A perspective on Minsky moments: the core of Financial Instability Hypothesis in the light of subprime crisis\(^1\)

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Abstract

This paper aims to contribute to bridge the gap between theory and facts on 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. The approach here suggested builds on Minsky’s contributions revisited in the light of subprime financial crisis. We start from a constructive criticism of the well-known Minskian taxonomy of financial units (hedge, speculative, and Ponzi units), and suggest a different approach that allows a continuous measure of units’ 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 Minsky moment as the starting point of a Minsky process, the phase of a financial cycle when many financial units suffer from both liquidity and solvency problems. Although the approach here sketched is very simple and has to be developed in many directions, we may draw from it a few policy insights on how to mitigate the financial cycle.

Keywords: financial instability, financial fragility, financial fluctuations, subprime crisis, Minsky moments, Minsky meltdown, speculative units, hedge units, Ponzi units

JEL: B50, E32, E44, G28

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\(^1\) I wish to thank Serena Sordi and Jan Toporowski for their valuable advice. I am also grateful to participants in seminars at the Universities of London (SOAS), Bergamo, Siena, Venezia (CEG), and Milano (Bicocca) for stimulating comments.
1. Introduction

This paper aims to contribute to bridge the gap between stylized facts on so-called “Minsky moments” and existing theory by revisiting Minsky’s “financial instability hypothesis” (henceforth FIH; see in particular Minsky, 1982 and 1986) in the light of the “subprime” (mortgages) 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 in a second time 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 (see, on this issue, e.g., Kregel, 2008, and Davidson, 2009).

The expression “Minsky moment” was coined in 1998 in occasion of the crisis of Russian debt by McCulley, manager of bond funds PIMCO, 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 also by other top-level practitioners and analysts (such as Magnus, senior economic adviser at UBS Investment Bank, 2007 a,b,c, and 2008), by leading financial journalists (such as Wolf, 2007, 2008, on the Financial Times; Lahart, 2007, on the Wall Street Journal; Cassidy, 2008, on The New Yorker), and also by a few academic economists (such as Whalen, 2008; Wray, 2008; Davidson 2008, Bellofiore and Halevi, 2009; 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 of time, consistently with the usual meaning of moment. Examples are Magnus (2007a): “the point where credit supply starts to dry up”, and Wolf (2008): “the point at which a financial mania turns into panic”. Most definitions of Minsky moment, however, refer to a process of undetermined length that is supposed to be short-lived, at
least relatively to the periods of financial tranquillity. Examples are McCulley (2001) “a self-feeding process of debt-deflation”, Lahart (2007) “when over-indebted investors are forced to sell even their solid investments”, Magnus (2007c) “when lenders become increasingly cautious”, Whalen (2008): “credit crunch or Minsky moment”, Davidson (2008): “when the Ponzi pyramid financial scheme collapses”. 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 confusions, throughout this paper we will distinguish between Minsky moment and 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 FIH.

The approach here outlined is at variance with a few consolidated principles of conventional economic analysis since both dynamic and structural instability play a crucial role, expectations are not rational, cognitive and psychological aspects play a role in explaining agents behaviour, 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 economic phenomena regularity 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, 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 units’ financial conditions. The field of possible financial conditions is then decomposed into six sub-fields that define categories of financial conditions having a clear relation with Minsky’s taxonomy. In the following two sections we use the classification of economic units here suggested 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 single units’ 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. 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 behaviour in a crucial way. Therefore, in order to understand units’ behaviour, we have to analyze how their financial conditions change over time. Minsky was thus on the right track when, at the risk of looking repetitious, started his numerous versions of the FIH on a classification of units’ financial conditions (see, in particular, Minsky, 1982 and 1986). The classification of units is often restricted by Minsky himself and his followers to banks or firms in general. In the spirit of Minsky, who in a few occasions emphasized how revealing is to look at all economic units as banks, we apply the 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 \( t \), \( e_{it} \):

\[
(1) \quad m_{it} = y_{it} - e_{it} .
\]
The index of solvency of unit \( i \) at time \( t \) is given by the capitalized expected net inflows \( m^*_i \), that may be expressed in the following way:

\[
(2) \quad m^*_i = \sum_{s=0}^{n} \frac{E[m_{i,t+s}]}{(1+r)^s},
\]

where \( n \) designates the time horizon of the unit’s decision strategy and \( r \) the nominal rate of interest.\(^2\) The value of \( m^*_i \), that may be interpreted as a rough measure of the unit’s net worth, is considered positive for all the units included in the taxonomy:

\[
(3) \quad m^*_i > 0.
\]

The index of solvency plays a crucial role in Minsky’s analysis of the dynamics of units’ 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:

\[
(4) \quad m_i > 0, \quad \text{in the current period (} t = 0),
\]

\[
E(m_i) > 0 \quad \text{for} \quad 1 \leq t \leq n,
\]

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:

\(^2\) We warn the reader that Minsky would have considered simplistic this procedure of discounting (see Tymoigne, 2006, pp.13-14). We adopted it here for the sake of comparison with the alternative classification suggested below.
A Ponzi unit is characterized instead by

\[
\begin{align*}
(5) & \quad m_i < 0, \quad t = 0, \\
& \quad E(m_i) < 0, \quad t < s < n, \text{ } s \text{ small}, \\
& \quad E(m_i) > 0, \quad s \leq t \leq n,
\end{align*}
\]

Both speculative and Ponzi financial units have problems of liquidity in the current period since their financial outflows exceed their financial inflows. 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. The Ponzi units, on the contrary, expect their liquidity problems to persist in all the future periods within their time horizon with the only exception of 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 $t$. 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). In the absence of a disaggregation of this kind, we do not discuss it here. 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, also 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). 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 analysis. However, a virtually insolvent unit (characterized by $m_t^* < 0$) does not need to bankrupt, as it may be rescued by a private or public bail-out, or it may get out of troubles 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, for a while 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 be pushed in turn beyond the solvency line, and so on. This process of contagion is particularly 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 behaviour is crucial to describe, explain and forecast financial crises and in order to choose 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

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3 Minsky himself betrays occasionally 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).
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, also 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 units’ 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 $t$

$$
(7)
$$

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

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

\[
(9) \quad k^*_u \leq 1.
\]

For the sake of simplicity we call \( k_i \) *liquidity ratio* and \( k^*_u \) *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 \( k_u \) and \( k^*_u \) within a box of dimension 1x1, or in the immediate proximity of its borders. This favours a rigorous analytic formulation of the core of FIH while keeping in touch with its economic meaning through its geometric representation. To this end, we draw in the Cartesian diagram an horizontal line starting from \( k_u = 1 \) that we call *liquidity line* as units have liquidity problems when they breach it (i.e. for values of \( k_u > 1 \)). Analogously, we draw a vertical line at \( k^*_u = 1 \) 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 \( (m_u > 0, \ m^*_u > 0) \), while the solvent units above the solvency line may be defined as speculative or Ponzi units \( (m_u < 0, \ m^*_u > 0) \); 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 \( k_u \) and \( k^*_u \) 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, 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 \( 1 - \mu_i \) such that: \( 0.5 < 1 - \mu_i < 1 \). We have thus to introduce a further vertical line at the left of the solvency barrier that represents the desired safety margin (see fig.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 neither from the liquidity point of view nor from the solvency point of view. Units in field 2 are speculative as they have liquidity problems but do not perceive solvency problems. Units in field 3 are hyper-speculative as they 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 in the current period to realize financial inflows higher than financial outflows, raising hopes of survival. This six-fold classification of units’ 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 non-financial 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 FIH deviates from the received versions 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; Toporowski, 2008). The viewpoint adopted here maintains that the scope of FIH goes beyond the investment behaviour of enterprises. From the historical point of view the financialization of all kinds of units deepened very much in the last decades. In particular, this process increasingly embedded within financial processes also households behaviour (Toporowski, 2009). The growing role of Pension funds, the increasing share of wealth detained in financial securities, the rising debt, made households growingly dependent on the vagaries of financial markets and the latter increasingly dependent on households behaviour. Not by chance, the subprime mortgages bubble swelled at the interface between households and financial system. Credit card and personal loans bubbles are other factors of financial instability that may become more important in the future. This evolutionary process made the pre-analytic vision underlying the FIH increasingly relevant for understanding the behaviour of all economic agents, including households. This requires, however, an updating of its analytical treatment. In what follows we suggest a preliminary step in this direction.

In order to study the dynamics of units’ financial conditions in the space defined by the index of liquidity $k_i$ and the index of solvency $k^*_i$, we need further assumptions. First of all, we assume that each unit prefers higher returns ceteris paribus (we do not need on this occasion to take issue 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 behaviour due to the pressure of market and mass psychology. Market pressure pushes the units towards rates of return comparable to the average one, 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 model explicitly these assumptions in order to keep the model as simple as possible to retain an intuitive understanding of its economic meaning. Under the preceding assumptions there is a tendency of units to
fluctuate along a clockwise orbit (see fig.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 de-leveraging; 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 behaviour of units 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 pushed to breach in turn the solvency barrier.

The feed-back between \( k_{it} \) and \( k^*_{it} \) may be represented by a very simple continuous-time model which aims to help an intuitive perception of the core features of financial fluctuations:

\[
\frac{\dot{k}_{it}}{k_{it}} = -a_{it} \left[ k^*_{it} - (1 - \mu_{it}) \right],
\]

\[
\frac{\dot{k}^*_{it}}{k^*_{it}} = \beta_{it} \left( k_{it} - 1 \right),
\]
where $\alpha_i, \beta_i > 0$ represent speeds of adjustment of the unit $i$ and a dot over a variable indicates the derivative with respect to time. 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 increase in principle 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. On this occasion we limit ourselves to defend 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 happen also 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 in 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 rigour and details in Sordi and Vercelli, 2009).

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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, differently from Vercelli (2000), shocks are not explicitly modelled; differently from Sordi and Vercelli (2006), they are taken into consideration in qualitative terms and play a crucial, although accessory, role in the restatement of the FIH’s core here suggested (see section 4).

5 Sethi (1992) argues convincingly that the financial instability hypothesis advanced by Minsky is not compatible with the rational expectations hypothesis, though it is consistent with a more sophisticated hypothesis of rational behaviour.
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 and represented in the most simple way by the model, a financial unit tends to fluctuate in a clockwise direction around the centre $\omega$ (see fig. 2). We have infinite possible orbits around the centre $\omega_i$ 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, $k_i^*$ or $k_i$ shifts the representative point to an external orbit, and vice versa. We wish to emphasize that $\omega$ is an equilibrium in the dynamic sense of the term, but it does not have the overtones of equilibrium modelling. In particular it does not maximize the objective function of the units. In fact it is reasonable to assume that a higher point on the vertical passing through $\omega_i$ would be associated in the short run with higher utility or returns with the same margin of safety. However, a unit set on $\omega_i$ cannot reach such a point without triggering a cycle characterized by a persistent disequilibrium. In fact a higher $k_i$ would imply a higher $k_i^*$ that would breach the safety margin. More in general, the higher points on the vertical 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 defence 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, that are often observed in the empirical evidence, depend on different factors that are exogenous to this elementary model, although not to the economic system (see Vercelli, 2009).

In order to understand the financial behaviour of economic units we have to introduce a further variable: financial fragility. This variable plays a crucial role in Minsky’s approach but its meaning is still quite controversial.
(see, e.g., Tymoigne, 2006, p.35). We define the financial fragility of a unit as the degree of its financial vulnerability that we measure as the minimal size of the shock that produces its virtual bankruptcy (see Vercelli, 2009, and the literature there quoted). In fig. 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 behaviour of a financial unit is characterised by fluctuations that are in principle cyclical, although not very regular, as they are affected by shocks, decisions of financial units and policy authorities that, for the sake of simplicity, have not been explicitly modelled here. 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 unexpected reduction in financial inflows. This cyclical tendency is enhanced by the pro-cyclical behaviour of expectations (see section 5). The less cautious (or less lucky) units are easily pushed by unexpected shocks beyond the solvency line into the zone characterized by virtual insolvency (i.e. where $k^\nu > 1$). If these units do not succeed to come back very quickly in the region of financial sustainability they are bound to bankrupt. Their insolvency triggers a debt-deflation process which characterises the most severe financial crisis: the insolvency of the first unit sharply reduces the actual and expected inflows of other financial units, so increasing both their $k^\nu$ and $k^\nu$, and pushes them into the unsustainable zone, and so on. In each period it is unavoidable that, in consequence of unexpected shocks, 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 FIH revisited: the economy as a whole
We have seen a tendency of financial units to fluctuate pro-cyclically in the space of financial conditions defined by $k_t$ and $k_t^\ast$. This is a necessary prerequisite for analysing how the aggregate of financial units behaves. However, the analysis has focused so far on an isolated financial unit so that its dynamic behaviour has been studied only in *vitro*. We should take into account that the dynamic behaviour of single units crucially depends on the dynamics of other units as they are interconnected by a network of financial relations: the outflows of a unit translate in inflows of other units and vice versa. As soon as we take account of this complex interaction, the relatively regular cyclical behaviour 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 their turn crucially affected by the dynamic behaviour of the economy as a whole. Therefore, only in a third stage we can come back to single units and study in more depth their dynamic behaviour. We have thus to study the dynamic behaviour 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 $k_t^\ast$. Analogously we get also a representative desired margin of safety $1 - \mu$ and a centre $\omega$ 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 behaviour of units is fairly synchronized along the financial cycle for two reasons determining their herd-like behaviour. First, the pressure of the market pushes comparable commercial units to accept a similar risk-taking position to obtain returns not inferior to those of the other units. Second, mass psychology spreads waves of optimism and pessimism that affect most units; in consequence,\(^6\)

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

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

\[
\frac{\dot{k}_t^*}{k_t^*} = \beta (k_t - 1),
\]

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 characterised by equations (10) and (11). Also 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.

So far, neither the micro nor the aggregate versions of the model have explained in explicit terms the tendency to instability that is in-built in 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.
As a combined consequence of these two effects the average fragility of units progressively increases in a growingly dangerous way. When the awareness of an excessive risk-taking finally spreads, it may be too late to avoid that the representative point comes very close to the insolvency barrier. In such a situation (as represented for example by the point $P$ in fig. 3, the dispersion of 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 in 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, units’ euphoria plays thus a non-essential 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 dynamically unstable the financial fluctuations of the representative point. We prefer, however, to keep separate these two building blocks of financial instability because they are characterized by a different degree of regularity. The dynamic behavior of euphoria, though correlated with that of cyclical fluctuations, like all psychological phenomena is much more irregular and is subject to sudden changes that depend very much on a host of specific factors that may vary widely from country to country and from period to period.

We are now in a position to give a fairly rigorous definition of Minsky moment and Minsky process. We have a Minsky process when the representative point is trapped in the field 3 characterized by both liquidity and solvency problems (as the part of the orbit between A and B in fig. 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 suffers 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 downwards 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 fig. 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 USA and the UK since October 2008.

The definition of Minsky moment here suggested 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 (see, e.g., 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 $\varepsilon$-instability: a disturbance of size not inferior to $\varepsilon$ 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 is the system, the higher is the probability that a disturbance, even small, 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. We had since the early 1980s an increasing number of Minsky meltdowns at the local level (for example in Corea 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 well alive, Minsky processes are short-lived and develop far from the solvency line. After many cycles, however, the fear fades away in the illusion that the evolution of financial system and of policy instruments can prevent it for ever. Therefore regulation becomes laxer 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 re-emerge.

5. Refinements to the model and policy implications

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

We have focused so far 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 complete 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 ratio 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 its expected cash flows. The effect is just that of shifting the solvency line to the right, the more so the higher is the stock of liquid reserves $\theta$ (see fig. 4). This reduces ceteris paribus 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 sufficient 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 $\lambda$ to the maximum value of the current imbalance between outflows and inflows. This translates in a horizontal line drawn above the liquidity line sufficiently close to it (see fig.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 problems persists all the 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
\[ D_u = k_u - 1 = \frac{e_u - y_u}{y_u} > 0. \]

It is easy to see from fig. 4 that the stock of debt increases, though at a diminishing rate also during a Minsky process. Although units are by now aware that their financial position is too risky and try to deleverage, they only succeed to slow 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 behaviour 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 reducing the extent and gravity of Minsky processes and making a Minsky meltdown extremely unlikely.

In any case, the prevention or mitigation of Minsky process must intervene much 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, look 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 when 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 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 in particular coordinate some of the most important
insights of Minsky’s vision within a simple model of financial fluctuations
that may incorporate also 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 the phase of a financial cycle that may be
explained by the core of 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 here sketched is very simple 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 irrespectively 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

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<th>Financial units</th>
<th>Minsky</th>
<th>This paper</th>
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More articulated classification of financial units

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Fig. 1
Financial fluctuations

Definition of Minsky moment and Minsky process

Fig. 2

A Minsky moment
A-B Minsky process
Financial fluctuations: dynamic and structural instability

Fig. 3
\[ k_t \]