Working Paper No. 582

Minsky Moments, Russell Chickens, and Gray Swans: The Methodological Puzzles of the Financial Instability Analysis

by

Alessandro Vercelli
Department of Economic Policy, Finance and Development (DEPFID),
University of Siena

November 2009

The Levy Economics Institute Working Paper Collection presents research in progress by Levy Institute scholars and conference participants. The purpose of the series is to disseminate ideas to and elicit comments from academics and professionals.

The Levy Economics Institute of Bard College, founded in 1986, is a nonprofit, nonpartisan, independently funded research organization devoted to public service. Through scholarship and economic research it generates viable, effective public policy responses to important economic problems that profoundly affect the quality of life in the United States and abroad.

The Levy Economics Institute
P.O. Box 5000
Annandale-on-Hudson, NY 12504-5000
http://www.levy.org

ABSTRACT

The recent revival of Hyman P. Minsky's ideas among policymakers, economists, bankers, financial institutions, and the mass media, synchronized with the increasing gravity of the subprime financial crisis, demands a reappraisal of the meaning and scope of the "financial instability hypothesis" (FIH). We argue that we need a broader approach than that conventionally pursued, in order to understand not only financial crises but also the periods of financial calm between them and the transition from stability to instability. In this paper we aim to contribute to this challenging task by restating the strictly financial part of the FIH on the basis of a generalization of Minsky's taxonomy of economic units. In light of this restatement, we discuss a few methodological issues that have to be clarified in order to develop the FIH in the most promising direction**.**

Keywords: Financial Instability; Financial Fragility; Financial Fluctuations; Subprime Crisis; Minsky Moments; Minsky Meltdown; Speculative Units; Hedge Units; Ponzi Units; Business Cycles

JEL Classifications: B50, E, E32, E44, G

1. INTRODUCTION

Although Minsky's financial instability hypothesis (FIH) has been discussed and extended by many scholars since its inception, 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 [2006a, 2006b, and 2006c]). 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 and 2008). For that reason most academic economists dismissed the FIH, although a few high-level 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 many of Minsky's critics. Implicit theorizing is typical of new revolutionary theories (in the sense of Kuhn [1970]). 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 model a 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, since we believe that in Minsky's contributions there are important insights that we should not ignore, we have to invest in their development and clarification in order to make them more explicit and operational.

What Schumpeter calls "preanalytic vision" (Schumpeter 1954) plays a crucial role in science, even in hard scientific disciplines such as physics (Kuhn 1970). This role is particularly important in a discipline such 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 preanalytic vision of the working of a sophisticated financial economy, rather than the fragments of economic analysis in which he tried to translate it; see, in particular, Minsky (1975, 1982, 1986). We believe that Minsky's vision proved to

[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 a theory explicit is almost never without costs, as it often relies on reductionist strategies.

be increasingly relevant for an economy in which finance has been playing a growing role.

The structure of the paper is as follows. In the second section we discuss 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 light of this revised classification, in the fourth section we express, in qualitative terms, an elementary model that aims to express the core of FIH, i.e., its strictly financial part. 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 with the conviction that the future of the FIH depends on their constructive solution. Section 6 concludes.

2. MINSKY MOMENTS, RUSSELL CHICKENS, AND GRAY SWANS

The sudden popularity enjoyed by Minsky's FIH during the subprime 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 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). Conventional theory is believed to be impotent to forecast, avoid, or mitigate a generalized and particularly deep financial crisis such as the subprime one. We 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 mainstream 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:

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

> "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." (Lucas 1981: 224)

Lucas does not deny that economic phenomena may be irregular, i.e., characterized by uncertainty (in the Knightian sense), disequilibrium, instability, nonstationarity, bounded rationality, and, thus, 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: 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 deep and persistent irregularity in economic phenomena. He believes, however, that this historical episode has been an exception and that its weight in secular trends 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 1981: 284)

This assertion betrays the conviction that "it"—a severe and persistent financial and economic crisis comparable to the Great Depression—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 have had financial crises of increasing severity and scope up to the grave subprime financial crisis that many observers likened to the Great Depression. In recent crises 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 even many academic economists often speak, write, and act as if orthodox economics were the true theory in most moments, with the only exceptions of Minsky moments considered as extremely rare states of affairs (that, as Greenspan said,

"happen once in a century"). They reason as if the 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, since the seeds of the following ones, as he often emphasized, are sown in periods of tranquility (Minsky 1975). We claim that we have to adopt a preanalytic vision that is valid both in calm and stormy periods. It is here where Minsky's FIH is still inspiring. 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. In our opinion, however, 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 2005).

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 Russell (1912):[4]

> "In the animals farm 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. One day he expressed the fear that the benevolent farmer was fatting them for the slaughterhouse. The other chickens did not take him seriously. They protested that he was a lugubrious troublemaker and that if some chickens had disappeared this depended on a fox occasionally perturbing the farm's tranquility. They claimed, however, that no one should worry for the future as the farmer had promised to strengthen the fence the day after. 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."

[3] Similarly, many physicists, even illustrious ones, believed that the laws of physics were distorted or "suspended" in proximity to black holes. J. Robert Oppenheimer, for example, maintained that time "stopped" in the region characterized by a black hole (Oppenheimer and Volkoff 1939). Physicists 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]).

[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).

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 on a particular morning, but that moment was the most important one. The eccentric chicken saved himself because he had a more general point of view than his fellow "rational" chickens.

A popular metaphor likens the subprime crisis to a different bird: a black swan. When explorers in the newly discovered Australia the found black swans, this surprise started to be used as a criticism of induction from empirical regularities to universal laws such as "all swans are white." 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), but cannot be entirely excluded from the set of possible events. Regularism, however, may still be defended on practical terms. According to the pragmatic version of the regularist view, such as that suggested by Lucas, if we live in Europe, we may be fairly confident that swans are white and this empirical regularity may be good enough to guide our choices in most circumstances. A landscape painter, for example, could safely decide to bring the color white, and not black, to portray a swan swimming in a European lake. Such an attitude, however, would be wrongly applied to financial crises for two basic reasons. First, although the probability of meeting a black swan in Europe is low, its effects (in our case, the consequences of a Minsky moment or, worse, a Minsky meltdown) are huge, so we have to take this possibility very seriously.[5] Second, even European swans are not always white: young swans are dark gray and become white only when they become an adult. Thus, we need a theory of the life cycle of swans in order to understand and forecast their color. Financial crises are gray (rather than black) swans because they are cyclically recurring. We need a theory that accounts for the whole life cycle of financial conditions to explain how they periodically change color and, under given circumstances, may become dark black. This is what Minsky did with his FIH.

3. A SUGGESTED CLASSIFICATION OF FINANCIAL CONDITIONS

Minsky often started his numerous restatements of the FIH by a classification of the financial units according to their financial conditions; see, for example, Minsky (1982

[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), while the world is becoming increasingly similar to Extremistan. This is particularly true with finance.

and 1986). We follow the same strategy in this paper, as we need this sort of microeconomic foundation 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 the behavior of economic units in a crucial way. As is well known, Minsky distinguishes between hedge and non-hedge financial units (speculative and Ponzi). Hedge financial units are characterized by realized financial outflows not exceeding realized financial inflows and therefore do not have liquidity problems in the current period; they expect that this will also happen 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, as 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 expect instead 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 also characterized by a second criterion: while the speculative units expect to be always able to pay the interest due, this is not true of Ponzi units that have a much more urgent need to roll-over their debt.

Minsky uses this threefold classification in a very suggestive way and applies it with a wealth of illuminating institutional and policy details. However, his taxonomy is not fully satisfactory for theoretical and empirical analysis, being a 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 period t, k_{it}, that measures the ratio between the current realized outflows e_{it} 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 $k_{it} = e_{it} / y_{it}$. Such a ratio may assume a value greater than 1 (which implies a financial deficit) and sustain it for many periods provided that it is properly financed; this implies a corresponding reduction in the stock of cash balances, 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 be expressed in a very simple way by an index of solvency, or net worth, of the unit obtained by capitalizing the expected k_{it}. We may thus define the following condition of financial sustainability:

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

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

These liquidity and solvency indexes are expressed as ratios, rather than differences (as in Minsky) because in this way we can represent all the units within a 1x1 box 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, in our opinion, this may be a significant advantage over Minsky's ternary classification for the dynamic analysis of financial fluctuations. However, we may keep in touch with Minsky's taxonomy: if we consider the space to the left of the solvency barrier, we can easily verify that the units underneath the horizontal line are hedge units in the language of Minsky, while the units above are speculative or Ponzi units. In his classification, Minsky does not explicitly consider the units beyond the vertical line that are virtually insolvent. We believe that this is a crucial shortcoming of Minsky's classification. A virtually insolvent financial unit does not necessarily go broke, as it may save itself through a radical restructuring/downsizing of its activity, or it may be bailed out by the state or other firms. The destiny of such *distressed* financial units, as we are going to call them, is crucial in describing, explaining, and forecasting financial crises, as well as in choosing the best possible policy to keep them under control. Therefore, the suggested continuous measurement of a unit's 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 solvency ratio sufficiently lower than 1, a threshold beyond which a unit does not want to go. Let's call

the safety margin $1 - \mu$ and let's assume that $0.5 < 1 - \mu < 1$. 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 figure 1). Units in field 1 may be called hyperhedge, as they do not have problems either from the liquidity point of view or 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 hyperspeculative, as they have both liquidity problems and solvency problems. Units in field 4 are hedge units because they do not have liquidity problems, but perceive that they may incur solvency problems in the future because 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 (field 5), and distressed units that are virtually insolvent, but in the current period have managed to obtain financial inflows in excess of financial outflows, therefore raising hopes of survival (field 6). This sixfold classification of financial conditions of economic units keeps a connection with Minsky's classification while trying to eliminate 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_{it} *and* k^*_{it}). We applied the analysis to all economic units (financial and nonfinancial firms and households), as their financial behavior became increasingly integrated in the last decades. This approach is sometimes followed also by Minsky (Arestis and Glickman 2002: 240). Of course, after this first stage of analysis, we should customize it for different categories of units. In this paper, however, we keep the analysis at a high 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 itself to be beyond the safety margin $1 - \mu_i$, it reacts by reducing its current illiquidity margin $(1 - k_{it})$ in order to decrease k^*_{it}. On the other hand, whenever it is within the safe zone ($k^*_{it} < 1 - \mu_i$) 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 of k_{it} beyond the

liquidity line ($k_{it} > 1$), in principle, deteriorates k^*_{it} by increasing debt while worsening expectations and vice versa (see figure 1).

The feedback 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:

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

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

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]

The phase diagrams of this Lotka-Volterra model show that financial units tend to fluctuate in a clockwise direction around the equilibrium point ω_i (see figure 1). The equilibrium ω_i is here a center, while a shock shifts the representative point on a different orbit that may be external or internal to the original orbit; for example, see Gandolfo (1997).

In order to understand the financial behavior 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 quite controversial so far (Goldsmith 1982). We define the financial fragility of a unit as the smallest 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 financial fragility of a unit is given by the smallest size of the shock that would make the net worth of the unit negative. 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 liquidity ratio k_t, and an aggregate solvency ratio, k^*_t. We interpret this process of aggregation not only as a statistical

[6] The specification of this model is based on Vercelli (2000) and Sordi and Vercelli (2006). The model here is expressed in continuous time, while shocks are taken into consideration in qualitative terms and play a crucial, although accessory, role (see section 5).

device, but as the counterpart of a real phenomenon. The dynamic behavior of the units is fairly synchronized along the financial cycle for two reasons that determine their herd-like behavior. 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.

The aggregate model so obtained explains why in a monetary economy there is a tendency toward persistent financial fluctuations. This is sufficient to account for the periodic increase of financial fragility when the representative point moves clockwise in fields 2 and 3 (see figure 2). When the economy gets close to the solvency line, a shock may push the most fragile units beyond the solvency line, determining their virtual bankruptcy. Their outflows are thus drastically cut, reducing the inflows of other units by the same amount so that many of them, in turn, are pushed beyond the solvency line. This chain reaction triggers the acute phase of a financial crisis. When the contagion affects many units and triggers a recession, we have a *Minsky meltdown*.

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

5. METHODOLOGICAL IMPLICATIONS

Although the heuristic model briefly discussed in the preceding section is extremely simple, it may be a useful reference for discussing a few methodological issues that have, so far, hindered a much-needed development of Minsky's research program.

Let me first observe that Minsky's vision is much less reductionist than most other research programs in economics. The economic system is seen as an open evolutionary system characterized by irreversible time. The system is thus characterized by complex dynamics so that periods of regular behavior cannot be lightheartedly projected into the future. This basic viewpoint has wide-ranging methodological implications (Vercelli 2005 and 2009). We tried to capture some of them in the simplest possible way through the model sketched above. The model may be sufficient to

represent the crucial self-referential loop in a stylized way, typical of a monetary economy, between part and whole (as k^*_t is nothing but the capitalization of expected k_t), and between present (realized k_t) and future (expected k^*_t). It is well known that a self-referential loop of this kind easily leads to complex dynamics and chaos; an example with a similar model may be found in Dieci, Sordi, and Vercelli (2006). Thus, the analysis cannot be restricted to stationary processes, equilibrium states, or steady paths (as in conventional economics) 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 analyzing the complex dynamics of the system. For example, in figure 1 the point ω_i is an equilibrium in the dynamic sense of the term, but this does not entail the normative overtones of conventional equilibrium modeling. In particular, there is no reason to believe that the objective function of a unit is maximized at this point. On the contrary, it seems reasonable to assume that a higher point on the vertical passing through ω_i may imply 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, according to the dynamic equations of the model, an exogenous shift towards a higher k_t would soon push k^*_t to breach safety margin and this would start to exert downward pressure on k_t . More in general, the higher points on the vertical describing the safety margin are transitory disequilibrium points.

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 stability alone would be sufficient to explain persistent financial fluctuations that periodically increase the financial fragility of units, but, as we have hinted at before, financial fragility should be interpreted instead as a measure of structural instability, i.e., the propensity of an economic unit to radically change the qualitative characteristics of its financial behavior. Although we referred to the mathematical concept of structural instability to clarify the logical meaning of financial instability, in order to apply it consistently to our object we had to modify it substantially by introducing ε-structural instability; see Vercelli (1991 and 2001). From the economic point of view, the important point is that financial fragility cannot be interpreted correctly in terms of mere dynamic instability. It depends, however, on the dynamic instability of the cyclical path and also affects it. We can infer from the model above that the less dynamically stable the financial cycle is, the higher the degree

of financial fragility eventually reached by the units; conversely, the higher the financial fragility of the system, the worse the contagion process that enhances the dynamic instability of the system during the acute phase of the crisis.

In the version of the FIH's core suggested here, as in that of Minsky, a unit's euphoria does not play a crucial role in explaining financial instability, both in its dynamic and structural sense, as the mechanism underlying financial fluctuations would produce financial instability and fragility even without euphoria. This is not to deny, however, that euphoria is typical of a sufficiently persistent boom and that its spreading encourages over-indebtedness and a more speculative stance of units, accelerating the inception of a financial crisis and aggravating its manifestations. By inserting in the model an endogenous mechanism of production of euphoria during the boom, we would make the financial fluctuations of the representative point dynamically unstable (Vercelli 2009). We prefer, however, to 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 very much depend on a host of specific factors that may vary widely from country to country and from period to period.

At this point we have to discuss a possible objection to the specification of the model. The model's conservative nature (in the dynamic sense) has been considered in other contexts as quite implausible in economics because it implies structural instability in the strict mathematical sense: an infinitesimal perturbation would change the qualitative dynamics of the system—a case in point is Goodwin's (1967) model, which has been criticized for this reason, for example, by Desai (1973), while an early defense on this point may be found in Vercelli (1983). In the model suggested in this paper, a possible justification is that this specification 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. We believe, following Minsky, that the crucial factor of instability of a financial system is the periodic increase in financial fragility that gradually emerges in periods of tranquility: "[…] success breeds daring, and over time the memory of past disaster is eroded. Stability—even of an expansion—is destabilizing […]" (Minsky 1975:127). For this to happen it suffices to assume that dynamic stability is too weak to thwart persistent fluctuations. In addition, such a specification may be

considered as an appropriate 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 are no doubt observed in the real world, depend on different factors that remain exogenous to this specification of the FIH's core.

The specification chosen for our model may help us to clarify another controversial methodological issue: the role of shocks in a model of financial fluctuations.[7] In our suggested approach, as we believe in that of Minsky, the financial cycle is explained by the structural characteristics of the economy, as represented by the equations of the model and is in sharp contrast with the conventional view prevailing in macroeconomics since the late 1970s. As is well known, the latter is based upon the equilibrium approach worked out by Lucas in the 1970s (Lucas 1981). In this view, business cycles should not be interpreted as disequilibrium fluctuations around an equilibrium trend, as was usual before, but as the consequence of random shocks displacing equilibrium without disrupting it. As for the nature of relevant shocks, the prevailing view changed through time. In the first version of equilibrium business cycle Lucas considered relevant shocks as essentially monetary impulses brought about by discretionary decisions of monetary authorities. In the early 1980s the prevailing view shifted towards the "real business cycles" approach (Kydland and Prescott 1982), where fluctuations are produced by real shocks (mainly technological impulses). A bit later, New Keynesian economics struggled to reintroduce Keynesian features in the model, such as asymmetric information; for a survey, see Clarida, Gali, and Gertler (1999). The ensuing "New Consensus" added real and nominal rigidities to the equilibrium approach, but did not modify it in a substantial way (Woodford 2003). On the contrary, in a model based on the FIH, shocks are not essential in explaining persistent financial fluctuations or a financial crisis. In particular, we do not need shocks to explain the periodic increase of speculative attitudes, indebtedness, and financial fragility of most units. This is not to say, however, that disturbances do not have any role to play in a FIH approach:

> "A break in the boom occurs whenever […] reversals in present-value relations take place. Often this occurs after the increase in demand financed by speculative finance has raised interest rates, wages of labor, and prices of material." (Minsky 1986: 220)

[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.

Reversals in present-value relations (that is, when k^*_{it} breaches the solvency barriers) are more probable the higher the fragility of the units. In a fragile financial system, even a "slight disturbance" may precipitate a crisis (Minsky 1964). The concept of financial fragility is one of vulnerability to shocks that is periodically increased for endogenous reasons, as is also shown in our model. In addition, the triggering shocks are also typically endogenous in the sense that they are produced within the economic system. There is no point, however, in excluding a role for exogenous shocks produced by forces not included in the theory (say, wars, natural catastrophes, or foreign impulses; see Arestis and Glickman [2002]). This is particularly important if we use 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 exogenous, we suggest distinguishing between *exogenous shock* in the usual meaning of factor not explicitly interacting with the endogenous variables of the model, and *uncorrelated shock* for a factor exogenous to the model that we believe to be also independent of endogenous variables in the real world. Summing up, disturbances have a role to play in the FIH; however, that role is very different from the one played in conventional models of the business cycle. In the conventional models, shocks are essential and not easily identifiable:

> "[…] we are used to thinking of shocks as exogenous events, arising from 'outside the model' so to speak. However, econometricians typically do not measure shocks directly but instead infer them from movements in macroeconomic variables that they cannot otherwise explain." (Bernanke 2004)

In this view, shocks are, by definition, the cause of fluctuations that economic fundamentals cannot explain, while in the FIH we would have fluctuations anyhow; in addition, the relevant disturbances affecting them are sizeable, identifiable, and have, in principle, an explanation.

Since the economic system is considered by the FIH 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 and decision theories unless we are in a period of tranquility. Even in this case, however, conventional probability and decision theories can

be used, but only with the greatest caution. We have to resort to unconventional probability theory (such as Choquet theory of capacities) or unconventional decision theories in conditions 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 the 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).

Finally, we emphasize that in the open 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 a unit's financial conditions, but is not derived from a simple linear aggregation of average behaviors. Aggregation is rooted in real-word processes that we mentioned above (section 4). The behavior of a financial unit, studied in isolation from the movement of other units, is unlikely to exhibit a very regular pattern because each unit 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.

Summing up, a full-fledged behavioral analysis of a unit's dynamic behavior requires macroeconomic foundations, while the study of aggregate fluctuations has to rely on microeconomic foundations (analysis of a single unit's financial conditions). The interaction between micro- and macro-foundations does not involve a vicious logical circle, as it is the consequence of a real process: the financial behavior of each unit is heavily influenced by the behavior 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 program that is still worth pursuing in order to understand the working and evolution of financial capitalism and, in particular, the recurring episodes of financial instability. What is really topical of

Minsky's contributions is the underlying vision concerning the working of a sophisticated monetary economy, rather than the analytical constructs in which he tried to translate it. In particular, we maintained that the complex and well-articulated vision underlying the FIH did not lose its 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 its insights from the analytical point of view. However, we cannot succeed in this task unless we understand the far-reaching methodological features of the approach designed and practiced by Minsky himself. This paper pursued this direction of analysis by suggesting a more general taxonomy of a unit's financial conditions. We argued that this alternative classification has the advantage of being continuous and has the ability to explicitly include the units that are nearly bankrupt. This allowed a study of a unit's fluctuations in the Cartesian space of financial conditions that has been used to clarify the core of the FIH and Minsky's powerful methodological approach. We hope that the approach here advocated may be a starting point to update and develop the FIH in order to increase its theoretical and empirical scope.

REFERENCES

Arestis, P., and M. Glickman. 2002. "Financial Crisis in Southeast Asia: Dispelling Illusion the Minskyan Way." *Cambridge Journal of Economics* 26(2): 237–260.

Bernanke, B.S. 2004. "The Great Moderation." Remarks at the meeting of the Eastern Economic Association, February 20, Washington, DC.

Clarida, R., J. Gali, and M. Gertler. 1999. "The Science of Monetary Policy: A New Keynesian Perspective." *Journal of Economic Literature* 37(4): 1661–1707.

Desai, M. 1973. "Growth Cycles and Inflation in a Model of the Class Struggle." *Journal of Economic Theory* 6(6): 527–545.

Dieci, R., S. Sordi, and A.Vercelli. 2006. "Financial Fragility and Global Dynamics." *Chaos, Solitons and Fractals* 29(3): 595–610.

Gandolfo, G. 1997. *Economic Dynamics*. Study Edition, 3rd completely revised and enlarged edition. Berlin: Springer Verlag.

Goldsmith, R.W. 1982. "Comment." in C.P. Kindleberger and J.-P. Laffargue (eds.), *Financial Crises: Theory, History, Policy.* Cambridge, UK: Cambridge University Press.

Goodwin, R. 1967. "A Growth Cycle." in C.H. Feinstein (ed.), *Socialism, Capitalism and Economic Growth*. Cambridge, UK: Cambridge University Press.

Hawking, S.W., and R. Penrose. 1970. "The Singularities of Gravitational Collapse and Cosmology." *Proceedings of the Royal Society of London, Series A, Mathematical and Physical Sciences* 314(1519): 529–548.

Kuhn, T.S. 1970. *The Structure of Scientific Revolutions*, 2nd edition. Chicago: Chicago University Press.

Kydland, F.E., and E.C. Prescott. 1982. "Time to Build and Aggregate Fluctuations." *Econometrica* 50(6): 1345–70.

Lucas, R.E. 1981. *Studies in Business in Business Cycle Theory.* Oxford: Basil Blackwell.

Minsky, H.P. 1964. "Financial Crisis, Financial System and the Performance of the Economy." in Commission on Money and Credit (ed.), *Private Capital Markets.* Englewood Cliffs, NJ: Prentice-Hall.

————. 1975. *John Maynard Keynes*. New York: Columbia University Press.

————. 1982. *Can 'It' Happen Again? Essays on Instability and Finance.* Armonk, NY: M.E. Sharp.

————. 1986. *Stabilizing an Unstable Economy.* New Haven, CT: Yale University Press.

Oppenheimer, J.R., and G.M. Volkoff. 1939. “On Massive Neutron Cores.” *Physical Review* 55(1): 374–381.

Russell, B. 1912. *The Problems of Philosophy.* London: Williams and Norgate.

Sordi, S., and A. Vercelli. 2006. “Financial Fragility and Economic Fluctuations.” *Journal of Economic Behaviour and Organization* 61(4): 543–561.

Schumpeter, J.A. 1954. *A History of Economic Analysis.* Oxford: Oxford University Press (reprinted by Allen and Unwin, London, 1982).

Taleb, N.N. 2007. *The Black Swan: The Impact of the Highly Improbable.* New York: Random House.

Tobin, J. 1989. Review of *Stabilizing an Unstable Economy* by Hyman P. Minsky. *Journal of Economic Literature* 27(1): 105–108.

Toporowski, J. 2005. *Theories of Financial Disturbance.* Cheltenham, UK: Edward Elgar.

————. 2008. “Minsky’s ‘Induced Investment and Business Cycles’.” *Cambridge Journal of Economics* 32(1): 725–737.

Tymoigne, E. 2006a. “The Minskyan System, Part 1.” Working Paper 452. Annandale-on-Hudson, NY: The Levy Economics Institute of Bard College.

————. 2006b. The Minskyan System, Part 2.” Working Paper 453. Annandale-on-Hudson, NY: The Levy Economics Institute of Bard College.

————. 2006c. “The Minskyan System, Part 3.” Working Paper 455. Annandale-on-Hudson, NY: The Levy Economics Institute of Bard College.

Vercelli, A. 1983. “Is Instability Enough to Discredit a Model?” *Economic Notes* 3(1): 173–189.

————. 1991. *Methodological Foundations of Macroeconomics. Keynes and Lucas*. Cambridge, UK: Cambridge University Press.

————. 2000. “Financial Fragility and Cyclical Fluctuations.” *Structural Change and Economic Dynamics* 11(1–2): 139–156.

————. 2001. “Minsky, Keynes and the Structural Instability of a Sophisticated Monetary Economy.” in R. Bellofiore and P. Ferri (eds.), *Financial Fragility and Investment in the Capitalist Economy*. Cheltenham, UK: Edward Elgar.

————. 2005. “Rationality, Learning and Complexity.” in B. Agarwal and A. Vercelli (eds.), *Psychology, Rationality and Economic Behaviour: Challenging Standard Assumptions*. London: Palgrave Macmillan (IEA series).

————. 2009. “A Perspective on Minsky Moments: The Core of Financial Instability Hypothesis in Light of Subprime Crisis.” Working Paper 579. Annandale-on-Hudson, NY: The Levy Economics Institute of Bard College.

Woodford, M. 2003. *Interest and Prices: Foundations of a Theory of Monetary Policy*. Princeton, NJ: Princeton University Press.

Figure 1: Classification of Financial Units and the Cycle of Financial Conditions

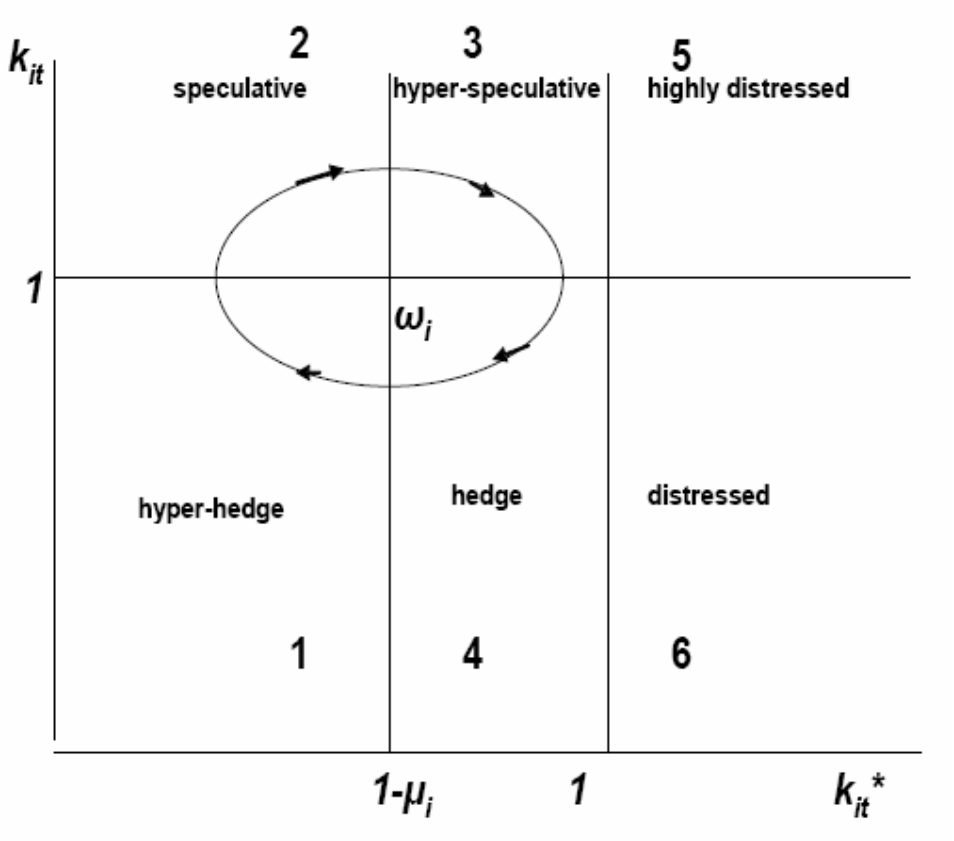

Figure 2: Aggregate Financial Fluctuations