Minsky moments, Russell chickens, and grey swans: a reformulation of the financial instability hypothesis

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Introduction

The unexpected recent revival of Minsky's ideas among policy makers, practitioners and mass media, synchronized with the increasing gravity of the subprime financial crisis, demands a reappraisal of the meaning and the scope of the "financial instability hypothesis" (henceforth FIH). In this paper we aim to contribute to this challenging task by suggesting a restatement of the FIH core based on a generalization of Minsky's classification of financial units. In the light of this restatement we discuss then a few methodological issues that have to be clarified before a constructive reappraisal is possible.

Minsky's FIH has been discussed and extended by many scholars since its inception but it is not yet a full-fledged theory as a precise specification of the relationship between some of the crucial variables is still missing or remains largely implicit (a critical survey of much of the literature may be found in Tymoigne, 2006). For that reason Minsky has been often accused of "implicit theorizing" (see in particular Tobin, 1989). In this view the theoretical axioms are not clearly spelled out and their implications for explanation and prediction are insufficiently argued (Toporowski, 2005). For that reason most academic economists dismissed the FIH, although practitioners continued to consider it quite relevant for their choices. In our opinion this is a *non sequitur*. We have to take seriously the criticism of implicit theorizing but we should draw from it conclusions quite different

from those of his critics. Implicit theorizing is typical of new revolutionary theories (in the sense of Kuhn, 1962). After the first intuition of a new paradigm, the underlying theory is made fully rigorous and explicit only through the systematic work of generations of scholars. The invisible hand argument put forward by Adam Smith is a case of implicit theorizing. Walras and Pareto made a crucial step towards explicit theorizing about the working of a competitive market one century later, but only with Arrow and Debreu the theory has been fully axiomatized after almost two centuries of efforts on the part of generations of economists.[1] Therefore, in the case we believe –as we do- that in Minsky's contributions there are important insights that we cannot find elsewhere, we have to invest in their development and clarification in order to make them more explicit and operational.

What Schumpeter calls "pre-analytic vision" (Schumpeter, 1954) plays a crucial role in science, even in hard scientific disciplines such as physics (Kuhn, 1962). This role is particularly important in a discipline as economics that has to deal with the complexity of human motivations. What is really important in Minsky's original version of the FIH is the powerful pre-analytic vision of the working of a sophisticated financial economy, rather than the fragments of economic analysis in which he tried to translate it. We believe that Minsky's vision proved to be increasingly relevant for an economy in which finance has been playing a growing role.

In the second section we argue why Minsky's "vision" is so badly needed today. In the third section we develop a constructive criticism of Minsky classification of financial units that underlies his approach. This leads us to suggest a more general and operational classification. In the light of this revised classification, in the forth section we express in qualitative terms an elementary model that aims to express the core of FIH. In the light of this model, we are in a position to discuss in the fifth section some of the most controversial methodological issues underlying the FIH in the conviction

[1] The Arrow-Debreu model, however, lost much of the institutional, sociological and psychological insights that we find in Smith. More in general we should be aware that the process of making explicit a theory is almost never without costs, as it often relies on reductionist strategies.

that the future of the FIH depends on their constructive solution. Section 6th concludes.

2. Minsky moments, Russell chickens, and grey swans

The sudden popularity enjoyed by Minsky's financial instability hypothesis during the last financial crisis (and in other similar episodes before) reveals a widespread dissatisfaction with received economic wisdom, at least as far as financial crises are concerned. The prevailing point of view, betrayed also by the language used, is that while orthodox theory is good enough in normal conditions (believed to apply most of the time) it is unsatisfactory in abnormal times characterized by severe financial instability (Minsky moments). It is in particular impotent to forecast, avoid or mitigate a generalized and particularly deep financial crisis such as the subprime one. I contend that in order to understand financial crises and learn how to avoid or mitigate them, we need an approach much more general than that of conventional economics. The inadequacy of orthodox theory in times of financial crisis does not depend on details that can be easily added or mended, but on its vision of the working of a monetary economy, and in particular on a fundamental assumption that underlies its approach. This is the postulate of *regularity* of economic phenomena that is considered by many orthodox economists as a necessary requisite for economics as a "science".[2] The most lucid and uncompromising statement of this position may be found in Lucas (1981). In his opinion economics as a "science" has to be based on the equilibrium method that applies only to stationary stochastic processes: "insofar as business cycles can be viewed as repeated instances of essentially similar events, it will be reasonable to treat agents as reacting to cyclical fluctuations as "risk" or to assume their expectations are *rational,* that they have fairly stable arrangements for collecting and processing information, and that they utilize this information in forecasting the future in a stable way, free of systematic and easily correctable biases"

[2] This assumption is very similar to the postulate of "uniformity of nature" claimed, among others, by Galileo, Hume, Kant and Stuart Mill to lie at the foundation of natural science. Stuart Mill maintained that such a principle is a necessary foundation of inductive arguments. Inductivism has been subsequently rejected by philosophers of science such as Russell and Popper even in reference to natural sciences..

(Lucas, 1981, 224). Lucas does not deny that economic phenomena may be irregular, i.e. characterized by uncertainty (in the Knightian sense), instability, limited rationality, non-stationarity, less-than-rational expectations. He mentions in particular the Great Depression that "remains a formidable barrier to a completely unbending application of the view that business cycles are all alike" (Lucas, 1981, p. 273).. He claims, however, that the analysis of irregular phenomena has to remain outside the scope of economic science. In Lucas's opinion this is not a serious problem since the Great Depression is the only significant example of persistent irregularity in economic phenomena. This is considered, however, an exception the weight of which has been vanishing with time: "If the Depression continues, in some respects, to defy explanation by existing economic analysis (as I believe it does) perhaps it is gradually succumbing to the law of Large Numbers" (Lucas, ibidem, p. 284). This betrays the conviction that "it" cannot happen again and that the period of serious financial crises is over. This conviction proved to be just wishful thinking since, starting from the early 1980s we had financial crises of increasing severity and scope up to the grave subprime financial crisis that many observers likened to the Great Depression. In each of these occasions, there has been a revival of Minsky's contributions that have been rapidly dismissed and denigrated in periods of apparent calm. Many mass-media economists, practitioners (both in management and government), and many academic economists, act as if orthodox economics were the true theory in all moments, with the only exceptions of Minsky moments considered as extremely rare states of affairs (that, as Grenspan said, "happen once in a century"). They reason as if the universal laws of economics were temporarily and locally suspended in proximity of Minsky meltdowns. [3]

We may wonder if this schizophrenic attitude is justified. Minsky is typically rediscovered when it is too late to avoid or thwart the crisis, while

[3] Similarly many physicists, even illustrious ones, believed that the laws of physics were distorted or "suspended" in proximity of black holes. Oppenheimer for example maintained that time "stopped" in the region characterized by a black hole (Oppenheimer and Volkoff, 1939). Phisicists struggled to build a more general version of relativity theory able to account for the physics of black holes obtaining remarkable success in recent years (starting from Hawking and Penrose, 1970).

the seeds of the following ones, as he often emphasized, are sowed in periods of relative calm. We claim that we have to adopt a pre-analytic vision that is valid both in calm and stormy periods. It is here where Minsky's contribution is still fully valid. Its contributions apply in both situations and account for the transition from normal to troubled times. Of course, it is much more difficult to translate such a general vision in explicit analytic models. However, in our opinion, a good economic theory is much more than "a set of instructions for building" economic models (Lucas, 1981). The preanalytic vision (in the sense of Schumpeter, 1954) must be general enough to help us choose the right approach for the circumstances (Vercelli, 1985).

The practical implications of the regularist approach and the need of a more general point of view may be expressed through a parable freely inspired by a famous remark by the great philosopher Bertrand Russel:[4]

«In the animals farm (where each animal speaks and reasons as an *Homo economicus*) there was a flock of rational chickens (rational in the sense of Lucas) that were more than happy to run to the farmer every morning to be fed. Only one eccentric chicken was increasingly nervous as he had noticed that older chickens had periodically disappeared. He expressed the fear that the benevolent farmer was fatting them to bring them to the slaughterhouse. The other chickens did not take him seriously: they claimed that he was a lugubrious troublemaker and that if some chickens had disappeared this depended on the fox; however the farmer had already promised to raise and strengthen the fence. That night the eccentric chicken escaped from the farm before a stronger fence would prevent it and saved himself. The following morning all the other chickens were put on a lorry and brought to the slaughterhouse.»

The moral of this parable is that the rational chickens behaved according to a "science" based on empirical regularities (the farmer fed them all the mornings): their empirical regularity was apparently wrong only in a particular morning but that moment was the most important one.

[4] This is the remark: "The man who has fed the chicken every day at last wrings its neck instead, showing that more refined views as to the uniformity of nature would have been useful to the chicken" (Russell, 1912, chap IV, *On induction*)

The eccentric chicken saved himself because he had a more general point of view than his fellow "rational" chickens.

A more popular metaphor likens the subprime crisis to a different bird: a black swan. This metaphor was originally introduced by philosophers critical of empiricism that maintained the viability of induction from empirical regularities of universal laws such as "all the swans are white". When in the new-discovered Australia the explorers had just found black swans, they used this surprise as a criticism of induction. Since then, the expression *black swan* has been used to indicate an event having a very small probability in the light of past empirical evidence that however cannot be excluded from the set of possible events. This metaphor may be used, and has been often used in the past, to justify a regularist approach, provided that we skip the possibility of universal laws. If we leave in Europe we may be fairly confident that swans are white and this empirical regularity may be good enough to guide our choices in many circumstances. A landscape painter could safely decide to bring the colour white and not black to portray a swan swimming in a European lake. Such an attitude, however, would be wrongly applied to the current crisis for two basic reasons. First, although the probability of meeting a black swan (a Minsky moment or, worse, a Minsky meltdown) is low its effects are huge so that we have to give a lot of importance to this possibility.[5] Second, even the European swan is not always white: young swans are dark grey and become white only when become adult. A better metaphor for the financial crisis would be the "grey swan" because it is cyclically recurring. We need thus a theory of the vital cycle of swans in order to understand and forecast the colour of swans. This is what Minsky did: a theory that accounts for the whole life cycle of swans explaining why and how they change colour.

[5] Taleb in his bestselling book "The black swan" uses the metaphor in a sense similar to that here suggested (Taleb, 2007). In his opinion black swans have a crucial importance in Extremistan (although not so much in Mediocristan) and the world is becoming increasingly similar to Extremistan. This is particularly true with the world of finance.

3. A suggested classification of financial conditions

Minsky always started his numerous restatements of the FIH by a classification of the financial units according to their financial conditions (see, e.g., Minsky, 1982, 1986). We follow the same strategy in this paper as we need this sort of microeconomic foundations to be in a position to pursue the aggregate analysis of financial fluctuations. The main reason for this is that, contrary to what is often assumed in mainstream economics, financial conditions matter as they influence in a crucial way the behaviour of economic units. As is well known, Minsky distinguishes first of all between hedge and non-hedge financial units (speculative and Ponzi). Hedge financial units are characterized by realized financial outflows inferior to realized financial inflows and therefore do not have current problem of liquidity, and expect that this will happen also in each of the future periods within the decision time horizon. Speculative and Ponzi financial units, on the contrary, have problems of liquidity in the current period since their financial outflows exceed their financial inflows. Speculative financial units expect that these liquidity problems will characterize only the early periods of their decision time horizon while they expect a surplus of outflows in subsequent periods assuring their solvency. Ponzi units instead expect that their liquidity problems will last longer so that only a huge expected surplus in the final period of their time horizon will assure *in extremis* their solvency. The Ponzi units are characterized also by a second criterion: while the speculative units expect that their financial units will be always able to pay the interests of their debt this is not true for Ponzi units that have thus a much more urgent need to roll-over their debt.

Minsky uses this trinitarian classification in very suggestive way and applies it with a wealth of illuminating institutional and policy details. However this classification is not fully satisfactory for theoretical and empirical analysis being a strongly discontinuous measure applicable only to solvent units. We adopt a different classification that allows a continuous measure in a two-dimensional space and applies also to virtually insolvent units. The dimensions we choose are closely related to the two basic dimensions considered by Minsky in his classification: an index of liquidity in the current period, the *current financial ratio* k_{it}, that measures the ratio

between the current realized outflows e_t and the current realized inflows y_{it} in a certain period, and an index of solvency k^*_{it} that measures the capitalization of expected k^*_{it} for all the future periods within the time horizon m.

The current financial ratio is thus given by:

$$k_{it} = \frac{e_{it}}{y_{it}} \ .$$

Such a ratio may assume a value greater than *1* and sustain it for many periods provided that it is properly financed by the unit; of course this implies a corresponding reduction in the stock of cash balances or an increase in the stock of debt or a mix of the two, and this affects the financial constraints faced by the unit in the future.

The crucial variable that defines the financial viability of an economic unit may therefore be expressed in a very simple way as the *intertemporal financial ratio*, i.e. the capitalization of the expected k_{it} discounted in the usual way by means of the current rate of interest, within a given time horizon m:

$$k^*_{it} = E\left(\sum_{s=1}^{n} \frac{k_{it+s}}{(1+r)^{t+s}} \right).$$

We may define the following condition of financial sustainability:

$$(1) \qquad k^*_{it} \leq 1.$$

We can understand this condition in intuitive terms by observing that when $k^*_{it} > 1$ the "net value" of the financial unit is negative. In this case the unit is virtually insolvent unless it succeeds to promptly realize a radical financial restructuring or to be bailed out by other units or the state.

For the sake of simplicity we call k_{it} current financial ratio and k^*_{it} intertemporal financial ratio. These two indexes are expressed as ratios, rather than differences as in Minsky, because in this way we can represent

all the units within a box *1x1* or in the immediate proximity of its borders. In principle, there are infinite financial conditions that can be represented in such a Cartesian space and this is a significant advantage over Minsky's ternary classification for the dynamic analysis of financial fluctuations. However, if we consider the space at the left of the solvency barrier, we can easily verify that the units underneath the horizontal line may be defined as hedge units in the language of Minsky, while the units above may be defined as speculative or Ponzi units. Minsky does not explicitly consider in his classification the units beyond the vertical line that are virtually insolvent. We believe that this is a crucial shortcoming of Minsky's classification. A financial unit that is virtually insolvent according to the expectations of the unit itself or its creditors does not necessarily go broke as it may be bailed out by the state, or another firm through merger or acquisition or it may save itself through a radical restructuring/downsizing of its activity. The destiny of such *distressed* financial units, as we are going to call them, is crucial to describe, explain and forecast financial crises and in order to choose the best possible policy to keep them under control. So, for the time being, the suggested continuous measurement of units' financial conditions allows a ternary classification that is similar, but not identical, to Minsky's classification: hedge, speculative (and Ponzi), and distressed units.

In order to use this Cartesian space for the study of financial fluctuations we need a further essential ingredient. We assume that units, in order to minimize the risk of bankruptcy, choose a margin of safety, i.e. a maximum value of the intertemporal ratio sufficiently lower than 1, beyond which a unit does not want to go. Let's call the safety margin $0,5 < \eta < 1$. So we have to introduce a further vertical line at the left of the solvency barrier and this allows a refinement of the classification in six financial postures (see fig.1). Units in field 1 may be called hyper-hedge as they do not have problems neither from the liquidity point of view nor from the solvency point of view. Units in field 2 are speculative as they have liquidity problems but do not perceive solvency problems. Units in field 3 are hyper-speculative as they have liquidity problems and solvency problems. Units in field 4 are hedge units because they do not have liquidity problems but perceive that they may have solvency problems in the future

as their safety margin is too small. Finally we have to consider the units in financial distress. We can distinguish between highly distressed financial units being both illiquid and virtually insolvent (in field 5), and distressed units that are virtually insolvent but have managed in the current period to obtain financial inflows higher than the financial outflows raising hopes of survival (in field 6). This six-fold classification of financial conditions of economic units keeps a bridge with Minsky's classification but eliminates some of its shortcomings.

4. The core of financial instability hypothesis revisited

The modified classification of financial units suggested in the preceding section allows a reformulation of the FIH's core through a very simple model of financial fluctuations in the space defined by k_{it} and k^*_{it}. We contend that the basic building block of the FIH is the interaction between liquidity and solvency conditions (respectively *k and k*).* We refer the analysis to all economic units (financial and non financial firms and households) as their financial behaviour became in the last decades increasingly integrated. Of course, after this first stage of analysis, we have to specialize it for different categories of units. In this paper, however, we keep at the maximum level of abstraction.

The feedback between k_{it} and k^*_{it} may be described in the following way (see Vercelli, 2009 for a more detailed elaboration). As soon as a unit perceives to be beyond the safety margin μ_i , it reacts by reducing its current illiquidity margin (1- k_{it}) and its debt in order to decrease k^*_{it}. On the other hand, whenever it is within the safe zone ($k^*_{it} < \mu_i$) the unit is pushed by competition to increase the financial outflows more than the inflows, and thus k_{it} , in order to increase utility or returns. An increase in k_{it} in principle deteriorates k^*_{it} by increasing debt or by decreasing cash balances, and vice versa (see fig 1).

The feed-back between k_{it} and k^*_{it} may be represented by a very simple continuous-time model which aims to help an intuitive perception of the main causal relations:

$$(2) \qquad \frac{\dot{k}_{it}}{k_{it}} = -\alpha_i \left[k^*_{it} - (1-\mu_i) \right],$$

$$(3) \qquad \frac{\dot{k}^*_{it}}{k^*_{it}} = \beta_i \left(k_{it} - 1 \right),$$

where α_i, $\beta_i > 0$ represent speeds of adjustment of the unit i and a dot over a variable indicates the derivative with respect to time.[6]

A simple inspection of the phase diagrams of this specific model (of the well-known Lotka-Volterra type) immediately shows that, financial units tend to fluctuate in a clockwise direction around the equilibrium point ω_i (see fig. 1). The equilibrium ω is here a centre, while a shock shifts the representative point on a different orbit that may be external or internal to the original orbit (see, e.g., Gandolfo, 1971).

In order to understand the financial behaviour of economic units we have to introduce a further variable: financial fragility. This variable plays a crucial role in Minsky's approach but its meaning has been so far quite controversial. We define the financial fragility of a unit as the degree of its financial vulnerability that we measure as the minimal size of the shock that produces its virtual bankruptcy. In geometric terms, the degree of financial fragility is given by the distance between the representative point and the insolvency line (plus an infinitesimal magnitude). A different, but equivalent phrasing for the same concept could be the following: the minimal size of the shock that would make negative the net worth of the unit. Both definitions lead us to interpret financial fragility in terms of structural instability (see section 5).

By aggregating inflows and outflows of the single units we obtain aggregate outflows e_t , aggregate inflows y_t , an aggregate financial ratio k_t and an aggregate intertemporal financial ratio, k^*_t . We wish to emphasize

[6] The specification of this model is based on Vercelli (2000) and Sordi and Vercelli (2006). However, differently from both, the model is here expressed in continuous time. In addition, differently from (Vercelli 2000), shocks are not explicitly expressed. However, differently from Sordi and Vercelli (2006), they are taken into consideration in qualitative terms and play a crucial, although accessory, role in the restatement of the FIH here suggested (see section 5).

that this process of aggregation is not only a statistical device but the counterpart of a real phenomenon. The dynamic behaviour of units is fairly synchronized along the financial cycle for two reasons determining their herd-like behaviour. First, the pressure of the market pushes comparable commercial units to accept a similar risk-taking position to obtain returns not inferior to those of the other units. Second, mass psychology spreads waves of optimism and pessimism that affect most units; in consequence, the perception of risk becomes insufficient in the boom and excessive in depression. By aggregating the financial conditions of all private units we obtain a model with the same qualitative characteristics of the micro model.

So far, neither the micro nor the aggregate versions of the model explained the tendency to instability that is in-built in a sophisticated financial economy. In order to account for financial instability we have to introduce a further ingredient in our conceptual framework. We find it in the relationship between cognitive psychology and expectations formation. There are good reasons to believe that, if the boom lasts long enough, the increasing euphoria will significantly improve expectations and reduce the perception of risk. This is bound to shift the margin of safety to the right. This extends the phase in which the representative point moves upwards and rightwards for two basic reasons. First, the center of the ongoing cycle shifts to the right pushing each orbit towards the insolvency line. Second, the representative point shifts to orbits that are progressively more external as it continues to grow beyond the point on the original margin of safety at which it would have started to decline (see fig. 1). As a combined consequence of these two effects, the fragility of units progressively increases in a dangerous way. When the awareness of an excessive risk-taking finally spreads, it may be too late to avoid that the representative point comes very close to the insolvency barrier. This implies that a further shock would push many units beyond the solvency barrier and become virtually insolvent. Their outflows are thus drastically cut reducing by the same amount the inflows of other units so that many of them are pushed in their turn beyond the solvency line. This chain reaction triggers the acute phase of a financial crisis. When the contagion affects most units we have a *Minsky meltdown*.

This core of FIH has to be developed in different directions. In a companion paper I develop the analytical features of the model and its policy implications (Vercelli, 2009). In this paper I only discuss a few methodological implications of the approach here outlined.

5. Methodological implications

Although the heuristic model briefly discussed in the preceding section is extremely simple, it may be enough to discuss a few methodological issues that have hindered so far a much-needed development of Minsky's research programme.

Let me first observe that Minsky's vision is one of the bravest non-reductionist research programme in economics. The economic system is seen as an open evolutionary system characterized by irreversible time. This basic viewpoint has wide-ranging methodological implications (Vercelli, 2005). The system is thus characterized by complex dynamics and periods of regular behaviour should never be lightheartedly projected into the future. This is captured in the simplest possible way by our model. Although the feedback between k_t and k^*_t is expressed by two elementary equations it is enough to represent in the best possible way the crucial self-referential loop typical of a monetary economy between part and whole (k^*_t is nothing but the capitalization of expected k_t), between present (k_t) and future (k^*_t), between realized (k_t) and expected (k^*_t) values. It is well known that a self-referential loop of this kind easily leads to complex dynamics and chaos (Dieci, Sordi and Vercelli, 2006). The analysis cannot thus be restricted to stationary processes or to equilibrium states or paths without missing the most important part of the story and giving a misleading account of the rest.

Equilibrium has a role but only as a benchmark and reference point for the analysis of the complex dynamics of the system. To wit, ω_i is an equilibrium in the dynamic sense of the term, but it does not have the overtones of equilibrium modelling. In particular it does not maximize the objective function of the unit. In fact it is reasonable to assume that a higher point on the vertical passing through ω_i would be associated with higher utility or returns with the same margin of safety. However a unit set on ω_i cannot reach such a point without triggering a cycle characterized by a persistent disequilibrium. In fact a higher k_t would imply a higher k^*_t that

would thus trespass the safety margin and this would exert a downwards pressure on k_t . More in general the higher points on the vertical of the safety margin are transitory disequilibrium points. In any case we cannot assume that equilibrium states or paths are dynamically stable, nor that the dynamic system is structurally stable. On the contrary, Minskyan financial instability is a combination of dynamic and structural instability. Weak dynamic instability is sufficient to explain persistent financial fluctuations that periodically increase the financial fragility of the units. As we have hinted at before, financial fragility should be interpreted instead as a measure of structural instability, i.e. of the propensity of a financial unit to change radically the qualitative characteristics of its dynamic behaviour (Vercelli, 2001). Although we used the mathematical concept of structural instability to clarify the logical meaning of financial instability, we had to modify it substantially to apply it consistently to our object (by introducing ε-structural instability: see Vercelli, 1991). From the economic point of view the important point is that financial fragility cannot be interpreted correctly in terms of dynamic instability. It depends, however, on the dynamic instability of the cyclical path and affects it. The less dynamically stable is the financial cycle the higher the degree of financial fragility eventually reached by units, and conversely the higher the financial fragility of the system the more the contagion process increases both k_t and k^*_t enhancing during the crisis the dynamic instability of the system.

In the version here suggested of the FIH, as in that of Minsky, units' euphoria plays a crucial role in explaining financial instability in its dynamic and structural sense. By inserting in the model an endogenous mechanism of production of euphoria we would make dynamically unstable the financial fluctuations of the representative point. We prefer, however, to keep separate these two building blocks of financial instability because they are characterized by a different degree of regularity. The dynamic behavior of euphoria, though correlated with that of cyclical fluctuations, like all psychological phenomena is much more irregular and is subject to sudden changes that depend very much on a host of specific factors that may vary widely from country to country and from period to period.

We have to discuss at this point a possible objection to the specification of our model, The conservative nature of the model has been considered implausible in economics in other contexts because it implies structural instability in the strict mathematical sense: an infinitesimal perturbation would change the qualitative dynamics of the system (for example in the case of the Goodwin's model (1967); see, e.g. Desai (1973), and for a defence Vercelli, 1981) . In this case the first possible justification is that it somehow captures structural instability observed in the real world. There is something in this answer: in fact a small perturbation may change in the real world the cyclical path from dynamically stable to unstable and vice versa. However we believe, following Minsky, that the crucial factor of instability of a financial system is the periodic increase of financial fragility. For this to happen it is sufficient to assume that dynamic stability is too weak to thwart persistent fluctuations. In addition such a specification may be considered as a fit representation of what we believe to be a stylized fact: the interaction between liquidity and solvency conditions of financial units brings about persistent fluctuations that do not have an *intrinsic* tendency to change through time. It seems reasonable to argue that these changes, that no doubt are observed in the real world, depend on different factors.

The specification chosen for our model has the advantage of clarifying in the best possible way the role of shocks on the behaviour of the model.[7] This is another controversial issue as Minsky and his followers insist that financial instability is produced endogenously. This is fully confirmed by our model. However some followers go further and claim that shocks cannot have any active role in the FHI. In our opinion this assertion should be rejected. The concept of financial fragility is one of vulnerability to shocks and this is clearly the case in Minsky. This vulnerability is periodically built up for endogenous reasons as is shown also in our model. In addition the crucial shocks are also typically endogenous in the sense that they are produced within the economic system. There is no point however to exclude a role for exogenous shocks produced by forces not included in the theory (say, wars or natural catastrophes). This is particularly important if we use

[7] We define a shock as an impulse from a factor not considered explicitly in the model that impinges on the variables of the model.

models in the analysis. Since models are bound to circumscribe the object of analysis, many factors, also economic factors, are condemned to remain exogenous to the model so that their impact on the endogenous variables has the logical nature of an exogenous shock, even if we rightly believe that these factors are in fact endogenous to the economic system. To avoid confusion between the two meanings of endogenous (exogenous) we suggest to distinguish between endogenous (exogenous) in the usual meaning of factor (not) explicitly interacting with the endogenous variables of the model, and correlated (uncorrelated) shock for a factor exogenous to the model that we believe (not) to depend in the real world on the behaviour of the endogenous variables. Summing up, disturbances have a role to play in the FIH although it is very different from that played in conventional models of business cycle (see e.g. Lucas, 1981). In our case we would have fluctuations anywhere, while the relevant disturbances are sizeable and identifiable.

Of course, since the economic system is considered as an open process characterized by irreversible time and complex dynamics it is intrinsically unpredictable. This does not imply that we are left completely without compass in our decisions. We cannot rely on traditional probability theory and conventional decision theories, unless we are in a period of tranquility. Even in this case, however, conventional probability theory and decision theory under uncertainty can be used, but only with the greatest caution. We have to resort to non-conventional probability theory (such as Choquet theory of capacities) or non-conventional decision theories in condition of hard uncertainty. In particular we should expect the periodic emergence of financial fragility and the risk of recurrent financial crises, unless we take structural measures to mitigate them.

In such a world the economic agents cannot be rational in the usual sense. We cannot assume that agents succeed in converging instantaneously to the equilibrium position maximizing their objective function. This, however, does not imply sheer irrationality. A rational agent may rely on rules of behavioral rationality adapting in the best possible way to a changing environment, taking account of the influence that may be exerted on the environment (Vercelli, 2005).

In the complex world of FIH the relationship between microeconomics and macroeconomics is much more complex than in conventional economics. The analysis of macroeconomic fluctuations is based on a previous analysis of the financial conditions of economic units but is not a simple linear aggregation of average behaviors. Aggregation is rooted in real word processes through mechanisms of market pressure based on the correlation between returns and risk taking that induces a generalized convergence towards the average *1-μ*, and the effect of herd behavior that derives from a psychological mechanism that determines the procyclical movement of *1-μ*.

The behaviour of a financial unit studied in isolation from the movement of the other units is unlikely to exhibit a very regular pattern because each of them is heavily conditioned by specific features: different risk aversion, technological impulses, regional constraints, and so on. A certain degree of regularity and synchronization is conferred to single units by the common influence exerted on them by aggregate financial fluctuations (see next section). A full-fledged behavioural analysis of units' dynamic behaviour requires thus macroeconomic foundations while the study of aggregate fluctuations has to rely on microeconomic foundations in conceptual terms (definition of the financial conditions of single units). The interaction between micro and macro foundations is not a vicious logical circle but the consequence of a real process: the financial behaviour of each unit is heavily influenced by the behaviour of all the other units as expressed by aggregate indexes.

6. Concluding remarks

In this paper we argued that Minsky's FIH initiated a research programme that is still worth pursuing to understand the working and evolution of financial capitalism and in particular the recurring episodes of financial instability. What is really important in Minsky's contributions is the underlying vision of the working of a sophisticated monetary economy rather than the analytical constructs in which he tried to translate it. We maintained in particular that the complex and well-articulated vision underlying the FIH did not lose the grip with the real world. On the

contrary, its relevance for understanding, preventing, or at least mitigating, financial crises has actually increased, provided that we update and develop his insights also from the analytical point of view. However, we cannot succeed in this task unless we understand the original, profound and far-reaching methodological approach designed and practiced by Minsky himself. This paper pursued this direction of analysis by suggesting a more general classification of units' financial conditions- The alternative classification here suggested has the advantage of being continuous and considering explicitly also the units virtually broke. This allowed a study of units fluctuations in the Cartesian space of financial conditions that has been used to clarify the kernel of Minsky'a FIH and his powerful methodological approach. We hope that the restatement here suggested of the core of Minsky's FIH may be a starting point to update and develop it in order to increase its theoretical and empirical scope.

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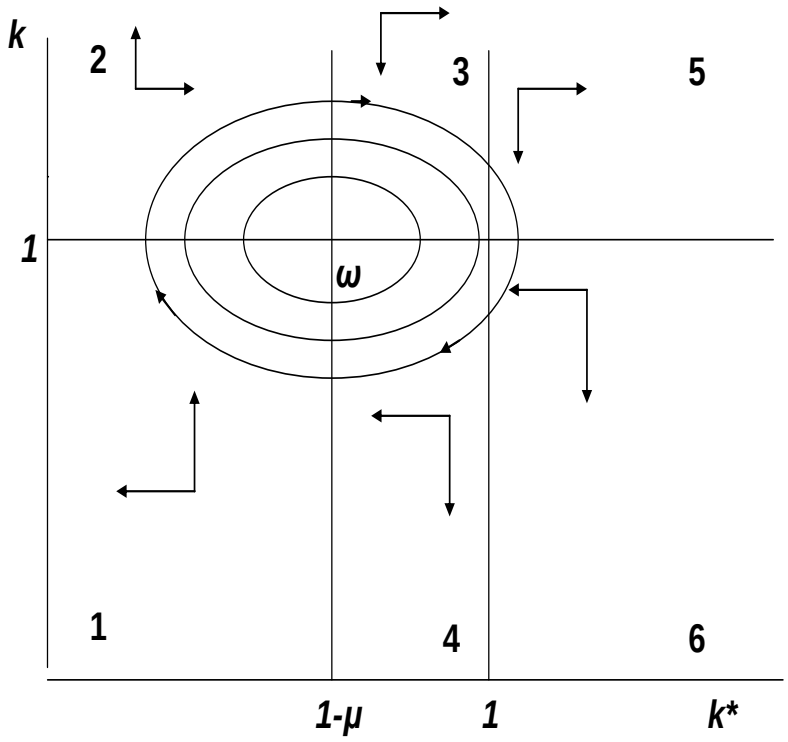

Fig. 1

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