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Instability and crisis in financial complex systems

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INSTABILITY AND CRISIS IN FINANCIAL COMPLEX SYSTEMS

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Abstract:

In this paper I try to contrast the *Efficient Markets Hypothesis* (EMH) with the *Financial Instability Hypothesis* (FIH) held by Hyman Minsky taking into account the *dynamic complexity* of financial markets and the role of fundamental *uncertainty* and *organic interdependence*. In my opinion this approach may provide indeed analytical tools to explain crisis through processes *endogenous* to contemporary economics. The relevance of *complex dynamic* has been particularly stressed recently by Barkley Rosser (2004; 2005); this author consider indeed *complex dynamic* a strong foundation for Keynesian models and results. *Complex dynamics* enter indeed into the analysis in at least two ways: it provides an independent source of *fundamental uncertainty* and this one, as discuss by Keynes himself (1936, 1937), can lead to *speculative bubbles* in assets markets and to *over-reactions* both in *lender's* and *borrower's* attitude toward risk. These aspects can lead to *financial fragility* and *instability* and follow a variety of *complex dynamics*. As I shall try to argue a *financially complex* system, according to the FIH, is indeed inherently flawed: in absence of adequate economic policy, *booms* and *busts* phenomena in financial markets fuelled by *credit booms* and *busts*, may generate *endogenous* instability and *systemic* crisis like the one occurred for the so-called “*sub-prime crisis*”.

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“... our economic leadership does not seem to be aware that the *normal* functioning of our economy leads to financial trauma and crisis, inflation, currency depreciations, unemployment, and poverty in the midst of what could be virtually universal affluence- in short, that *financially complex capitalism is inherently flawed*”

(cf. H.P.Minsky, 1986)

Introduction

The severe consequences on the real economy of the current and over-cited “*sub-prime crisis*” have reopened the theoretical and empirical debate on the causes and on the possible remedies for *financial instability* and *crisis*. One of the most puzzling aspects of the recent crisis was indeed just how it was *unpredicted* by the *economic leadership* both academic and inside the international institutions¹. Recently, many economists that work in the Keynesian tradition (cf. Kregel, 2007; Chick, 2008; Dow, 2008; Wray, 2008 and 2009; Whalen, 2008; Lawson, 2009) have very frankly denounced the inadequacy of the *mainstream* models of instability and cycles in explaining the origins, nature and effects of current crisis, especially as regards the aspects connected with the *persistence* of the real variables (production, investment, employment) and with the phenomena of *contagion* (which produced chain reactions) and *propagation* both inside the USA and among others developed countries.

As well-known, traditional approaches in economics and finance has indeed been based on the proposition of the so-called *Efficient Markets Hypothesis* (EMH) developed at the University of Chicago since ‘70s. According to this theoretical approach financial market are *efficient*, and instability and crisis may happen only as temporary shock since markets are always *self-regulating* and *self-stabilizing*. As a consequence New Classical Macroeconomics (NCM), as leading theoretical approach, has put *real exogenous shocks* at the centre of the analysis of the cycle and of the instability of developed capitalist systems. Furthermore standard views in economics, up to date, seem to ignore that current capitalistic economies are characterized by *complex* and more and more *sophisticated* financial systems driven by the fundamental activity of *money-managers* (cf. Whalen, 2001, 2005; Wray, 2009). *Money-managers*

¹ As well known Queen Elisabeth II recently addressed many embarrassing questions to several economists in a speech at London School of Economics concerning the origin and the absence of forecast of the current crisis.

move indeed today's markets and played a predominant role in the process that created *financial fragility* and *instability* at a *system* level².

In this paper I try to contrast EMH with the *Financial Instability Hypothesis* (FIH) held by Hyman Minsky taking into account the *dynamic complexity* of financial markets and the role of fundamental *uncertainty* and *organic interdependence*. In my opinion this approach may provide analytical tools to explain crisis through processes *endogenous* to contemporary economics. The relevance of *complex dynamic* has been particularly stressed by Barkley Rosser (2004; 2005) in several works; this author consider indeed *complex dynamic* a strong foundation for Keynesian models and results³.

Complex dynamics enter indeed into the analysis in at least two ways. *Complex dynamics* provide an independent source of *fundamental uncertainty* and this one, as discuss by Keynes himself (1936, 1937), can lead to *speculative bubbles* in assets markets and to *over-reactions* both in *lender's* and *borrower's* attitude toward risk . These aspects, along with *organic interdependence* can lead to *financial fragility* and *instability* and follow a variety of *complex dynamics* (cf. Day and Huang, 1990; Keen, 1995, 1997, 2009; Vercelli, 2000; Sordi-Vercelli, 2006)⁴.

As I shall try to argue a *financially complex* capitalism, according to the FIH, is indeed inherently flawed; that is, in absence of adequate economic policy, *booms* and *busts* phenomena in financial markets fuelled by *credit booms* and *busts*, may generate *endogenous* instability and *systemic* crisis⁵ like the one occurred recently.

The paper is structured thus: Paragraph (1) overviews and moves critical assessments of the EMH; Paragraph (2) is concerned with financial markets as *complex dynamic*

² The succession of bankruptcies in the financial and in the real sectors in the USA and in other developed countries has led indeed to the risk of global economic collapse since it constituted a threat to the international financial system and to the world economy (cf. Wray, 2008; Krugman, 2009; Roubini, 2008; Reinhart and Rogoff, 2008).

³This point is controversial particularly in the Post Keynesian literature. Distinguished scholar Paul Davidson (1994, 1996) does not consider the analysis of complexity in capital markets a real enrichment to study Keynesian's results, and contrasts the approach taken by Barkley Rosser on this point. This controversy remain, up to date, an open question and is beyond the aim of the present paper.

⁴ Barkley Rosser quoted Basil Moore (2005), another distinguished Post Keynesian, since Moore recently has pointed out the role of *complexity* in various forms as intrinsically linked with the process of endogenous money formation and uncertainties of economic dynamics. He argues that all this implies the need for non-equilibrium and open-system approaches.

⁵ See the quotation in epigraph. The association of financial crisis with booms and busts phenomena in financial markets, fuelled by credit booms and crunches, has been a long tradition; authors that represent this tradition are not only Minsky (1977; 1982) and Kindleberger (1978) but also Mitchell (1913) and, of course, Fisher (1933).

systems; Paragraph (3) shows how *complexity* and *fundamental uncertainty* may provide the analytical tools to explain current crisis through *endogenous* processes; Paragraph (4) stresses the relevance of *organic interdependence* to analyse both the national and international effects.

1. Efficient Markets Hypothesis: critical assessments

The central propositions of the EMH had their infancy in the University of Chicago (cf. Fama, 1970), that became the leader academic center of mainstream monetary macroeconomics and finance for nearly thirty years (cf. Shleifer, 2000). As well known, this theoretical approach have stressed the relevance of different types of *efficiency* of the financial markets: *fundamental-valuation efficiency*, *information-arbitrage efficiency*, *full-insurance efficiency* and *functional efficiency*.

According to the principle of *fundamental-valuation efficiency* investors are *perfectly* rational, from which it follows that market are *efficient* in the sense that all the usable information about *fundamentals* is *discounted* into the current prices.

On the other hand if financial markets satisfy the *information-arbitrage efficiency*, thus *speculative* profits, via technical trading or others means, are not obtainable (i.e. an average investor *cannot* hope to consistently “*beat the market*”!). In fact, if there are some investors that are not rational they trades are *random* and, being uncorrelated, they cancel out each other; even in the presence of *correlated* trading strategies, EMH stressed that the activity of rational *arbitrageurs* or *market makers* may perfectly eliminate their irrational influences on prices (Fama, 1965): selling out over-priced and buying underpriced securities with respects to fundamentals. It follows that temporary or persistent *bubbles* and *crashes* cannot occur, other than as adjustments to market news (i.e. “the information that might lead to them would indeed be discounted into the price instantaneously”!).

As to *full-insurance efficiency* financial markets as a whole are *efficient* if it is possible to *insure* the delivery of goods and services under a complete set of “*state of nature*” that is, if it is possible to consider an environment *à la* Arrow-Debreu (A-D).

Considering for example the *mortgage* contracts, according to EMH these markets are efficient if, and only if, the *probabilistic risk* of the debtors to be unable to meet all

future cash outflows can be known with *actuarial* certainty. In this case *insurance companies* (i.e. AIG in the current crisis) can always provide insurance guaranteeing solvency by the debtors, to the investors in these financial assets (cf. Davidson, 2009, p. 20).

Concerning with *functional efficiency*, it is concerned with various activities assured by the financial system that is: to mobilize saving; to allow for the *diversification* and *sharing* of risk; to *produce* and *disseminate* information; to enhance *corporate governance*; to facilitate *investments* and *innovation*; and least but non last, to promote an *orderly financial* market for liquid and illiquid assets⁶.

Following the observations by Whalen (2008, p. 8), one of the starting point of EMH (i.e. *fundamental-valuation efficiency*) is that if “even if individual decision makers get asset prices or portfolio values wrong, the market as a *whole* gets them right which means that financial instruments are driven by a sort of an *invisible hand* to some set of prices that reflect the underlying or *fundamental* value of assets: traditional finance assumes that when processing data, practitioners use statistical tools appropriately and correctly”. In the classical EMH, any observed market price variation around the actuarial value (i.e. price) determined by fundamentals is indeed presumed to be a statistical “*white noise*”. That is as a *group* investors are not predisposed to *over-confidence* and to other *biases*” (cf. Shefrin, 2000, p. 4).

The *mainstream* approach indeed handle *forecasting* assuming *agents* who possess *perfect rationality* and arrive at shared, logical conclusions or expectations about a situation they face. When these expectations induce actions that in the aggregate create a world that validates them as predictions, they are in equilibrium and are called *rational expectations*: these one are useful in demonstrating logical *equilibrium* outcome and analyzing their consequences. This is because the New Classical Macroeconomics (NCM) explains *economic fluctuations* and *cycles* as due only to *exogenous shocks*, describable by a probability function *implicitly* known by agents with *rational expectations*.

But if people are *perfect rational*, EMH is unable to provides guidelines for how to deal with financial crisis both *domestically* and/or *globally*. Such crisis are impossible! *Efficient markets* would indeed never permit neither *over-borrowing* (i.e. households and firms to spend an amount that so exceeds their income or cash-flows that the debt

⁶ Concerning with *functional efficiency*, EMH stress, once again, the existence of a *complete* set of *markets* and the presence of a secondary *perfect resale* market.

cannot be serviced) nor *over-lending* (i.e. by banks and other financial institutions). That is *future inter-temporal budget constraints*, is assumed perfectly known by the decision makers from which it follows that they act accordingly. If this is the case there can never be problems of *loans defaults, insolvency, and bankruptcy*: “market would not be efficient, if people today enter into contractual transactions they cannot fulfil when the future occurs” (cf. Davidson, 2009, p. 3)⁷. That is the future in EMH is not *radically uncertain* but only *probabilistically risky*. The presumption that the future is *known* is the foundation of all today’s *efficient market theories*. This argument was become even stronger in the recent decades since a vast *risk management and pricing* system has evolved, combining the best insights of mathematician and financial-economists with the highly sophisticated computer models. In recent years to evaluate and manage the risks, investment bankers in Wall Street based indeed on *statistical probability* the analysis of historical data to predict the future. For example, as stressed again by Davidson (2009; p. 20): “the A-D general equilibrium model is the basic analytical framework from which most mathematical computer economic models used by economists are based. Modern financial *efficient market theory* suggests that the institutional arrangements for *market maker* specialists to create orderliness are even *antiquated* in this computer age. With computers and the internet, it is implied that the meeting of huge numbers of buyers and sellers can be done rapidly and efficiently in virtual space”.

But from a statistical point of view, if the size of the sample increases, then the variance (the quantitative measure of *white noise*) decreases. Since computers can bring together many more buyers and sellers globally than the pre-computer market arrangements, the size of the sample of trading participants in the computer age rose dramatically. If therefore one believed in EMH, then permitting computer to organize the market may *reduce* significantly the variance and therefore *increase* the probability of a more *well organized, insurable and orderly market* than before. During the computer era, *financial instability and crisis*, once more, may be only the result of *exogenous shock*!

To move further critical assessments to EMH, one has to restate that Keynes himself (1936: ch. 12) and the Keynesian’s analysis of financial markets (cf. Minsky, 1982; Tobin, 1984; Davidson, 2009) stressed the *speculative attitude* and activity of the

⁷ As point out in the next paragraphs EMH do not take into the consideration the possibility of Minsky’s speculative and Ponzi financial units.

investors. In chapter 12th, as I'll emphasize in the next paragraph, Keynes pointed out that *speculation* is “*the activity of forecasting the psychology of the market*”; that is the aim of the speculator is to “*beat the gun*”: exactly the *opposite* stressed by the EMH approach !

The major puzzle in finance seem to be that *mainstream* theorists see markets differently from the way traders or practitioners do, that is: investors believe that technical trading is profitable! Furthermore, as stressed by Keynes (1936, 1937) “*market psychology* ” and “*herd effects*” unrelated to market news can cause *endogenously* persistent *bubbles* and *crashes*. Markets themselves possessing indeed “*moods*”, sometimes describing it as “*nervous*” or “*sluggish*” or “*jittery*”⁸. The empirical analysis shows that trading volume and price volatility in real financial markets are *higher* than the standard theory predicts All these aspects are in contrast with EMH (i.e. both with *fundamental-valuation efficiency* and with *information-arbitrage efficiency*).

These are also serious problems that contrast with the hypothesis of *full-insurance efficiency*, stressed by EMH, despite the fact that financial innovation increases the set of financial instruments linked to different “*state of nature*”. But, as I'll point out in the next paragraph, the economic system is *complex* and the future is characterized by *radical uncertainty*: “if it is the case, future outcomes cannot be reliably *predicted* on the basis of existing past and present data, then there is no *actuarial* basis for *insurance companies* to provide holders of these assets protection against *unfavourable* outcomes” (cf. Davidson, 2009, p. 9).

As to *functional efficiency* a great problem is concerned particularly with the existence of true *orderly financial markets* for *liquid* and *illiquid assets*, that is markets that encourage each holder (investor) of the securities/assets to believe they may have a fast *exit strategy* when they need suddenly decide for it. Indeed, as long as the future is *uncertain* and not just *probabilistically risky*, the price that *liquid* and *illiquid* assets can sell for at any future date in a free market could vary dramatically and almost instantaneously. That is, in real economic system there are no *perfect resale* markets for any assets and securities. As I shall try to show in par. 3, this is particularly relevant to understand what has happened for example to the prices of *real estates* and to *mortgage backed securities* and especially to *sub-prime mortgage derivatives* in USA.

⁸ On this point see Shiller's (2000) “irrational exuberance” and the acute observations by Arthur (1995).

2. Financial markets as complex and inherently flawed systems

As argued in the previous paragraph EMH is founded on A-D-type analytical context in which the hypothesis of *complete markets*, *perfect information* (that is given and common to all the players) and the idea that *risk* can be always *perfectly shared* or *insured*, seem at most applicable to an *ideal world* rather than to real economy. In this sense EMH is based on a *simplistic* approach since it assumes or seems to ignore the actual processes that unfold within and beyond *economic* and *financial complex systems* (cf. Rosser, 1999; 2001; Foster, 2005).

Behind an economy that consists of real and tangible aspects such as technologies, markets, financial institutions and firms there are indeed *beliefs*⁹ (cf. Arthur, 1995, p. 12) that are founded on *conventions*. The latter influence and guide the behaviour and the actions of the economic agents shaping, in aggregate, the macro economy. That is, in contrast with EMH (cf. Lucas, 1978) that largely ignored the people's behaviour, in preference to the observation of prices, "the way agents think about the environment, how they learn and process information ect.." does matter for economic decisions.

These *beliefs* form indeed an ocean of both *mutual competing* and *mutually reinforcing* entities and only "by accident" they get into a simple homogenous equilibrium set. More often they produce *complex*, ever changing patterns. Interacting, non equilibrium *beliefs* are unavoidable and since they govern economic behaviour they may give rise to *instability* and *crisis* in the financial markets¹⁰.

As pointed out recently by Marchionatti (2009; p. 2), Keynes was very well aware of these aspects since his work as an economist "was essentially an attempt to cope with the *complexity* of economic world and with the *organic interdependence* of the variables, founded on a conception of economics as science of *social complexity*"¹¹. As emphasized by this author, the most important loci of *economic complexity* in the General Theory are the analysis of the *long-term expectations* and that of the *business cycle* (cf. Marchionatti, 2009; p. 21-24). Concerning with *conventions* Keynes stressed

⁹ With similar arguments Shleifer (2000) considered *investors sentiment* as a cornerstone in the study of the behavior of *financial markets*.

¹⁰ Some (cf. Rosser, 2005) have argued that "complexity implies a new philosophical perspective on how humanity relates to nature and to the world indeed on how each individual does so, replacing formal deduction with inductive methods as analysts seek to understand an ever-changing and evolving *complex reality*."

¹¹ On this point see also Carabelli (1988), Rosser (1999).

the relevance of them for economic behaviour particularly in his 1937 article on the *Quarterly Journal of Economics*.

When Keynes wrote the General Theory the *leading actors* were the *stock market investors*¹² and investment depends on “the average expectation of those who deal on the Stock Exchange as revealed in the price of shares”(p. 151). Investors found their actions and decisions from *conventions*. The essence of *conventions* lies “in assuming that the existent state of affairs will continue indefinitely, except in so far as we have specific reasons to expect a change” (cf. p. 158)¹³ and: “knowing that our own individual judgement is worthless, we endeavour to fall back on the judgement of the rest of the world which is perhaps better informed. The psychology of a society of individuals each of whom is endeavouring *to copy* the others leads to what we may strictly term a *conventional judgement*” (cf. 1937, p. 115).

As stressed again by Marchionatti (cf. 2009), in financial markets the evaluations of the investment opportunities depend on the “judgement of the rest of the world” or on the attempt “to conform with the behaviour of the majority or the average” (Keynes, 1937, p. 114). Instead economic activity is fundamentally guided by *conventional judgement*. Very often both *entrepreneurs* and *stock market investors* must draw from motives which are “not rational in the sense of being concerned with the evaluation of the consequences” but rather “*decided by habit, instinct, preference, desire, will, ect...*” (Keynes, 1938, p. 249). These factors determine people’s *state of confidence* and therefore the magnitude of investment. Both *conventional judgements* and *animal spirits* make up a fundamental determinant of the *state of confidence*.

Furthermore, Keynes consider the meaning of the *state of confidence* as *twofold*:

“So far we have had chiefly in mind the *state of confidence of the speculator* or speculative investor himself and may have seemed to be tacitly assuming that, if he himself is satisfied with the prospects, he has unlimited command over money at the market rate of interest. This is not of course the case. Thus we must also take account of the other facet of the state of confidence, namely, the confidence of the *lending*

¹² In par. 3, I’ll argue that these *leader actors* have change during the latest *stage of capitalism* since an increasing role was assumed by *money-managers*.

¹³ Furthermore, quoting Keynes’s 1937 article he argued: “We assume that the present is much more serviceable guide to the future than a candid examination of past experience would show it to have been hitherto. In other words we largely ignore the prospects of future changes about the actual character of which we know nothing” and “We assume that the existing *state of opinion* as expressed in prices and the character of existing output is based on a correct summing up of future prospects, so that we can accept it as such unless and until something new and relevant comes into the picture”.

institutions towards those who seek to borrow from them, sometimes described as the *state of credit*. A collapse in the prices of equities, which has led disastrous reactions on the marginal efficiency of capital, may have been due to the weakening either of *speculative confidence* or of the *state of credit*. But whereas the weakening of either is enough to cause a collapse, recovery requires the revival of both. For whilst the weakening of credit is sufficient to bring about a collapse, its strengthening, though a necessary condition of recovery, is not a sufficient condition.” (1936, p.158)

The fluctuations of the *state of confidence* is what make the business cycle a “*highly complex*” phenomenon (cf. Marchionatti, 2009, p. 25). Expectations and investment cannot indeed be modelled by using *probabilistic* relationships, the study of instability and crisis are therefore beyond the domain of *probabilistic* inference as assumed by EMH. Put in more plain English, under conditions of *fundamental uncertainty* the behaviour of economic agents is so *complex* that a formal *probabilistic* treatment of expectations is not feasible.

In *complex economic systems* the predictability that is so successful for *hard sciences* does not work, and theories claiming *predictability* and *computability* have misled policy makers and continue to do so (cf. quotation of Taylor- Shipley in Davidson, 2009 p. 11). For crucial decisions that involved potential large spending outflows or possible large income inflows that span a significant length of time (as I have pointed out following the observations by Davidson and by other post-keynesian) *uncertainty* is *radical*.

There are indeed serious *epistemological* problem associated with *complex economic* systems which imply that there exist serious *bounds on the rationality*¹⁴ (cf. Dequech, 2001; Rosser, 2001; Marchionatti, 1999) of economic agents assumed by EMH models. These bounds take many forms, inability to understand the *internal relations* of a system, inability to fully know crucial parameter values, inability to identify critical thresholds or bifurcation points, inability to understand *the interactions of agents*, especially when *these agents are thinking about how each other are thinking about each others' thinking*¹⁵.

This can lead, in turn, to *group dynamics* as analyzed by Keynes for the well-known “*beauty contest*” where each party tries to guess the *average state of expectations* of

¹⁴ As well-known, the notion of *bounded rationality* is associated with the analysis by Simon (1987) which argued that “human behavior is *intendently rational*, but only *limitedly* so”. Following Dequech (2001, p. 913) with “*bounded rationality*” one denotes the type of rationality that people resort to when the environment in which they operate is too *complex* relative to their limited mental abilities; he tried indeed to establish a relation between *bounded rationality* and *fundamental uncertainty* via *complexity*.

¹⁵ Infinite regress problems imply non-decidability and non-computability for hyper-rational agents (cf. Rosser, 2004, p. 18 and Koppl-Rosser, 2002)

the other parties; i.e. participants in financial markets tend to be more interested at the *average level* of “*sentiment*” in the market than in the relation of prices to the “*fundamentals*”.

Quoting Keynes (1936, p. 156):

“... professional investment may be likened to those newspaper competitions in which the competitors have to pick out the six prettiest faces from a hundred photographs, the prize being awarded to the competitor whose choice most nearly corresponds to the average preferences of the competitors as a whole: so that each competitor has to pick, not those faces which he himself find prettiest, but those which he thinks likeliest to catch the fancy of the other competitors, all of whom are looking at the problem from the same point of view. It is not a case of choosing those which, to the best of one’s judgement, are really the prettiest, nor even those which average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences to *anticipating what average opinion expects the average opinion to be*. And there are some, I believe, who practise the fourth, fifth and higher degrees”.

Whenever forming expectations means predicting an aggregate outcome that is formed in part from *others’ expectations*, expectations formation can become *self-referential*.¹⁶

The problem of logically forming expectations that becomes ill-defined, and rational deduction finds itself with no bottom ground to stand upon: i.e the so-called *infinite regress problem* (cf. Arthur, 1995, p. 8) in decision making. The latter can imply *indeterminacy* of expectations formation and *non-computability* (cf. Koppl-Rosser, 2002). The *indeterminacy* of expectation-formation is by no means a *rarity* or *anomaly* within the real economy. On the contrary, it pervades all of economics and, as pointed out above using Keynes’s “*beauty contest*”, particularly the *financial markets*. This is the reason why one has to shift the ‘*paradigm*’¹⁷ suggested by EMH and consider the *dynamic complexity* of the *financial markets* (cf. Arthur, 1995; Rosser, 2005).

The “most obvious implication of the study of *complexity* in its various forms is indeed that a general assumption of *rational expectations* is very *unlikely* to hold: “complexity theory has shifted the perspective of many economists towards thinking that what was viewed as *anomalous* or *unusual* may actually be the usual and expected, especially in the realm of *asset market* where the *unusual* seems increasingly

¹⁶ *Self-referential* rationality or *cognitive rationality* has indeed been emphasized particularly by behavioural finance (Shleifer, 2000)

¹⁷ On this point see Fontana (2008) and Colander and al. (2009).

commonplace”! (cr. Arthur, 1995, p. 12). The indeterminacy of expectations formation may be avoided by making a decision only on “intuitive grounds” that is relying ultimately on “conventions”, “herding” and “animal spirits”.

When different people have different views about each other’s expectations the results can indeed be *dynamically complex*. This is the problem of *heterogeneous* expectations identified with the “narrow tent complexity” view (cf. Rosser, 2005 p. 9). As pointed out by Allen et al. (2003) for the stock markets, in the case of *heterogeneous agents* the consideration of *average expectation* that followed causes the failure of the law of *iterated expectations* about payoffs and agents *over-weight* the relevance of *public information* with respect to the private one, in forming their guesses¹⁸.

The fact that the result of one’s decision *depends* on the decisions taken by the others gives rise to a special character to *interdependence*. Nevertheless, interdependence in itself is not a source of *fundamental uncertainty*, since it may merely generate *complexity* in a constant, or predictability changing environment with sufficiently capable people. One have to consider *organic interdependence*, where the *whole may be more than the sum of its parts*. *Organic interdependence* create *fundamental uncertainty* in the sense that expectations must be about other people’s expectations and this spreads *fundamental uncertainty* (cf. Dequech, 2001, p. 919).

Following this approach, and in contrast to EMH, *financial markets* are indeed *complex dynamic systems*. In compliance with the analysis moved by Day (1994) and by Rosser (1999) a *system is dynamically complex if due to endogenous reasons it fails to converge to a point, a limit cycle, or a smooth explosion or implosion*. The reality of *complex dynamics* undermines the classical view on two grounds (cf. Rosser, 2005, p. 6): “first, the presence of *complex endogenous dynamics* means that the economy is not necessary *self-stabilizing* or *optimal* and *efficient*; second, that such dynamics *undermine* the assumptions of *rational expectations*”.

Even if no single definition is adequate, in compliance with Foster (2005; p. 877) one can discern different order of *complexity*¹⁹. *Forth-order complex systems (the so-called interactive knowledge case)* is particular important to study financial markets’ behaviour: “....Such systems come into being when *mental models* interact with each

¹⁸ Indeed, If one agent is asked to guess the *average* expectation of one asset’s pay-off, since he knows that others have also observed the same *public* information about the asset, *public information* become a better signal of the *average opinion* than the private information.

¹⁹ Foster (2005, p.) classifies 4 different types of complex systems: first order or the *imposed energy case*; second order or the *imposed knowledge case*; third order or the *acquired knowledge case*; forth order or the *interactive knowledge case*. For an exhaustive analysis and surveys of *economics of complexity* see Fontana (2008).

other. My imagination can still mould reality, but knowledge that this is so leads others to imagine what my imaginings might be”.

As I shall try to show in what follow, *complex dynamics* can lead to *fundamental uncertainty* and to *speculative* dynamics that imply *financial fragility* and the possibility of *financial crisis*. Several authors has pointed out that a source of *uncertainty* in *financial markets* is indeed linked to the *inability to know* what other people are thinking (cf. Carabelli, 1988; Davis, 1993; Arestis, 1996; Koppl and Rosser, 2002; Rosser, 2001).

This kind of *complex system* becomes prevalent when people form aspirations and commitments into the future and enter into forward contracts and other arrangements with terminal dates in the future. In financial markets *agents* are not *identical* and do not act according to the *rationality* assumed by EMH theorists, but they decide in compliance with Keynes’s “*beauty contest*” where *beliefs* are driven by the *state of confidence* and *conventions*.

But in this case, their activity can began a *bull market*²⁰ in the securities market (expecting from others buying and then, resell its assets when the trend is reaching its top level) fuelled by an *over-lending* and *over-borrowing* process in the *credit market*²¹. In this case, *efficiency* is not reached because not only capital is not allocated according to results of the entity, but also this strategy lead to *financial bubbles* followed by a market *crashes* (when other holders realise that their assets value is starting to *decrease*) a *credit crunch* and the risk of severe *downturns* like the ones occurred recently.

That is, such *financial complex systems* present many threats. In fact, when aggregate beliefs cease to bear a relationship to realistic possibilities in the presence of *positive feedback* (Arthur, 1990) or *positive information spillover* (i.e. a given trader is made

²⁰ That is expectations formation may be *instable*. At this respect, for example, Day and Huang (1990) labelled *herding-agents* as “sheep”, when these one dominate, their model shows destabilizing effects since market oscillates between chaotically rising *bull* markets and chaotically declining *bear* markets. On this point see also Farmer et al. (2002).

²¹ During a *boom*, over-indebtedness is linked to the magnitude of both *lender’s* and *borrower’s* attitude toward risk: “two types of risk affect the volume of investment which have not commonly been distinguished but which is important to distinguish. The first is the entrepreneur’s or *borrower’s risk* and arises out of doubts in his own mind as to the probability of his actually earning the prospective yield for which he hopes. If a man is venturing his own money, this is the only risk which is relevant. But where a system of borrowing and lending exists, by which I mean the granting of loans with margin of real or personal security, a second type of risk is relevant which we may call the *lender’s risk*. This may be due either to moral hazard, i.e. voluntary default or other mean of escape, possibly lawful, from the fulfilment of the obligation, or to the possible insufficiency of margin of security, i.e. involuntary default due to the disappointment of expectation.”...”during a boom the popular estimation of the magnitude of *both these risks*, both borrower’s risk and lender’s risk, is apt to become unusually and *imprudently low*”(See Keynes GT: p. 144-145). During a *burst* and a *crash* the effects are the opposite of the ones described above.

better off if *everybody* else is trading on his information) severe *structural discontinuity* can be the result²². This is in sharp contrast with most *information-based asset pricing models*: in these models the *information spillover* is indeed negative (i.e. a given trader is made better off if *nobody* else is trading on his information).

But these “*bull*” and “*bear*” *markets* as well as *booms* and *busts* may characterize not only the stock market, the exchange-rate market, the price of gold and other non-reproducible goods, but particularly the long-term bonds market, the markets for futures on commodities and, least but not last, the market for *real-estate*! (Cf. Tobin, 1984).

In *complex financial markets*, the participants does analyse more the reaction of the market they have in front than the fundamentals (this is in contrast with *information efficiency* stressed by EMH). If everybody has henceforth the *same way* of thinking (i.e. *herd behaviour* ; cf. Keynes, 1937)²³ this may promote indeed both a *boom* of the price on the rise, as well a *bust* in the decline. During an ascending trend, every operator knows pertinently that the price may deviate from *fundamental* value, and he knows that the others also know it, but everybody has anticipated that the *upward trend* was going on. This is, as already stressed, a *convention* (cf. Keynes, 1937)!

The *convention* notion refers to a *dynamic* phenomenon. It is about a code which has been gradually established in the market and which, unless being questioned by new information reaching a certain degree of importance, is called to last. Even the sceptic operators get caught up the purchase, considering indeed that it would be pity that they do not take advantage of a *surplus* value during the resale of the assets.

With *dynamic complexity* and *fundamental uncertainty* he does not buy the bond or other *asset* only because the intrinsic value is good, nor only because he thinks that the market things it is, but because *everyone thinks that the market thinks that the tendency is going to continue*. The purchase is *rational* given the *convention* which prevails at this moment. During a *crash*, the pattern is even simpler, the tacit agreement has been broken so that every operators begin to sell. Now, even when the assets becomes widely *devalued* compared with its intrinsic value, each operator, although realizing this fact, still forced to liquidate to not take the risk of having a worthless asset in his hands at the end.

²² Positive information spillovers are evident in Keynes’s *beauty contest*: the judges would be better off if they could coordinate their choices, even if they coordinate on somebody who is less than beautiful. Likewise, *short-horizon traders* would be better off if they could *coordinate* their research efforts on the *same* piece of information, even if that information is less revealing about the asset’s long-run value. This justify the relevance of *short-termism* in financial decisions making.

²³ On herding behavior see: Banerjee (1992) and Bikhchandani et al. (1992).

The *break* of the *convention* engenders a sum of behaviours called *self-referential*, symbolized by *mimicry* the *panic* not leaving any alternative. But it is also possible to wonder if it is not about a new *convention* which wants that, when certain threshold is reached in the decline, everyone settles his position. Each one knows that each one knows that is necessary to *withdraw* or to *sell*, and since no-one wants to wait for confirmation because the consequences to wait and see can be very dangerous.

Self-referential refers to the history. In fact, if each participant thinks that the uptrend, or the decline, is going to continue, because it has always been like that, and as everybody remembers. The collective consciousness, acquired by memorisation, even if tacit of past events, is omnipresent. Financial markets know also this tendency of *repetition*, which is maybe not rationalized by everyone, but every operator knows that large-scale movements stop late and brutally. Each one knows that the *tacit agreement* in the increase are rather long-lasting to have the time to buy and to resell more expensively before the crash (*no orderly exit strategy* as in EMH!). And if he has not had the time for resell, he perfectly knows how ends a fall of prices after the break of the *convention*. So the *self-referentiality* does not lead either to the *efficiency* of markets since such an *automatic* coordination leads inevitably to *financial fragility* and to *crisis*.

3. The “normal” evolution of complex financial systems towards fragility

In the previous paragraph I tried to show how a *complex financial* system is *inherently* flawed. As emphasized, this view is in contrast with the EMH and in compliance with FIH. *Financial instability* is indeed considered *endogenous* to the system: i.e. *booms* and *busts* are the result of the *internal dynamics* of the financial markets. In this paragraph I try to compound this theoretical approach trying to explain several aspects of the *current sub-prime* crisis.²⁴

To understand recent *financial turmoil*, one has before to outline that one²⁵ of the most important aspect of the USA economy²⁶ in ‘80s and ‘90s was the increasing role of

²⁴ Even if a complete analysis of 2008 crisis is, of course, beyond the aim of this paper.

²⁵ Another important aspect is connected with the *great moderation* period as a “radical suspension of disbeliefs” that is the idea that the world was more stable and less vulnerable to instability and crisis.

institutional investors-money managers. That is, financial markets in USA were indeed not driven primarily by masses of individual investors or even by a few huge professional stock-market investors (as stressed by Keynes in the GT; cf. par. 2) or by investment bankers, the leaders being *money-managers* (MM)²⁷!; *corporate executives* could not operate with the autonomy that they had in the early days after 2nd World War, since MM put intensive pressure on the former to *drive up* the short-term *stock market valuation* of their firms (cf. Wray, 2008). As well known, *money managed funds* includes not only *pension* and *mutual funds*, but also *venture capital funds*, *private equity funds*, and of course *hedge funds*²⁸.

The consolidation of market power in the hand of MM has been driven by a huge process of *financial liberalization*, *deregulation* and *reduce supervision* that has characterized the financial economic policy in USA for near thirty years. These policies had special relevance for two important aspects that characterized *structural changes* in the financial system: *securitization* and *globalization*. *Securitization* involved pooling illiquid assets (mortgages, car loans, student loans) and issuing *securities* representing an interest in the pool. On the other hand, financial *globalization* was link with the process of *internationalization* in both the *funds* and in the *assets* of the funds that has characterized the last stage of capitalism.

Furthermore, financial market *innovations*, by the early '80s, take many business away from banks (cf. Chick, 2008). Allowing for diversification of risk, these innovations, in the form of *issued securities collateralized* by pooled loans- eliminate the advantage banks had previously held. Trough these new instruments *institutional investors-money managers* continually *eroded* the bank share of assets and liabilities, *since pension*, *insurance* and *hedge funds* provided *new* and *alternative* source of funds and force banks to become more “*market oriented*” (cf. Wray, 2008, 2009). At the same time *lenders* “become more and more creative and enticed new and increasingly less creditworthy *homebuyers* into the market with exotic mortgages such as “interest only” loans and “option adjustable rate” mortgages”. (cf. Whalen, 2008, p. 12).

²⁶ In this paragraph I stress the evolution of the financial system in USA, but the importance of *money-managers* characterized all the so-called *Anglo-Saxon* or *market-based* models of financial capitalism.

²⁷ In his analysis of capitalist development Minsky labeled this era as *Money Manager Capitalism* (cf. Whalen, 2008)

²⁸ It is important to point out that these *institutional investors*, likewise *banks*, are fundamental and essential factors for the financing of investments and economic growth, that is for a well functioning of a modern capitalist system. Nevertheless, as I shall try to show taking into account the *complexity* of financial markets and in absence of strong *regulation* and *supervision*, they may *produce* and magnify *instability* as in the current crisis.

These *structural changes* in the system generate a *systemic* problem that results from the incorrect notions of EMH approach (cf. Par. 1) which stresses *functional efficiency* (cf. par.1), that is financial markets can *properly assess risk*, *hedge* and *shift* risk to those best able to bear it, and will always *discipline* decision making²⁹. Furthermore increasing competition encouraged ever-riskier activities forced *fund managers* to take on excessive risk given returns, to rely on *ratings agencies*. Since similar models were widely used, the model themselves drive *financial sophisticated* and *complex* markets – generating *herding* both inside the USA and outside³⁰. As argued in the previous paragraph *mimic behaviours* were founded on *complex dynamics* and *fundamental uncertainty*.

This environment may explain indeed, in my opinion, both the *over-lending* (by institutional investors, banks and other financial institutions) and *over-borrowing* (by households and firms) processes in the *credit market* and the *boom* phase in the value of *real estate* and in the *stock market* that drive the evolution towards the *fragility* of the financial system and then to *crisis*.

As to the *over-lending* process, even though from the microeconomic perspective no financial institution alone is sufficient to generate a lending *boom*, this may come about as a consequence of the action by *lenders* who, in a context of *complex dynamics* and *fundamental uncertainty* “*hunt in herds*”. In other words, financial institutions adapted their behaviour regarding the *granting of loans* to that of the others because in this way they had less to lose in terms of their *reputation* (cf. Keynes, 1936, 1937; Azariadis, 1981; Honohan, 1997).

Herding is also concerned with MM’s behaviour and to the *boom* phase in the *stock market* and in the prices of *real estates*. Taking a conservative or contrarian position as a *bubble* builds up should result indeed in performance *unfavourable* to peers and this might have affected the MM’s own employment and compensation.

As stressed *mimicry* (cf. par. 2) happens every time the operators act by *conventions* and by *observing* the behaviour of the others. Given that people’s decisions are influenced by their *beliefs* and that decisions constitute “signals” for others, the improvement (or deterioration) in the “*state of confidence*” can spread with more or less speed to the whole system.

²⁹ For further critical assessments of these arguments see Stiglitz, (1985).

³⁰ UK was the country that has the first symptoms of contagion (cf. par. 4) since its financial system’s reforms were very similar with the ones adopted in USA.

In a situation of *financial constraints*³¹, *over-indebtedness* may arise, which is fuelled by the excess availability of *supply of funds*. In practice, a right-ward shift in the supply of funds causes a shift in demand in the same direction (i.e. *households* and *firms* have indeed a passive role in the process) and this may explain why the economy moves progressively towards a *boom*. An improvement in the “*state of credit*” induced by *herd behaviour* increases indeed the value of *capital goods* and *real assets* but this, in turn, has positive effect on the credit constraints³² with *pro-cyclical* effects.

As well known, in USA the processes described above produced a *boom* phase, not only in the real economy (production, investment and employment) but particularly in the *housing* prices and in the *real estate* sectors. This *boom* began around the year 2000, after the “*dot.com*” bubble burst; *real estate* seemed the only safe bet to many Americans, especially since *interest rates* were unusually low.

When the aforementioned elements (which are not meant to be a comprehensive list of factors contributing to recent financial-market events) are mixed together the tendency was toward an increasing in the so-called “*Ponzi financial units*”³³ and then to an increasing of the overall *financial fragility*: i.e by *lending institutions*, by *households* and by *purchasers of mortgage-backed securities*.

4. From the credit crunch to the international financial crisis

The process of *over-indebtedness* described in the previous paragraph, essentially hinges on the *complexity* of the *financial system*. Since banks and other institution’s financial structure became particularly *fragile*, the risk of a *credit crunch* and of *systemic financial crisis* increased.

The weight of this growing risk resulted in a rise in the cost of credit in the *post-boom* phases. In fact, banks and institutional money funds intensified their *monitoring*

³¹ On this point see Fazzari-Papadimitriou (1992) and Stiglitz (1985).

³² The following statement by George Soros is significant in this respect (cf. Kregel, 1998, p.2): “the very act of lending may change expectations and thus the value of the collateral used to secure the loan. This suggests a *positive relation* between the value of the collateral and the value of the loan it secures, lending may strengthen the firm and thus the bank” and again Kiyotaki-Moore (1997, p. 212): “durable assets such as land, buildings and machinery play a dual role: not only are a factor of production, but they serve as collateral for loans. Borrowers’ credit limits are affected by the prices of collateralized assets. And in the same time, these prices are affected by the size of the credit limits”.

³³ As labeled by Minsky (1982).

activities with a consequent increase in the agency costs or of the *collateral* required because of the increase in the *lender's risk*. More particularly, this happened as soon as the payment obligations increased at a higher rate than the expected future cash-flow; *financial institutions* will be driven to hold that the new financial structure had worsened too much (in other words, they deem the increase in leverage excessive) and then pushed for a *reversal in tendency*. Furthermore, to the extent that the contracts made in the past were financed with *short term loans*, the evolution of the financing costs will have a negative impact on the value of these latest contracts when the time comes to refinance them. The worsening of the “*state of credit*” lead to a drop in *employment* and in the *production* financed with loans.

Moreover, on account of the *information asymmetry*, the interest rate rise will worsen the “quality” (*adverse selection*) of the patrimonial assets of the banks which, once the rate considered optimal is exceeded, may decide to *ration* the credit (cf. Whalen, 2008): this drove *investment, income* and *employment* down even further. At this point as the credit available to the private sectors was *rationed* or the conditions on which they can get access to credit became more onerous³⁴, *households* and *firms* were forced to liquidate their financial assets, or even sold their *real estates* in order to meet their obligations. Alternatively, they could attenuate the problems by offering their creditors further collateral (guarantees). However during the *credit crunch* the sale of *capital goods* and *real assets* triggered a *collapse* in the price of these *assets*³⁵ and so not only provoked a drop in the patrimonial value of *collateral* itself but, through the effect on the general price levels, caused a further drop in the internal net worth of *households* and *firms* in real terms³⁶.

The *credit crunch* also negatively influenced the *stock market*, the price of demand and the price of supply of *capital goods* (i.e. *real estate*) and therefore reduce the aggregate *consumption* and the aggregate *investment*, further aggravating the drop in *income* and *employment*. A deterioration in the “*state of credit*” therefore reduced the levels of income and employment not only directly, but also indirectly because of the process of *deflation* on the *prices of assets* which may be set off with effects on the real variables that, as we have seen, was the *opposite* of those which characterized the *boom*.

³⁴ In such a case the firms and households are said to be in *financial distress*.

³⁵ In contrast with EMH there are not any *perfect resale* markets for these kind of assets.

³⁶ Such a situation increased the risk of *debt-deflation* process (cf. Fisher, 1933; Roubini, 2007; Krugman, 2008). The fall in the value of capital goods may occur both because there is no market for them³⁶ (i.e. no *orderly financial markets* as in EMH case) and therefore the value that is realized is generally much lower than the effective one, and because if the desire for liquidity grows, the discount rate with which the entrepreneurs discount the future cash-flow which derives from the investment increases.

The first bank failure (i.e. Lehman Brothers on September 15th 2008) caused the foreign investors to lose *confidence* and raised the possibility of *bank panic*³⁷. In the USA case, for example, the first bankruptcies by *financial institutions* were actually interpreted as a sign that the entire financial system was in danger, and so many believed³⁸ that it was time to ask for the loans to be repaid, thereby triggering a *self-fulfilling* systemic crisis.

The latter further aggravated the negative impact on the real variables. Indeed, the drop in the lenders' *level of confidence* and the presence of *asymmetric information* among foreign investors (especially banks) and American banks and financial institutions, set off a withdrawal of capital even in respect of the ones which were still sound from a point of view of the balance sheet. This caused a big drop in loans and, through the multiplier, of deposits, thus driving other banks to *insolvency* and then to *bankruptcy*.

In compliance with FIH in a *complex financial system* one is not to be surprised by observing the huge wave of *defaults* by homeowners, highly leveraged mortgage-backed lenders, and holders of mortgage backed securities. This was partly due to *panic*, but it was also partly due to the recognition of the fact that precarious borrowing had woven its way into the entire system- indeed into the *global financial system*- and nobody really knew where the greatest dangers were (cf. Wray, 2008).

According to this analysis *panic* phenomena originated, once again, in a situation of *complex dynamics* and *organic interdependence* (cf. Par. 2), make it possible to explain the effect of *contagion* and *propagation* which occurred in the case of USA. The effect was even more disastrous because the prominent role of the *inter-bank market* caused a chain reaction *within* the area and also *among the banks* in the other countries³⁹.

The bankruptcies of several *banks* and *financial institutions* in USA, meant that there was a drastic reduction in funding for those firms which were not able to secure credit by turning to the market, instead of financial intermediaries⁴⁰. But the absence of bank financing led to "equity rationing" for many of them due to the effect of the

³⁷ The financial panics result when short-term debts looms large relative to short-term liquidity; some trigger investors into calling loans, and the borrower cannot refinance.

³⁸ As I have emphasized in par. 2, *herd behaviour* plays a key role also during the *bust* and the *crash*.

³⁹ Banks are operators which "produce" information and make it possible to reduce the phenomena of *adverse selection* and *moral hazard*. If they go bankrupt or their assets collapse due to *debt deflation*, the result is a drop in efficiency in the allocation of the resources between operators with a surplus and of funds and those with a deficit of funds, thereby lowering the levels of employment and production and may lead to the *collapse* of economic activity.

⁴⁰ According to Bernanke (1983), this effect seems to have been one of the factors which explains the persistence in the fall of the real variables during the Great Depression of the 1930s.

negative signal⁴¹ or the possibility of securing direct sources of financing only on onerous terms: the *information spillovers* (within individual countries) can therefore provide a plausible explanation of why the effects of the bank crisis were so devastating on the *stock market* inside USA.

The *information spillovers* also had a strong impact on *other* countries, having led to the possibility that phenomena of *financial instability present* in USA could be transmitted to others, with the same *institutional characteristics* as regards the *financial system* and by means of a change in the *global state of confidence*.

The emphasis on the failure of the *banks* and of the *financial institutions* and the process of *disintermediation* was therefore particularly important because it was linked to the phenomenon which led to *information destruction* and then to the *coordination failure*. The latter would inexorably led, in absence of international *lender's of last resort activity* and big *deficit spending policies*, to the risk of the collapse of the entire economic-financial system.

Conclusions

In this paper I have tried to contrast the *Efficient Markets Hypothesis* (EMH) with the *Financial Instability Hypothesis* (FIH) held by Hyman Minsky, taking into account the *dynamic complexity* of financial markets and the role of fundamental *uncertainty* and *organic interdependence*: this approach may provide indeed analytical tools to explain *crisis* through processes *endogenous* to contemporary economics.

The leading theoretical approach in finance (i.e. EMH) and in macroeconomics (i.e. NCM) were, up to date, unable both to *anticipate* and to *explain* the causes and the effects of such a *phenomenon*. In order to gain a more thorough understanding of what happened in the current *financial crisis* it is necessary indeed to re-elaborate a new approach which includes the role of *complexity* in the *financial system*.

Complex dynamics can fuel a *speculative bubbles* in assets markets and propel *over-reactions* both in *lender's* and *borrower's* attitude toward risk. These aspects can

⁴¹ In a phase of *deflation* the direct issue of shares is in fact perceived as a sign that the firm has not been able to obtain credit (see James, 1987).

lead, in turn, to *financial fragility* and *instability* and follow a variety of *complex dynamics*.

Taking into account these observations and the *structural* financial development occurred since '80, I have showed how the *internal dynamic* of the *financial system* through the actions of *money managers*, *bankers* and *financial institutions*, can lead to a process of overall *over-indebtedness*⁴² and increase the risk of *systemic* financial crisis. As for FIH approach a *complex financial system* is indeed inherently flawed: in absence of adequate economic policy, *booms* and *busts* phenomena in financial markets fuelled by *credit booms* and *busts*, may generate *endogenous* instability and *systemic* crisis like the one occurred for the so-called “*sub-prime crisis*”.

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⁴² In the absence of adequate institutions who exercise “supervision” and “prudential regulation”.

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