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A Perspective on Minsky Moments: The Core of the Financial Instability Hypothesis in Light of the Subprime Crisis*

by

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ABSTRACT

This paper aims to help bridge the gap between theory and fact regarding the so-called “Minsky moments” by revisiting the “financial instability hypothesis” (FIH). We limit the analysis to the *core* of FIH—that is, to its strictly financial part. Our contribution builds on a reexamination of Minsky’s contributions in light of the subprime financial crisis. We start from a constructive criticism of the well-known Minskyan taxonomy of financial units (hedge, speculative, and Ponzi) and suggest a different approach that allows a continuous measure of the unit’s financial conditions. We use this alternative approach to account for the cyclical fluctuations of financial conditions that endogenously generate instability and fragility. We may thus suggest a precise definition of the “Minsky moment” as the starting point of a Minskyan process—the phase of a financial cycle when many financial units suffer from both liquidity and solvency problems. Although the outlined approach is very simple and has to be further developed in many directions, we may draw from it a few policy insights on ways of stabilizing the financial cycle.

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

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1. INTRODUCTION

This paper aims to bridge the gap between the stylized facts on so-called "Minsky moments" and existing theory by revisiting Hyman Minsky's "financial instability hypothesis" (henceforth FIH; in particular, see Minsky [1982] and [1986]) in the light of the "subprime" (mortgage) financial crisis. Our analysis in this paper is limited to the "core" of the FIH, that is to its strictly financial part. Since the emphasis is on the bridge between theory and facts, neither theory nor facts are analyzed in depth. This may be done later if the bridge here suggested, or a more sophisticated version of it, will be able to withstand critical scrutiny. In particular, we will not discuss to what extent the subprime crisis conforms to Minsky's FIH, as this sort of analysis would require a thorough reconstruction of Minsky's approach and of subprime crisis that are both beyond the scope of this paper; on this issue, see Kregel (2008) and Davidson (2008).

The expression "Minsky moment" was coined in 1998 in occasion of the crisis of Russian debt by Paul McCulley, manager of bond funds at PIMCO, an investment company that runs one of the largest bond funds. This neologism became a fashionable catch word during the subprime crisis as it was soon adopted by other top-level practitioners and analysts such as George Magnus (2007a, 2007b, 2007c, and 2008), senior economic adviser at UBS Investment; by leading financial journalists, such as Martin Wolf (2007 and 2008) of the *Financial Times*; Justin Lahart (2007) of the *Wall Street Journal,* and John Cassidy (2008) of *The New Yorker*; and also by a few academic economists, such as C.J. Whalen (2008), L. Randall Wray (2008), Paul Davidson (2008), Riccardo Bellofiore and Joseph Halevi (2009), and Jan Kregel (2009). Most definitions of Minsky moments put forward in these writings have in common the declared purpose of establishing a link between crucial features of the subprime financial crisis and Minsky's FIH. However, the features underlined are different and not always clearly defined. Let's examine a sample of the existing definitions. Some of them define a Minsky moment as a point in time, consistent with the usual meaning of moment. Examples are: "the point where credit supply starts to dry up" (Magnus 2007a); and "the point at which a financial mania turns into panic" (Wolf 2008). Most definitions of a Minsky moment, however, refer to a process of undetermined length that is supposed to be short-lived, at least relative to the periods of financial tranquility. Examples are: "a self-feeding process of debt-deflation" (McCulley 2001); "when over-indebted investors are forced to sell even their solid investments" (Lahart 2007); "when lenders become increasingly cautious" (Magnus 2007c); "credit crunch or Minsky moment" (Whalen 2008); and "when the Ponzi pyramid financial scheme collapses" (Davidson 2008). The two categories of definitions do not exclude each other since a point of time may start a process, but we should always be explicit on the time dimension we are speaking about. To avoid confusion, throughout this paper we will distinguish between a *Minsky moment* and a *Minsky process*, defining the first as the starting point of the second. More troubling is the fact that the existing definitions focus on disparate aspects of a financial crisis that may play a distinctive role in different historical episodes. In this paper we aim to provide a more rigorous definition of a Minsky moment based on a restatement of the core of the FIH.

The approach outlined here is conflicting with a few consolidated principles of conventional economic analysis, both dynamic and structural instability play a crucial role (expectations are not rational), cognitive and psychological aspects play a role in explaining agent's behavior and economic processes are not stationary. Many commentators recently maintained, even in leading mass media, that mainstream economics proved to be unable to predict and suggest efficacious policy interventions to prevent, thwart, and mitigate financial crises. We maintain that this depends on the postulate of the regularity of economic phenomena underlying mainstream economics and justifying its reductionist focus on stable equilibria, while ignoring disequilibrium, instability, bounded rationality, and strong uncertainty (Vercelli 1991 and 2005). Minsky's vision is able to cope with financial crisis because it clearly rejects the regularity assumption and is able to articulate an alternative vision in which disequilibrium, instability, limited rationality, and subjective features play a crucial role (this point is developed in a companion paper [Vercelli 2009]).

The structure of the paper is as follows. In the second section we briefly reconsider the well-known Minskyan classification of financial units in three categories (hedge, speculative, and Ponzi). A constructive criticism leads us to suggest a different, more general classification that allows a continuous measure of a unit's financial conditions. The field of possible financial conditions is then decomposed into six subfields that define categories of financial conditions having a clear relation to Minsky's taxonomy. In the following two sections we use the classification of economic units suggested here in order to explain the cyclical fluctuations of their financial conditions that lead to a Minsky moment. In the third section we discuss the fluctuations of a single unit's financial conditions, while in the fourth section we analyze the financial cycles of the private sector as a whole. In the fifth section we extend somewhat the model in order to clarify a few policy implications on the mitigation of financial crises. The sixth section concludes.

2. THE CLASSIFICATION OF FINANCIAL UNITS: THE SHORTCOMINGS OF MINSKY'S TAXONOMY AND A SUGGESTED ALTERNATIVE

The financial conditions of economic units affect their behavior in a crucial way. Therefore, in order to understand a unit's behavior, we have to analyze how their financial conditions change over time. Minsky was therefore on the right track when, at the risk of looking repetitious, started his numerous versions of the FIH on a classification of a unit's financial conditions (in particular, see Minsky [1982 and 1986]). The classification of a unit is often restricted (by Minsky himself and his followers) to banks or firms in general. In the spirit of Minsky, who on a few occasions emphasized how revealing is to look at all economic units as banks, we apply this classification to all economic units, including households (see Arestis and Glickman [2002]). Minsky's well-known threefold taxonomy of hedge, speculative, and Ponzi units is based on two indexes, one describing the current liquidity of the unit and the other its expected solvency. The index of current liquidity of unit *i* at time *t* is given by the current excess (or net) financial inflows m_{it} , i.e., the difference between the current financial inflows of unit *i* at time *t*, y_{it}, and the current financial outflows of unit *i* at time *t*, e_{it}:

$$m_{it} = y_{it} - e_{it} . \qquad (1)$$

The index of solvency of unit *i* at time *t* is given by the capitalized expected net inflows m^*_{it} that may be expressed in the following way:

$$m_{it}^{*} = \sum_{s=0}^{n} \frac{\mathrm{E}\left[m_{it+s}\right]}{\left(1+r\right)^{s}} , \qquad (2)$$

where n designates the time horizon of the unit's decision strategy and r the nominal rate of interest.[2] The value of m^*_{it}, which may be interpreted as a rough measure of the unit's net worth, is considered positive for all the units included in the taxonomy:

$$m^*_{it} > 0. \tag{3}$$

The index of solvency plays a crucial role in Minsky's analysis of the dynamics of a unit's financial conditions and their possible shifts to a different category of the taxonomy. Since, however, the index of solvency does not discriminate between different categories of the taxonomy at a given point of time, we ignore it in this very brief account of Minsky's taxonomy in its static version.

As is well known, the basic distinction introduced by Minsky is between hedge and speculative units. A hedge unit is characterized by realized financial outflows inferior to realized financial inflows in each period:

$$\begin{aligned} &m_{it} > 0, && \text{in the current period } (t = 0), \\ &E(m_{it}) > 0 && 1 \leq t \leq n, \end{aligned} \tag{4}$$

where E designates the expectations operator. Therefore, a hedge unit does not have current problems of liquidity and expects that this will happen also in each of the future periods within the decision time horizon. On the contrary, a speculative unit is characterized by:

$$\begin{aligned} &m_{it} < 0, && t = 0, \\ &E(m_{it}) < 0, && t < s < n,\ s \text{ small}, \\ &E(m_{it}) > 0, && s \leq t \leq n. \end{aligned} \tag{5}$$

[2] We warn the reader that Minsky would have considered this procedure of discounting simplistic; see Tymoigne (2006a: 13–14). We adopted it here for the sake of comparison with the alternative classification suggested below.

A Ponzi unit is characterized instead by:

$$\begin{aligned} m_{it} &< 0 && t = 0, \\ E(m_{it}) &< 0 && 1 \leq t \leq n\text{-}1, \\ E(m_{it}) &>> 0 && t = n. \end{aligned} \quad (6)$$

Since their financial outflows exceed their financial inflows, both speculative and Ponzi financial units have problems of liquidity in the current period. Speculative financial units, however, 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. On the contrary, the Ponzi units expect their liquidity problems to persist in all the future periods within their time horizon with the only exception being the last one, when a huge surplus is expected to assure, *in extremis,* their solvency. The distinction between speculative and Ponzi units is meant to signal the different gravity and urgency of liquidity problems. To this end, Minsky suggests a second criterion of distinction: speculative units can repay interest due, but not principal in all t, while Ponzi units cannot repay even the interest due in all periods but the last one. This second criterion provides stimulating insights on the implications of different degrees of speculative finance; it applies, however, at a level of abstraction lower than that of the first criterion, as it requires a disaggregation of inflows and outflows in different categories (income, balance sheet, and portfolio). Since we are not dealing with a disaggregation of this kind, we will leave the discussion of this issue for another time. We stress, however, that the first criterion does not imply the second and vice versa.

Minsky's classification of financial units has been, and still is, a source of inspiration for the concrete analysis of financial crises, because its use by Minsky and followers is full of illuminating historical and institutional details. From the analytical point of view, however, this threefold classification is wanting and is likely to have hindered quantitative-oriented and model-based developments of the FIH. The first weakness is that all the units in the taxonomy, even the Ponzi units, are considered solvent, as they satisfy condition (3).[3] The idea behind this choice is probably based on the common view that a virtually insolvent unit is bound to bankrupt and that a bust unit is an interesting issue for corporate law rather than for economic

[3] Minsky himself occasionally betrays the temptation of considering Ponzi units as virtually insolvent. He came to say that the net worth of a Ponzi unit is negative "for any honest computation of present value" (Minsky 1977).

analysis. However, a virtually insolvent unit (characterized by $m^*_{it} < 0$) does not need to bankrupt, as it may be rescued by a private or public bail-out, or it may get out of trouble through a prompt adoption of extraordinary measures, such as the sell-out of illiquid and strategic assets to realize a radical downsizing or redirection of activity. Second, in any case, even the bankruptcy (in legal sense) of a unit does not fully discontinue its economic and financial consequences, as is obvious in the case of big banks. As we have observed during the subprime crisis, the economic impact of virtually insolvent units may be particularly important in a financial crisis when many units become virtually insolvent in short sequence, but there is a climate of opinion particularly favorable to their rescue. In any case, their financial outflows have to be radically curtailed and this severely cuts the inflows expected by recipient units. This significantly increases the financial fragility of the latter units that may, in turn, be pushed beyond the solvency line, and so on. This process of contagion is especially virulent if big units are involved, particularly when they are linked by a thick and complex web of financial relations with many other units. A paradigmatic case is that of Lehman Brothers in the subprime crisis. This may lead to what has been called a Minsky meltdown, a self-feeding process of contagion that, in the absence of prompt and radical intervention, may become a devastating epidemic. In what follows, we call *distressed* financial units the virtually insolvent units. In our opinion, the analysis of their dynamic behavior is crucial in describing, explaining, and forecasting financial crises, as well as in choosing the best possible policy strategy to keep them under control.

The second criticism of Minsky's taxonomy regards its articulation in just three discrete categories. Its underlying liquidity and solvency indexes are simply characterized by two-valued magnitudes. The liquidity index m_{it} may be positive in all periods (hedge units) or negative in some of them (speculative and Ponzi units). In the real world, however, units are characterized by different degrees of liquidity or illiquidity. Analogously, in Minsky's taxonomy the index of solvency may by only either positive (when the unit is solvent) or negative (when it is virtually insolvent). In the real world, the degree of solvency or virtual insolvency may be higher or lower. This may be understood better by observing, as Minsky himself did, that within his cash-flow approach the solvency index may be interpreted as the net worth of the unit: when the net worth is positive the unit is solvent, while it becomes virtually insolvent as soon as its net worth becomes negative. We are interested, however, not only in the sign, but also in the measure of units' net worth.

In order to overcome the shortcomings of Minsky's taxonomy we suggest a classification of a unit's financial conditions based on modified continuous measures of liquidity and solvency. We restate the liquidity index as a continuous variable k_{it} that measures the ratio between the current realized outflows e_{it} and the current realized inflows y_{it} in a certain period t

$$k_{it} = \frac{e_{it}}{y_{it}} \ . \qquad (7)$$

Such a ratio may assume a value greater than 1, and sustain it for many periods, provided that it is properly financed; of course, 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, as well as its net worth.

We restate the solvency index as a continuous variable k_{it}^* that measures the capitalization of expected excess outflows k_{it} for all the future periods within the time horizon n, discounted in the usual way on the basis of the current rate of interest:

$$k_{it}^* = \frac{\sum_{s=0}^{n} \mathrm{E}\left[e_{it+s}\right] / \left(1+r\right)^s}{\sum_{s=0}^{n} \mathrm{E}\left[y_{it+s}\right] / \left(1+r\right)^s} \qquad (8)$$

We may thus define the following condition of financial sustainability:

$$k_{it}^* \leq 1. \qquad (9)$$

For the sake of simplicity we call k_t *liquidity ratio* and k_{it}^* *solvency ratio*. These two indexes are expressed as ratios, rather than differences (as in Minsky), because in this way we can represent all the possible financial conditions in a Cartesian diagram of coordinates k_{it} and k_{it}^* within a box with dimensions of 1x1 or in the immediate proximity of its borders. This favors a rigorous analytic formulation of the core of the FIH while keeping in touch with its economic meaning through its geometric representation. To this end, we draw in the Cartesian diagram a horizontal line starting from k_{it} = 1 that we call *liquidity line,* as the units have liquidity problems when they breach it (i.e., for values of $k_{it} > 1$). Analogously, we draw a vertical line at $k^*_{it} = 1$ that we call *solvency line* (or *barrier*), as units get virtually insolvent beyond it. In principle, there are infinite financial conditions that can be represented in such a Cartesian diagram and this seems a significant advantage over Minsky's threefold classification for the dynamic analysis of financial fluctuations. However, we may keep in touch with Minsky's classification. The units underneath the liquidity line to the left of the solvency line may be defined as hedge units in the language of Minsky ($m_{it} > 0$, $m^*_{it} > 0$), while the solvent units above the liquidity line may be defined as speculative or Ponzi units ($m_{it} < 0$, $m^*_{it} > 0$; see table 1 for more precise rules of conversion between Minsky's taxonomy and that here suggested).

In order to use the Cartesian space spanned by k_{it} and k^*_{it} for the study of financial fluctuations we need a further essential ingredient. In order to minimize the risk of bankruptcy, we assume that units choose a margin of safety (i.e., a maximum value of the solvency ratio sufficiently lower than 1) beyond which a unit does not want to go, fearing unexpected (but possible) contingencies that would make it insolvent (see Kregel [2008] on the origin and meaning of this margin of safety). Let's define the safety margin of unit *i* as 1 - μ_i, such that 0.5 < 1- μ_i < 1. We have thus to introduce an additional vertical line at the left of the solvency barrier that represents the desired safety margin (see figure 1). This allows a refinement of the classification of financial conditions into six financial postures. Units in field 1 may be called *hyper-hedge*, as they do not have problems 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 are still solvent, but have liquidity problems and worry about their excessive fragility. Units in field 4 are *hedge units*, as they have surmounted their liquidity problems, but perceive that they are still too fragile so that they struggle to increase their safety margin. Finally, we have to consider the units in financial distress beyond the solvency line. We can distinguish between *highly distressed financial units* being both illiquid and virtually insolvent and *distressed* units that are virtually insolvent, but have managed to realize financial inflows in the current period higher than financial outflows, raising hopes of survival. This sixfold classification of a unit's financial conditions keeps an affinity with Minsky's threefold classification while eliminating some of its shortcomings.

3. THE FINANCIAL INSTABILITY HYPOTHESIS REVISITED: SINGLE UNITS

The classification of financial conditions, or units, suggested in the preceding section is general enough to be applied to any sort of financial units. While Minsky's threefold classification has been applied mainly to banks and other financial and nonfinancial enterprises, we apply our classifications to all financial units, including households, in order to understand the typical cyclical fluctuations of their financial conditions. This is a crucial point where our restatement of the core of the FIH deviates from the standard approach of Minsky and his followers (with significant exceptions: see Arestis and Glickman [2002]). There are historical and analytical reasons to proceed in this way. From the analytical point of view, this assumption avoids the fallacy of composition attributed by some interpreters to the usual formalization of the FIH in terms of Kalecki's aggregate identities (Lavoie and Seccareccia 2001 and Toporowski 2008). The viewpoint adopted here maintains that the scope of the FIH goes beyond the investment behavior of enterprises. From the historical point of view, the financialization of all kinds of units deepened significantly in the last decades. In particular, this process has increasingly embedded households' behavior within financial processes (Toporowski 2009). The growing role of pension funds, the increasing share of wealth retained in financial securities, and the rising debt made households growingly dependent on the vagaries of financial markets and the financial markets increasingly dependent on household's behavior. Not by chance, the subprime mortgage bubble swelled at the interface between households and financial system. Credit card and personal loan bubbles are other factors of financial instability that may become more important in the future. This evolutionary process made the preanalytic vision underlying the FIH increasingly relevant for understanding the behavior of all economic agents, including households. This, however, requires an updating of its analytical treatment. In what follows, we suggest a preliminary step in this direction.

In order to study the dynamics of a unit's financial conditions in the space defined by the index of liquidity k_{it} and the index of solvency k_{it}^* we need further assumptions. First of all, we assume that each unit prefers higher returns, *ceteris paribus* (on this occasion we do not need to take issue with whether units are maximizing or "satisficing" decision makers). We assume in addition that financial returns are positively correlated (within the desired margin of safety) with risk-taking, as expressed by the distance from the safety margin. Finally, we assume that units are characterized by herd behavior due to the pressure of the market and mass psychology. Market pressure pushes the units towards rates of return comparable to the average, while they are vulnerable to a wave of optimism typical of a prolonged boom—or a wave of pessimism when it busts. On this occasion, however, we do not explicitly model these assumptions in order to keep the model as simple as possible so as to retain an intuitive understanding of its economic meaning. Under the preceding assumptions, there is a tendency for units to fluctuate along a clockwise orbit (see figure 2). In fact, units in field 1 increase their financial outflows more than their inflows without getting into liquidity troubles; in addition, since they continue to have a surplus of inflows, their perceived insolvency risk continues to decrease. Units in field 2 improve their returns by increasing their leverage while reducing the margin of safety until they reach its minimum desired value. Units in field 3 try to reduce the excessive risk of insolvency by deleveraging; however, since they continue to have an excess of outflows over inflows, though a diminishing one, their perception of insolvency risk continues to increase. Units in field 4 have succeeded in rebuilding an excess of inflows and this progressively reduces the risk of insolvency. Most units follow this sequence of financial conditions describing a financial cycle. If the margin of safety is too small and the reaction to liquidity problems and/or solvency risk is too weak, the financial unit may be pushed to cross the solvency barrier and become virtually insolvent (field 5). After this barrier, the financial behavior of the unit has to change radically to avoid bankruptcy. This result may be obtained either through a restructuring that abates current and prospective outflows much more than inflows or through a bail-out by the state or private firms. If the unit is able and lucky, it may rapidly shift from field 5 to field 6 and immediately after in field 4, starting a new financial cycle. In any case, there is a sudden and huge cut of outflows that reduces the inflows of other units, some of which are, in turn, pushed to breach the solvency barrier.

The feedback between k_{it} and k_{it}^* may be represented by a very simple continuous-time model, which aims to create an intuitive perception of the core features of financial fluctuations:

$$\frac{\dot{k}_{it}}{k_{it}} = -\alpha_i \left[k^*_{it} - \left(1-\mu_i\right) \right], \tag{10}$$

$$\frac{\dot{k}^*_{it}}{k^*_{it}} = \beta_i \left(k_{it} - 1 \right), \tag{11}$$

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.[4] The rationale of the relation (10) is straightforward. Whenever the solvency ratio has a value inferior to the safety margin of a financial unit, the current liquidity ratio tends to grow, as this may, in principle, increase its utility and/or returns; on the contrary, as soon as the safety threshold is breached, the unit tries to come back in the safe area by trying to increase its liquidity and reduce its leverage. The rationale of equation (11), after three decades of rational expectations, requires a more careful justification.[5] On this occasion we limit ourselves to defending the plausibility of this simple specification in terms of extrapolative expectations. When units observe a realized liquidity ratio greater than 1 (because of excess outflows over inflows) they expect that this will also happen in the immediately subsequent periods and vice versa. Even if they are aware of financial cycles and anticipate a shift towards excess inflows (or excess outflows) in the longer period, the latter have a lower weight in current decisions because of discounting. Extrapolative expectations are thus not as irrational as they seem at first sight since they are substantially consistent with the general features of financial cycles observed in the past. They prove to be irrational ex post only in proximity of the turning points of the cycle; however, as is well known, these turning points are intrinsically unpredictable. The awareness of unavoidable systematic mistakes connected to this intrinsic uncertainty translates into the choice of an enhanced safety margin rather than in a more complicated process of expectations formation that would be unlikely to give much better results (this argument is spelled out with more rigor and detail in Sordi and Vercelli [2009]).

A simple inspection of the phase diagram of this specific model (of the well-known Lotka-Volterra type) immediately shows that, on the basis of the feedback described before

[4] The specification of this model is based on Vercelli (2000) and Sordi and Vercelli (2006). The model here is expressed in continuous time. In addition, different from Vercelli (2000), shocks are not explicitly modeled; different 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's core suggested here (see section 4).

[5] Sethi (1992) argues convincingly that the FIH advanced by Minsky is not compatible with the rational expectations hypothesis, though it is consistent with a more sophisticated hypothesis of rational behavior.

and represented in the simplest way by the model, a financial unit tends to fluctuate in a clockwise direction around the center ω_i (see figure 2). We have an infinite number of possible orbits around the center ω_i according to initial conditions. A shock shifts the representative point on a different orbit that may be external or internal to the original orbit (see, e.g., Gandolfo [1997]). A shock that increases, *ceteris paribus*, k_{it}^* or k_{it} shifts the representative point to an external orbit, and vice versa. We wish to emphasize that ω_i is an equilibrium in the dynamic sense of the term, but it does not have the overtones of equilibrium modeling. In particular it does not maximize the objective function of the units. In fact, it is reasonable to assume that a higher point on the vertical axis passing through ω_i would, in the short run, 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_{it} would imply a higher k_{it}^*, which would breach the safety margin. In general, the higher points on the vertical axis of the safety margin are transitory disequilibrium points.

The conservative nature (in the dynamic sense) of the model has often been considered implausible in economics (see the debate on the model of Goodwin [1967]; the basic criticism may be found in Desai [1973] and an early defense in Vercelli [1983]). We use it here as a simple 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. We maintain that these changes, which are often observed in the empirical evidence, depend on different factors that are exogenous to this elementary model, although not to the economic system (Vercelli 2009).

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 is still quite controversial (Tymoigne 2006a: 35). We define the financial fragility of a unit as the degree of its financial vulnerability that we measure as the smallest shock that produces its virtual bankruptcy (see Vercelli [2009] and the literature there quoted). In figure 2 the degree of financial fragility is given by the distance between the representative point and the insolvency line (plus an infinitesimal magnitude).

Summing up, it seems reasonable to assume that the behavior of a financial unit is characterized by fluctuations that are cyclical, although not very regular, as they are affected by shocks, decisions of financial units, and policy authorities that have not been explicitly modeled here for the sake of simplicity. These fluctuations are broadly correlated with the macroeconomic cycle, as the real economy boom produces unexpected increases in financial inflows and the real economy crisis produces unexpected reductions in financial inflows. This cyclical tendency is enhanced by the procyclical behavior of expectations (see section 5). The less cautious (or less lucky) units are easily pushed beyond the solvency line by unexpected shocks into the zone characterized by virtual insolvency (i.e., where $k_{it}^{*} > 1$). If these units do not succeed at coming back into the region of financial sustainability very quickly they are bound to bankrupt. Their insolvency triggers a debt-deflation process which characterizes the most severe financial crisis: the insolvency of the first unit sharply reduces the actual and expected inflows of other financial units, thereby increasing both their k_{it} and k_{it}^{*}, and pushing them into the unsustainable zone, and so on. As a consequence of unexpected shocks, in each period it is unavoidable that a certain number of units become insolvent and a few of them go bankrupt; however, if most units have a consistent margin of safety, they are in a position to bear the shocks. In the case of a financial crisis, the number of insolvent units and their size is such that safety margins progressively break down unless the debt-deflation process is promptly aborted by massive policy measures (see section 5).

4. THE CORE OF THE FIH REVISITED: THE ECONOMY AS A WHOLE

We have seen a tendency of financial units to fluctuate procyclically in the space of financial conditions defined by k_{it} and k_{it}^{*}. This is a necessary prerequisite for analyzing how the aggregate of the financial units behave. However, the analysis has focused so far on an isolated financial unit so that its dynamic behavior has been studied only *in vitro*. We should take into account that the dynamic behavior of a single unit crucially depends on the dynamics of the other units, as they are interconnected by a network of financial relations: the outflows of a unit translate into inflows of other units and vice versa. As soon as we take account of this complex interaction, the relatively regular cyclical behavior of an isolated unit blurs, since in the real world it is heavily disturbed by intrinsically unpredictable decisions taken by other units; these decisions are, in turn, crucially affected by the dynamic behavior of the economy as a whole. Therefore, only in a third stage can we come back to a single unit and study its dynamic behavior in more depth. We have thus to study the dynamic behavior in the space of financial conditions of a "representative point" that characterizes the average financial conditions of all units in a certain economy at a certain moment of time.[6] By aggregating inflows and outflows of 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^*. Analogously, we also get a representative desired margin of safety $1 - \mu$ and a center ω of the fluctuations of the representative point. We wish to emphasize that this process of aggregation is not simply a statistical device, but largely the counterpart of a real phenomenon. The dynamic behavior of these 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 that are not inferior to those of the other units. Second, mass psychology spreads waves of optimism and pessimism that affect most units; as a consequence, the perception of risk becomes insufficient in the boom and excessive in depression.

The following model represents the aggregate fluctuations of the entire economy as determined by financial constraints:

$$\frac{\dot{k}_t}{k_t} = -\alpha\left[k_t^* - (1-\mu)\right], \tag{12}$$

$$\frac{\dot{k}_t^*}{k_t^*} = \beta\left(k_t - 1\right), \tag{13}$$

where $\alpha > 0$, $\beta > 0$ represent average adjustment coefficients and a dot on a variable represents its time derivative. This model describes cyclical fluctuations of the endogenous variables, which are qualitatively altogether similar to the micro fluctuations, *in vitro,* described by the model characterized by equations (10) and (11). In this case, however, there is no reason to believe that the representative point remains on a given orbit, as shocks may shift it inwards or outwards.

[6] This representative point is not meant to cloud the heterogeneity of the units and their mutual relations since they have a crucial role to play in the analysis. In particular, the dispersion of the financial conditions of the single unit around the representative point has a crucial impact on the behavior of the system (Chiarella, Dieci, and He 2009).

So far, neither the micro nor the aggregate versions of the model have explained in explicit terms the tendency toward instability that is built into a sophisticated financial economy. We have just described a tendency to persistent financial fluctuations brought about by the interaction of liquidity and solvency ratios, and the ensuing increase of financial fragility. In order to account for financial instability we have to introduce at least a further ingredient; 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 figure 3). As a combined consequence of these two effects the average fragility of units progressively increases in a dangerous way. When the awareness of excessive risk-taking finally spreads, it may be too late to avoid a situation in which the representative point comes very close to the insolvency barrier. In such a situation (as represented, for example, by the point *P* in figure 3) the dispersion of the units around the representative point (evoked by the broken circle around *P*) implies that some of them, the most fragile, are pushed beyond the solvency line. In addition, as a consequence of individual shocks, other fragile units near *P* happen to cross the solvency barrier and become virtually insolvent. In our version of the financial instability hypothesis, as—we believe—in that of Minsky, a unit's euphoria thus plays a nonessential but significant role in explaining financial instability in its dynamic and structural sense. By inserting in the model a production mechanism of euphoria we would make the financial fluctuations of the representative point dynamically unstable. We prefer, however, to keep these two building blocks of financial instability separate because they are characterized by a different degree of regularity. Like all psychological phenomena, the dynamic behavior of euphoria, though correlated with that of cyclical fluctuations, 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.

We are now in a position to give a fairly rigorous definition of a Minsky moment and Minsky process. We have a Minsky process when the representative point is trapped in field 3, characterized by both liquidity and solvency problems (as the part of the orbit between A and B in figure 2). A Minsky moment is thus nothing but the starting point "A" of this process. This phase of the financial cycle is a very delicate one, as a substantial share of economic units suffer from both liquidity and solvency problems. They try to deleverage all at the same time: this reduces the price of assets and increases the need to deleverage further, while, notwithstanding all the efforts, financial fragility increases and the solvency line dangerously approaches. Such a situation, however, does not need to degenerate in a Minsky meltdown. If the representative point crosses the safety line not too far from the liquidity line, or monetary authorities promptly react to a Minsky moment by creating a sufficient amount of liquidity, the representative point may be pushed to cross the liquidity line sufficiently far from the solvency line to avoid a generalized systemic contagion. If, on the contrary, the representative point turns back too close to the solvency line, many of the most fragile units dispersed around the representative point are pushed beyond the solvency line (see figure 3). This is bound to start a chain reaction that may lead to a Minsky meltdown, in which most units would go broke very rapidly unless the government and monetary authorities intervene with extraordinary measures similar to those taken in the United States and the UK since October 2008.

The definition of a Minsky moment suggested here is meant to clarify the role of financial fragility and the relationship between financial instability and financial fragility. Many interpreters of Minsky had problems with this distinction, considering both concepts (financial instability and fragility) as variants of the concept of *dynamic* instability (Goldsmith 1982). On the contrary, we have suggested an interpretation of financial fragility as a variant of the concept of *structural* instability; to be more precise, we interpreted it as a case of what we have called ε-instability, in the sense that a disturbance of a size not inferior to ε induces a qualitative change in the dynamics of the system (Vercelli 1991, 2000, and 2001). Notice that a unit that trespasses the solvency line undergoes a radical change in its dynamics. The dynamic instability introduced, or enhanced, by the generalized shrinking of the margin of safety greatly increases the fragility of financial system, i.e., of most financial units. The more fragile the system is, the higher the probability that a disturbance, even a small one, triggers a Minsky meltdown. A Minsky meltdown is no doubt a rare event, particularly in a developed country, and even more so as a global phenomenon. In order to find another *global* Minsky meltdown before the subprime crisis, we have to go back to the Great Depression of the 1930s. Since the early 1980s, we have had an increasing number of Minsky meltdowns at the local level (for example in Korea in 1998 and in Argentina in 2002), but only the subprime crisis degenerated in a really global meltdown.

To understand the plausibility of a Minsky meltdown, we have to consider a sequence of financial cycles. After a Minsky meltdown, regulations are strengthened and the fear of its repetition makes most units very cautious for a long while until the memory of such an event fades away with subsequent generations. Until the collective memory of a Minsky meltdown is alive and well, Minsky processes are short-lived and develop far from the solvency line. After many cycles, however, the fear fades away into the illusion that the evolution of financial system and policy instruments can prevent it forever; therefore regulation becomes more lax and units progressively less cautious. From this moment on, the typical countercyclical fluctuations of the margin of safety exhibit a sort of ratchet effect: the average value of the margin of safety shrinks progressively, increasing the length and gravity of Minsky moments until the conditions for a new Minsky meltdown reemerge.

5. REFINEMENTS TO THE MODEL AND POLICY IMPLICATIONS

We may easily introduce further refinements into the model. In this paper we limit ourselves to focusing on two additions that are crucial to drawing a few policy indications from the preceding analysis.

So far we have focused on the financial flows without considering the stocks. We may fear that this is a grave shortcoming of the preceding analysis that completely invalidates its conclusions. The consideration of stocks, no doubt, is essential to completing the analysis, but we believe that the overall picture and its implications would remain, in their essence, surprisingly unscathed. Since we focus mainly on Minsky moments and processes, let's consider only liquid reserves L, the variation of which may modify the relationship between liquidity rate and indebtedness (analyzed above). For our limited purposes we do not consider illiquid and strategic assets, as it is reasonable to assume that the liquidation of illiquid or strategic assets is a last-resort move, typical of a distressed unit. Liquid reserves have to be added to the net worth of the units that we have calculated so far just by capitalizing their expected cash flows. The effect is the same as if we had shifted the solvency line to the right; the further we shift, the higher the stock of liquid reserves will be (see figure 4). *Ceteris paribus,* this reduces the financial fragility of the units, since the distance of the representative point from the solvency line increases in the same measure. As is obvious, the higher the liquid reserves of a unit, the higher its financial solidity. The same is true also at the aggregate level. However, liquid reserves are typically a small percentage of the unit's net value. Thus liquid reserves may play a significant role when the lack of liquidity is not particularly serious; on the contrary, as recent evidence suggests, they are depleted at an amazing speed when the unit approaches or, worse, breaches the solvency barrier. This suggests that a higher compulsory requirement of liquid reserves may help to stabilize the economy, but is not enough to reach this objective. In any case, the focus on cash flows seems to capture the essential part of the process, although not the whole of it. This confirms that the cash-flow approach adopted by Minsky (and other scholars in the field of financial crises) is well-founded.

To stabilize the economy we may add a further safety margin: a liquidity constraint, i.e., a cap λ to the maximum value of the current imbalance between outflows and inflows. This translates into a horizontal line drawn above the liquidity line sufficiently close to it (see figure 4). This would act as a ceiling to the financial cycle and would be a very efficient means for preventing financial instability. If just voluntary, however, a liquidity safety margin is likely to be progressively relaxed by the growing euphoria in the boom period. We should thus resort to a compulsory illiquidity cap, imposing on financial enterprises a maximum value of k_t, to be respected to avoid sanctions (say $k_t = 1 + \lambda$). Such a limit would act as a ceiling in our model, forcing the representative point to bounce back before reaching the maximum value implied by a given orbit constraining it on an inner orbit. This requirement would considerably reduce the length and gravity of a Minsky process.

In order to understand the role of a leverage cap, we observe that as soon as a unit breaches the liquidity line, it has to finance the deficit of financial flows that adds to its extant debt. This problem persists the whole time the unit remains over the liquidity line and thus the stock of debt keeps cumulating while the unit moves in the fields 2 and 3 of the cycle. We may better understand this crucial aspect of financial cycles in a few elementary steps. The financial deficit D_{it} of the unit i at time t is defined:

$$D_{it} = k_{it} - 1 = \frac{e_{it} - y_{it}}{y_{it}} > 0 \,. \qquad (14)$$

It is easy to see from figure 4 that the stock of debt increases during a Minsky process, though at a diminishing rate. Although units are by now aware that their financial position is too risky and try to deleverage, they only succeed in slowing down the growth of the debt stock and their financial position becomes increasingly precarious. This is due to the inertia of the cycle and the herd behavior of units that try to deleverage all together. We may thus introduce a further preventive stabilization intervention: a cap on the leverage. Under the simplifying assumptions here maintained, a leverage cap would have effects similar to those of an illiquidity cap by reducing the extent and gravity of Minsky processes and making a Minsky meltdown extremely unlikely.

In any case, the prevention or mitigation of a Minsky process requires intervention long before it begins. A compulsory requirement of liquid reserves may help, but a compulsory cap on liquidity imbalances, and/or on the admissible maximum leverage, looks to be more decisive. Capital requirements are by no means useless; however, they are a less efficacious measure of stabilization because buffer stocks are typically used too late and then they are easily depleted. Minsky maintained that "a financial crisis is not the time to teach markets a lesson by allowing a generalized debt deflation to 'simplify' the system" (quoted by Papadimitriou 2008). Massive interventions on the part of the state may thus be justified. However, in order to stabilize the financial cycle, we have to rely on persistent structural regulations that reduce its width and shorten Minsky moments, forcing the representative point to turn back at a fairly safe distance from the insolvency line.

6. CONCLUDING REMARKS

This paper tried to clarify and, to some extent, develop the core of the FIH in the light of recent financial crises, in particular of the subprime crisis. Taking into account the growing financialization of the economy and the increasing participation of all economic units (including households) to the financial process, we applied the analysis to all of them. In addition, we modified a crucial cornerstone of Minsky's analysis, the classification of financial units. This permitted a simplification and generalization of what we believe to be the core of the Minskyan approach, i.e., the interaction between liquidity and solvency conditions of single units and of the entire private sector. We could coordinate some of the most important insights of Minsky's vision within a simple model of financial fluctuations that may also incorporate a few insights from the debate on the subprime crisis. In particular we suggested a rigorous definition of a Minsky moment, a neologism that played a crucial role in the recent debate on the determinants and consequences of the subprime crisis. We interpreted it as the starting point of a Minsky process, when the representative point is trapped in a situation characterized by both liquidity and solvency problems. A Minsky process is nothing but a well-defined phase of a financial cycle that may be explained by the core of the FIH. Finally we have seen that each cycle is part of a sequence of financial cycles whose characteristics depend on the structural features of the economy and the prevailing policy strategies. This path from the particular to the general confirms that, in order to understand and control financial crises, we need a comprehensive vision of the working of a sophisticated financial economy that avoids, as far as possible, any form of reductionism.

Although the approach is very simply sketched here and has to be developed in many directions, we may draw from it a few policy insights on how to mitigate the financial cycle. We have seen that stricter capital requirements of units and well-designed constraints on their illiquidity and indebtedness may help to stabilize the economy. Financial authorities should enforce these rules irrespective of the cycle phase. As Minsky often repeated, the only effective stabilization measures are those that intervene much before the first serious stress symptoms emerge. All the other extemporaneous stabilization measures, though often unavoidable, may ease the situation in the short period only at the cost of sowing the seeds of higher instability in the future.

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Table 1: Relationship between Minsky's and this paper's taxonomies: rules of translation

Financial units	Minsky	This paper
	$m_{it} = y_{it} - e_{it}$ $m_{it}^{*} = \sum_{s=0}^{n} \frac{\mathrm{E}[m_{it+s}]}{(1+r)^{s}}$	$k_{it} = e_{it} / y_{it}$ $k_{it}^{*} = \frac{\sum_{s=0}^{n} \mathrm{E}[e_{it+s}] / (1+r)^{s}}{\sum_{s=0}^{n} \mathrm{E}[y_{it+s}] / (1+r)^{s}}$
Hedge unit	$m_{it} > 0$, $t = 0$ $E(m_{it}) > 0$ $1 \le t \le n$ $m_{it}^{*} > 0$, $1 \le t \le n$	$k_{it} < 1$, $t = 0$ $E(k_{it}) < 1$ $1 \le t \le n$ $k_{it}^{*} < 1$, $1 \le t \le n$
Speculative unit	$m_{it} < 0$, $t = 0$ $E(m_{it}) < 0$, $t < s < n$, s small $E(m_{it}) > 0$, $s \le t \le n$ $m_{it}^{*} > 0$ $1 \le t \le n$	$k_{it} > 1$, $t = 0$ $E(k_{it}) > 1$ $t < s < n$, s small $E(k_{it}) < 1$ $s \le t \le n$ $k_{it}^{*} < 1$ $1 \le t \le n$
Ponzi unit	$m_{it} < 0$, $t = 0$ $E(m_{it}) < 0$ $1 \le t \le n-1$ $E(m_{it}) >> 0$ $t = n$ $m_{it}^{*} < 0$, $1 \le t \le n-1$	$k_{it} > 1$ $t = 0$ $E(k_{it}) > 1$ $1 \le t \le n-1$ $E(k_{it}) << 1$ $t = n$ $k_{it}^{*} > 1$ $1 \le t \le n-1$

Figure 1. More Articulated Classification of Financial Units

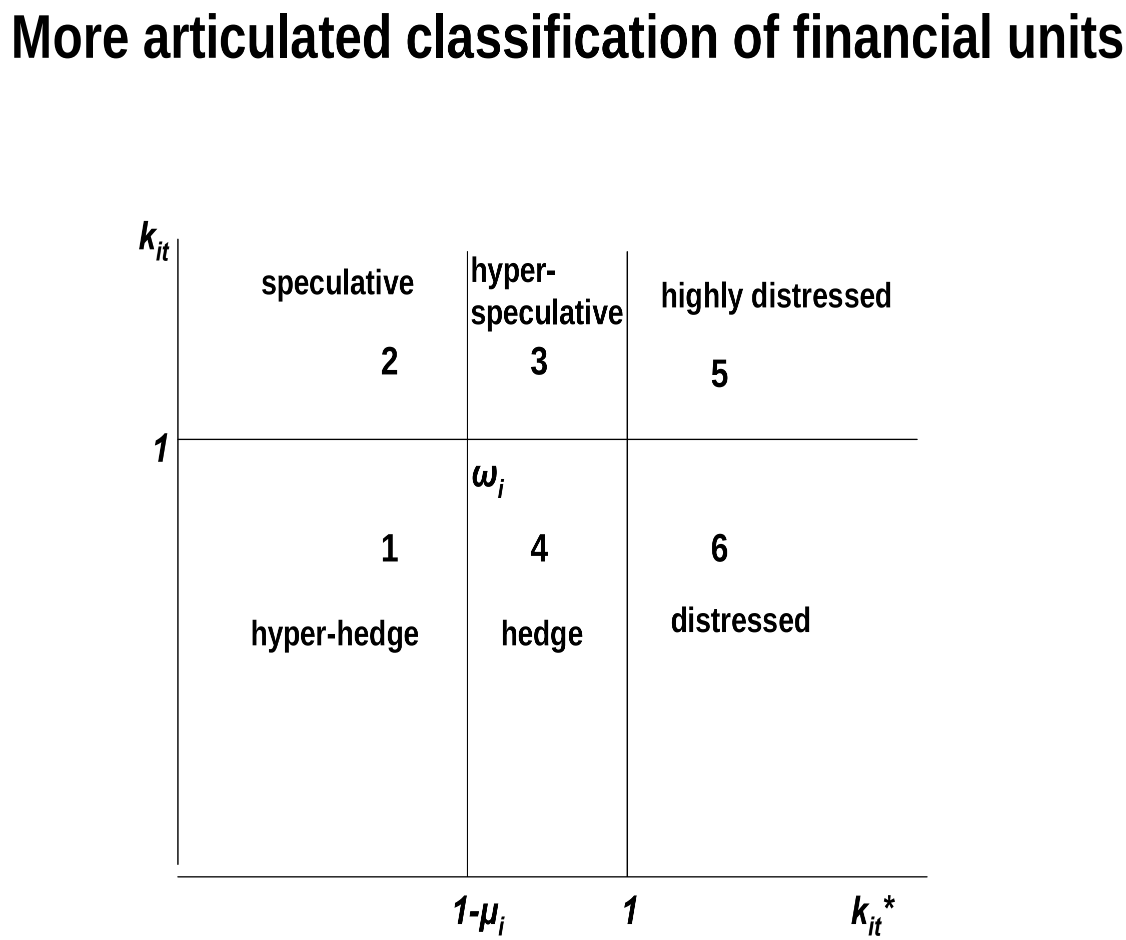

Figure 2. Financial Fluctuations: Definition of Minsky Moment and Minsky Process

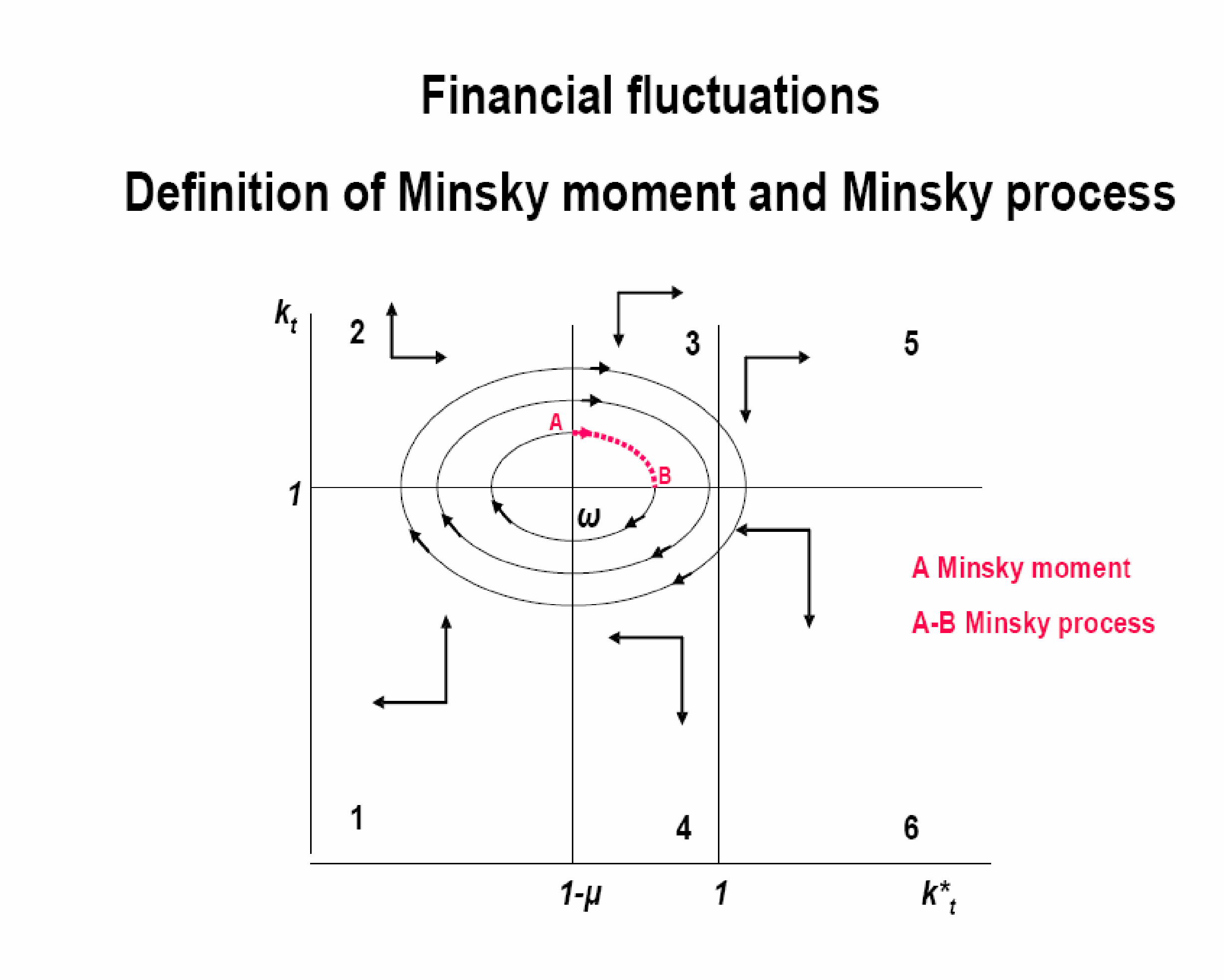

Figure 3. Financial Fluctuations: Dynamic and Structural Instability

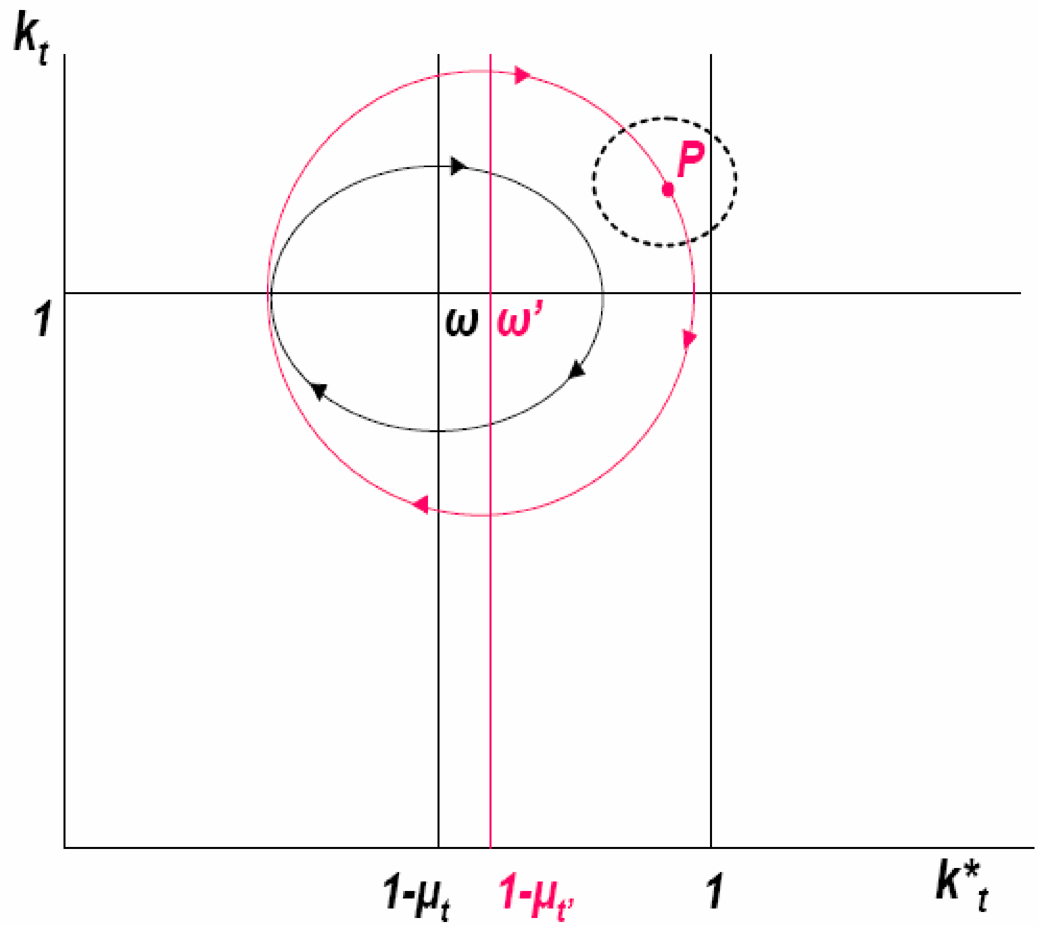

Figure 4. Liquid Reserves and Liquidity Constraint