fees of 0.4 to 2.5 percent of the quantity sold; for example, Citigroup made up to $US500 million in fees from the CDO business in 2005 alone.

The defining feature of CDOs is the financial engineering operation of 'repacking by tranching.' To verify this, we just have to look at the manufacturing process of a CDO. The first outcome of securitization is a large collection of risky assets termed *special purpose vehicle*. If the process stops here, the collection of assets is called a *pass-through securitization*. To create a CDO two additional steps are necessary. First, sub-collections of assets included in the special purpose vehicle must be identified and there has to be a rule establishing how these sub-collections will absorb losses from the original pool of assets. Second, CDOs are classified by degree of risk called 'tranches.' For example, a CDO could refer to either a senior tranche (lower risk/lower yield) or a mezzanine tranche (medium risk/medium yield) or a junior tranche (higher risk/higher yield).[17]

As the US housing market took flight around 2001, the CDO market grew immensely as more and more mortgages were pooled into new-fangle securities: over time, the size and complexity of the 'financial repacking' increased. Investment banks reapplied the CDO manufacturing process to junior tranches created in the first round, making the underlying risks even more opaque. In fact, these banks sliced up CDOs and repackaged them into CDOs of CDOs known as CDOs squared or CDO^2s. There were cases of CDO^3s.

The complexity of the CDOs does not end here. There were three main types of CDOs (cash-flow CDO, synthetic CDO and market-value CDO) and the issuer motivations were not uniform. For example, 86% of CDOs issued from 2004 through the first half of 2008 were 'arbitrage-motivated,' which means that the CDOs were sponsored

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by a hedge fund or an investment manager that bought the assets in the open market and packaged them into a CDO to obtain management fees on the deal.

Additional aspects contributing to the complexity of the CDOs abound. For example,

> (…) synthetic CDOs obtain their credit exposure through derivatives contracts instead of asset purchases. A synthetic CDO issues notes to investors, invest the proceeds in risk-free securities, and enters into a series of credit default swaps (selling protection). Investors in a synthetic CDO receive periodic payments from swap premiums, and their principal is written down if the reference entities on the swaps default.
>
> Benmelech and Duglosz (2009, p. 9)

Sub-prime mortgages securities had prospectuses of about 500-600 pages, most of which devoted to legalese. Yet they did not contain information about individual loans that is needed to detect default risk. The reason is not far to seek. There was an inherent difficulty in assessing the growing risks of the CDOs due to the buffling complexity surrounding re-securitization. Indeed, this intricacy made it virtually impossible to model the risk inherent to the CDOs.

> Modern finance is supposed to be all about measuring risks, yet corporate and mortgage-backed CDOs were a leap in the dark. According to Mr Derman, with Black-Scholes "you know what you are assuming when you use the model, and you know

> exactly what has been swept out of view, and hence you can think clearly about what you may have overlooked." By contrast, with CDOs "you don't quite know what you are ignoring, so you don't know how to adjust for inadequacies."
>
> The Economist (2009, p. 12).

The set of all CDOs could be likened to an iceberg: while the junior tranches were only the tip of the iceberg, the hidden portion contained the higher tranches. What investors could not see was the deteriorating quality of the senior tranches.[18]

5.3. Mission Impossible: Risk Evaluation

There is evidence that some banks undertook the task of evaluating CDOs risk. As an illustration, consider the case of the Citigroup, one of the world's largest banks with operations in more than 100 countries. In late 2002, the bank moved aggressively into CDOs. After five years (circa September 2007), the Citigroup ended up owning $US43 billion in mortgage-related assets. The bank's risk evaluation procedures were grotesque, to say the least. For example, Citigroup's risk models assumed *away* the possibility of a US housing downturn, on which millions of homeowners could default on their mortgages. As reported by the New York Times, the Citigroup's top executives were indulging in daydreams:

> Even as the first shock waves of the sub-prime mortgage crisis hit Bear Stearns in June 2007, Citigroup's top executives expressed few concerns about their bank's exposure to mortgage related securities.

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> In fact, when examiners from the Securities and Exchange Commission began scrutinising Citigroup's sub-prime mortgage holdings after Bear Stearns' problem surfaced, the bank insisted
> the probability of those mortgages defaulting was so tiny that they excluded them from their risk analysis, says a person briefed on the discussion.
>
> Dash and Creswell (2008)

A tranche is, by definition, a sub-collection of assets –call them 'mortgages.' It should be intuitively clear that to compute the probability of default of a tranche, we need to know not only the default probability of each mortgage but also the probability that all mortgages default simultaneously.

Due to the securitization procedure, neither the investment banks nor the rating agencies had access to the original loan applications.[19] Furthermore, the computation of a CDO default probability should have taken into account the actual evolution of the mortgage sector, that is, the fact that the sector was morphing into a speculative bubble prompted by the sub-prime mortgage innovation.

Even if under ideal circumstances the investment banks would have been able to collect the relevant statistical data and history repeated itself, the probability distribution of a CDO is structurally unstable. Coval et al. (2009) have shown that "modest imprecision in the parameter estimates can lead to variation in the default risk of the structured finance securities that is sufficient, for example, to cause a security rated AAA to default with a reasonable likelihood."

Having said this, it is an open secret that rating agencies such as Standard & Poor's and Moody's claimed that they were able to evaluate the risks underlying CDOs *without* verifying the information provided in the original loan applications. Using sophisticated econometric models under the assumption that historical patterns of default were a good predictor of risk they did the job on a regular basis. For example, they considered securitized pools of, say 2,000 sub-prime mortgages, and using historical performance from 1970s onward asked: what percentage of borrowers will pay their loan?

Investors placed too much faith in the rating agencies which failed to recognize the virtual impossibility of doing their job properly. CDOs ABS were the assets for which the rating models experienced a dramatic failure. The market's excessive reliance on ratings is understandable. Numerous laws and regulations use ratings for permissible investments or required capital levels.

It is clear that the rating agencies ignored the fact that the mortgage sector was morphing into a speculative bubble. This provoked a severe mismatch between the credit ratings of CDOs and the credit quality of the underlying collateral. What may not be as obvious is the fact that the agencies were paid by those issuing the CDOs, and consequently, there was a conflict of interest. What mattered to issuers (Wall Street) was the rating –not the accuracy of the risk evaluation.

6. SHADOW BANKING SYSTEM AND SYSTEMIC RISK

Financial evolution is brought about by innovations together with all their effects and their responses to them by the financial system. For example, in the last 20 years or so financial firms developed a new (and largely unregulated) banking system which was,

by 2007, as large as the traditional banking system. This unregulated enhancement of the financial system –known as *shadow banking system*– involved large firms such as Bear Stearns and Lehman Brothers that were dubbed 'non-bank banks.'

Needless to say, this expression implies a contradiction in terms. However, the pun is not nonsensical. By definition, banking involves financing long-term risky and relatively illiquid assets with very short-term liabilities. It is natural to call a firm doing banking a *bank*. For example, both Bear Stearns and Lehman financed large investments in risky securities mainly with short-term borrowing, and consequently, they were banks. However, these two firms were considered as non-banks for regulatory purposes. Hence Bear and Lehman were non-bank banks.

It should be clear that this is not a mere terminological quibble. Non-bank banks were vulnerable to bank runs, but without the protection that the banking system typically has in place (deposit insurance) to ameliorate such destabilizing events.

The financial crisis 2007-08 taught us that a first-mover advantage attitude can make financial institutions in general (not only banks) vulnerable to runs. In the traditional notion of a 'bank run,' we find depositors (individual consumers) and a local house bank. Bad news about the bank's financial situation provoke a bank run when depositors run for fear that others will run, leaving no money available for those who do not run.

Although the traditional idea of a bank run revolves around the behaviour of deposit holders, it can be easily extended to equity holders such as, for example, investors in a hedge fund. The rule in this case is: equity holders who withdraw their capital as soon as possible receive the full share of the hedge fund's net asset value, but late withdrawers incur losses.

The following hypothetical example suggests –correctly– that a 'bank run' and a 'hedge fund run' display striking similarity. Consider a hedge fund HF with mark-to-market net asset value of $1 billion, dispersed as follows: 30% in highly liquid assets (cash cushion) and 70% in CDOs (illiquid securities). Suppose that there is a bad rumour about the hedge fund implying that HF is about to go bust. If investors demand their money out and the fund manager use the cash cushion to service early withdrawals, then early withdrawers will receive the full share ($300 million) of the net asset value of $1 billion. To pay out the remaining investors the fund manager has to sell the CDOs at fire-sale prices and late withdrawers will receive only a fraction of the hedge fund's asset value, say $200 million or 20% of the initial asset value. In a nutshell, a first-mover advantage attitude is beneficial because investors who withdraw their money early get the full amount while those who move late cannot.

The financial market turmoil 2007-08 threw up a variety of run inextricably linked to the shadow banking system that may be called 'systemic financial run.' Somewhat roughly, this sort of run happens when there is uncertainty about who is broke because no one knows who owes what to whom. More precisely, a systemic financial run occurs when sophisticated institutional investors run on some core financial institutions because of the uncertain value of a set of complex securities (think of particular tranches of MBSs) guaranteed by the core financial institutions. A systemic financial run is not enacted by the uncertain situation of a particular bank or non-bank bank, but rather by investor sentiment responding to pervasive uncertainty.

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In the new regulatory road map proposed by the Obama administration on 17 June, 2009, the risks posed by non-bank banks and systemic financial run are explicitly contemplated. As Paul Krugman explains:

> When Lehman fell, we learn just how vulnerable shadow banking was: a global run on the system brought the world economy to its knees.
>
> One thing financial reform must do, then, is bring non-bank banking out of the shadows.
>
> The Obama plan does this by giving the Federal Reserve the power to regulate any large financial institution it deems "systemically important" –that is, able to create havoc if it fails whether or not that institution is a traditional bank. Such institutions would be required to hold relatively large amounts of capital to cover possible losses, relatively large amounts of cash to cover possible demands from creditors and so on.
>
> And the government would have the authority to seize such institutions if they appear insolvent –the kind of power that the Federal Deposit Insurance Corporation already has with regard to traditional banks, but it has been lacking with regard to institutions like Lehman or AIG.
>
> Krugman (2009)

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7. THE DEBT BUBBLE SEQUENCE

Each financial crisis is unique in terms of its causes and the types of assets that involves. The unique manifestation of the debt bubble 2001-08 was the growing importance of interlinked securities, i.e. sub-prime mortgages, debt securitization and credit derivatives.

To gain an understanding of the financial meltdown 2007-08 it is convenient to view the speculative bubble 2001-08 in a stylized manner which I call the 'debt bubble sequence.' In fact, the process of discarding the inessentials and going straight for the essential elements involved in the debt bubble 2001-08 is equivalent to constructing an historical sequence starting in 2001 and ending in the last quarter of 2008. In rough outline, the number of terms in this sequence can be reduced to four: the first three (overlapping) terms indicate collections of important aspects in the inflation of the bubble and the last one corresponds to the bursting of the debt bubble.

❶ Housing Bubble

Public policy decisions influenced the creation of new financial products. For example, the US government's support for the development of secondary mortgage markets through government sponsored firms (Fannie Mae and Freddie Mac) encouraged the development of new products such as the sub-prime mortgage innovation.

The US banks and non-bank lenders provided loans to people who could not possibly pay them back, including but not limited to sub-prime borrowers. The US housing boom period started in 2001 and ended in 2006: US housing prices reached a peak in 2006 exceeding replacement costs by as much as 100% and fell 50% from this peak in 2006-07. The high housing prices of 2001-06 were a short-run response to high

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demand. Individuals assumed that housing prices will keep on rising forever, while elementary economic logic predicts that housing prices will revert back to replacement costs.

❷ Credit Bubble

The immense demand for MBSs led to a decline in the lending standards and misleading ratings of these securities by the rating agencies. The sub-prime mortgages and other loans were all packed up and Wall Street sold them to different investors creating an immense amount of financial products (CDOs). The huge amount of CDOs introduced in the economy was largely driven by the immense demand for AAA securities by money markets, insurance companies and other investors.

The CDS market was a largely unregulated, over the counter market that posed systemic risk (think, for example, of the disruption created by the collapse of Lehman Brothers, a big CDS dealer). This market was blamed for the spread of speculative behaviour in widening circles.

> Yet as well as being a shambles, the CDS market now stands accused of being a speculator's playground. One conspiracy theory is that the hedge funds distorted the CDS prices, which in turn spooked the stock market and caused a collapse in confidence. Even the Chairman of the Securities and Exchange Commission, America's financial regulator, says "significant opportunities…exist for manipulation."
>
> The Economist, (2008, p. 80).

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For example, John Paulson focused on BBB-rated tranches (the lowest in sub-prime securities) and bought protection using CDSs. When Lehman went bust, one $US 22 million trade netted him $US1 billion. The Economist (2009b)

❸ Asset Metamorphosis

The housing and credit bubble fuelled by re-securitization entailed a gradual transformation of risky assets into uncertain assets in the strict sense. CDOs were complex financial products, a significant proportion of which were financial catastrophe bonds. Investors were unable to compute the risks associated with them because the necessary data either did not exist or was practically impossible to collect. As the housing bubble collapsed, mortgages began to default. A significant amplification of the perceived uncertainty occurred when investors trashed the credit agencies rosy ratings.

Investment banks got themselves into so much trouble because they sold CDOs and also hold inventories of these assets on their own books. There are at least two plausible reasons for this dual role of banks. One is that the bankers believed that these securities were worthwhile investment:

> The investment banks played a dual role of investors and dealers in the structured finance market. The business offered enormous short-run payoffs, which seemed to be too compelling to ignore even if value-destroying in the long-run. The banks were generally eager to keep the structured finance business going even as underwriting standards fell. The combination of low capital requirements imposed on AAA-rated assets and a commonly held perception that they were "safe,"

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> allowed banks to hold on to any senior tranches that were not sold to investors. But when the
> structured finance market collapsed in late 2007, the investment banks found themselves holding billions of dollars of low-quality asset pools, many of which consisted of leveraged buy-out loans, sub-prime mortgages, and bonds from collateralized debt obligations in process –that is, where the tranches had not yet been sold to other investors.
> Coval et al. (2009, p. 22)

A similar point is made by Diamond and Rajan (2009, p. 4). The second reason –not necessarily inconsistent with the first one– is that the banks had to have a 'skin in the game' (holding a fraction of loans to outside investors) to signal the good credit quality of the securities. Shleifer and Vishny (2009, p. 9).

Investment banks, rating agencies and regulators did not fully appreciate that the financial system was generating pervasive uncertainty. For example, with rapid falling prices in MBSs, banks sold off their inventory very slowly. It is not inconceivable that some banks may even have increased CDOs exposure through CDSs.

❹ Uncertainty and Collapse

The fourth (and last) term of the debt bubble sequence refers to the bursting of the bubble. Once economic agents realized that highly leveraged financial institutions were holding a substantial proportion of securitized sub-prime mortgages the effectiveness of the financial sector was reduced dramatically. Market participants attempted to convert

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uncertain assets into cash.[20] Most financial firms were unable to raise capital and refused to lend. This provoked the seizing up of the world's credit markets.

Uncertainty was magnified by the lack of knowledge about the criteria for government intervention to prevent financial institutions from failing. For example, the question: what was the policy argument for intervening with Bear Stearns, and then not with Lehman Brothers, and then again with American International Group? remains to be answered.

The last term of the debt bubble sequence is best described by Alan Greenspan:

> Global financial intermediation is broken. That intricate and interdependent system directing the world's savings into productive capital investment was severely weakened in August 2007. The disclosure that highly leverage financial institutions were holding toxic securitized American subprime mortgages shocked market participants. For a year, banks struggled to respond to investors demands for larger capital cushions. But the effort fell short and in the wake of the Lehman Brothers default on September 15th 2008, the system cracked. Banks fearful of their own solvency, all but stopped lending. Issuance of corporate bonds, commercial paper and a wide variety of other financial products largely ceased. Credit-financed economic activity was brought to a virtual standstill. The world faced a major financial crisis.
>
> Greenspan (2008, p. 122)

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In a state of affairs chiefly characterized by a totally unpredictably future, individuals could not possibly follow any course of action because economic reasoning was worthless. As mentioned before, on 10 October, 2008, share markets around the world crashed. The predominance of uncertainty in Knight's sense created a 'financial black hole' that sucked in the real economy.

Diagram 2 seeks to illustrate a stylized view of the sequence of events and episodes conducive to the financial crisis 2007-08. Being stylized, the diagram is not comprehensive, but it does provide a snapshot of the once-in-a-life-time financial tsunami. The central point underlying the debt bubble sequence is that a set of concatenated financial innovations led to a massive debt expansion and transformed risky assets into uncertain assets in the strict sense.

DIAGRAM 2 HERE

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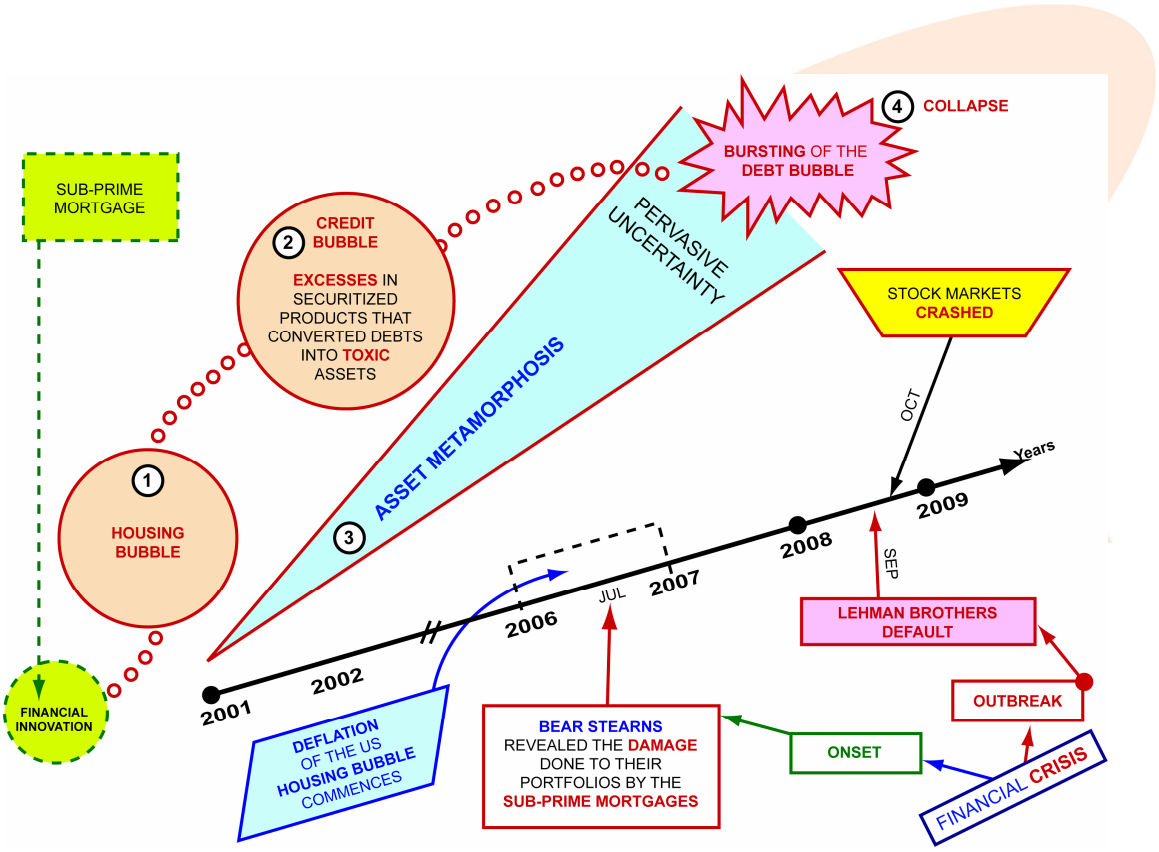

Diagram 2, The debt bubble sequence

8. CONCLUDING REMARKS

What caused the financial crisis that provoked worldwide panic at the end of 2008? While some economists may focus on a single explanatory factor, and thus on a single remedy, it appears that there was a *bundle* of causes explaining the current financial crisis. In a recent paper, John B. Taylor has provided empirical evidence about the causes of the financial crisis 2007-08 and concluded that this crisis was provoked, prolonged, and worsened by the US government actions and interventions. Taylor (2009, esp. p. 27). In his view, the use of sub-prime mortgages was a complicating factor and the complex re-securitization of these and other mortgages a significant amplification factor. One way of knowing whether the existence of a malignant innovation in combination with securitization was necessary for the financial crisis to occur would be to construct a model to see what would have happened in the counter-factual event where the sub-prime mortgage innovation did not exist.

This paper has sketched the explanatory factors involved in the pictorial description of the global financial crisis 2007-08 presented in the introduction (Diagram 1). The following factors operated singly and jointly in the generation of the once-in-a-lifetime financial crisis:

(1) **Global Saving Glut 2002-04:** Net financial savings generated in one part of the world (e.g. China) were absorbed by deficits in developed countries such as US, UK, Ireland, Spain, and the Netherlands;

(2) **Monetary Excesses:** unusually low interest rates in the wake of the Internet bubble crash; the Federal Reserve made clear that interest rates would be low for a considerable period of time and that they would rise gradually afterwards;

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(3) **Sub-prime Mortgage:** The existence of permanent excess demand for financial assets propelled an innovation, namely the sub-prime mortgage, to restore equilibrium of the financial system; this financial innovation drew marginal-credit quality buyers into the US housing market and provoked a housing bubble in the United States;

(4) **Securitization:** The housing bubble was accompanied by a major credit expansion; mortgages and other loans were to a very significant extent securitized;

(5) **Re-securitization:** Repeated securitization of the original package of loans was routine; there was so much money to be made during the housing and credit bubble expansion that a Snatcher culture of excessive risk-taking prevailed over risk aversion, especially regarding CDOs (re-securitized financial products);

(6) **Poor Supervision**: One of the distinguishing features of the financial crisis 2007-08 was regulation failure, not lack of regulation. The failure emerged from the inability of financial market regulations and supervisory systems in some developed countries to stop excessive risk taking and faulty management practices.

Although further research, the passing of time, and reflection will deepen our understanding of the recent financial crisis, I am confident that Diagram 1 will remain an integral part of the explanation. The two messages conveyed by this diagram are: first, it is impossible to explain the financial crisis 2007-08 on the basis of loose monetary policy alone because financial innovations (singly and jointly) played a fundamental role in this unfortunate event; and second, the internal dynamics of the financial system led to an

incessant increase in Knightian uncertainty due to the obscure nature of the re-securitized financial products.

If there is a lesson to be learned from the evolution of the financial system, it is that there is no such thing as 'self-regulation' of the financial system. In fact, if by *self-regulation* we mean that the system will never suffer a catastrophic collapse the recent financial meltdown as well as the financial crisis 1930-33 shows that self-regulation cannot be taken for granted.

The worst financial crisis since the Great Depression will probably redraw the boundaries between government and financial markets. In order to be successful, regulatory reform needs to convince the public that the financial system will be fairer in the future than it has been in the past, that is, the gains will be spread more equitably on the real economy and failure will not be rewarded.

The overriding goal of public policy underlying the regulation of financial institutions is financial stability. Calls for regulation on executive pay or breaking up the biggest banks, or for the identification and management of asset bubbles, all divert the public policy debate from where it should focus. The public debate should focus on regulating financial innovations and systemic risk.

All regulations are vulnerable to financial innovation in that given any specific regulation there will always be innovators able (and willing) to circumvent the constraints imposed by the regulation. Modern finance is unstable and prone to excess due to clever financial engineers working around the rules. The foundation stone of financial regulation should involve the scrutiny of financial innovations along the lines developed in Pol (2009).

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Endnotes

[1] The then Governor Ben Bernanke warned in his influential 'saving glut' speech: "…the risk of a disorderly adjustment in financial markets always exists, and the appropriately conservative approach for policymakers is to be onguard for any such developments." Bernanke (2005, p. 9).
[2] The Internet bubble deflated in two consecutives stages in 2000 (called 'great tech wrecks') and analysts identified this phenomenon as *tech meltdown.*
[3] This monetary policy stance is known as the 'Greenspan Put."
[4] A security is said to be a *financial catastrophe bond* when no solid basis exists for a reasonable calculation of its risk, and consequently, the value of the bond is shrouded in mystery. The intuition behind this definition is as follows. If a large number of ignorant individuals invest in these bonds, a sudden realization that they are worthless is likely to lead to financial instability.
[5] Bear Stearns was taken over by JP Morgan in March 2008.
[6] The CDSs are insurance contracts whose main function is to hedge against default. The buyer of the CDS makes payments to the seller in order to receive protection. The buyer receives a payment if a credit instrument (for example, a bond or a loan) goes into default or in the case of a specified credit event such as bankruptcy.
[7] The risk that a negative event in one part of the economic system will uncontrollably rippled to otherwise healthy parts of the economy is known as 'systemic risk.'
[8] A company is said to be 'too big to fail' if its failure would pose systemic risk. In February 2009, AIG insured 180,000 entities, which collectively employed 106 million people in the US alone. At that time, AIG cost US taxpayers $US170 billion, mostly to repair the damage done by one of its units, AIG Financial Products. Federal Reserve Chairman Ben Bernanke said in March 2009: "Any firm whose failure pose a systemic risk must receive especially close supervisory oversight of its risk taking, risk management and financial condition, and be held to high capital and liquidity standards." Quoted in Damian Paletta, 'Bernanke Cracks the Whip for More Regulation,' *The Wall Street Journal,* 11 March, 2009.
[9] The cloistered $US306 billion included the bank's most noxious holdings, e.g. mortgages and commercial property loans.
[10] This is a slightly modified version of the original definition formulated by Mason (2008, p. 11): "Nominal innovations are vehicles that primarily increase Wall Street compensation with few real benefits."
[11] ABS is the general term for bonds backed by pools of assets rather than a single firm or government. This means that in case of default, owners of ABSs are entitled to seize and sell the corresponding assets.
[12] More on collateralized debt obligations in Section 5 of the present paper
[13] Brunnermeier (2009, esp. pp. 91-98) explores four different amplification mechanisms through which the US mortgage crisis ultimately led to a severe financial crisis.
[14] The biggest problem is that information is often incomplete or outright incomprehensible.

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[15] I have developed the idea of a Financial Innovation Administration in Pol (2009). Needless to say, this sort of regulation cannot eliminate the possibility of a financial crisis. However, it can minimize the probability of devastation.
[16] According to Lucas et al. (2006, p. 3), the CDOs have been around since 1987.
[17] The senior tranche offered low interest rate, but it was the first to be paid out of the cash flows of the portfolio. At the other extreme, (junior tranche, usually referred to as 'toxic waste') would be paid only after the senior and mezzanine tranches have been paid. In general, when losses occur investors in the higher rated tranches are protected from loss by the lower tranches.
[18] In hindsight, these tranches constituted an example of 'low probability – high impact event' because they could default only under extreme systemic failure and provoke a large decline in the overall economy.
[19] Securitization transferred ownership of mortgages from lenders who knew their borrowers (lenders had information about the probability of default of their borrowers) to investment banks who did not.
[20] This appears to be the inevitable impact of Knightian uncertainty on financial markets. Alan Greenspan (2004).