A Theory of Minsky Moments: a Restatement of the Financial Instability Hypothesis in the light of the "subprime" crisis

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Abstract

This paper aims to bridge the gap between theory and facts on the so-called "Minsky moments" and "Minsky meltdowns" by revisiting the "financial instability hypothesis" in the light of the subprime financial crisis. We argue that we need an approach different and broader than the mainstream's, not only to understand Minsky moments but also the periods of financial calm between them. This approach, inspired by Minsky, leads us to interpret crucial stylized facts exhibited by recent financial crises through an elementary model of financial fluctuations that endogenously generates instability and fragility. The model here suggested builds on Minsky's contributions but introduces a few crucial modifications. In particular, we address a constructive criticism to the well-known Minskyan classification of financial units in three categories (hedge, speculative, and Ponzi) and suggest a different classification that allows a continuous measure of units' financial conditions. We show that this continuum of financial conditions may be aggregated into six categories of financial units that have a clear relation with Minsky's trinity. We use the suggested classification of economic units to explain the cyclical fluctuations of their financial conditions and the circumstances that lead to Minsky moments and, under given conditions, eventually to a Minsky meltdown. Finally, we use the approach here suggested to shed some light on the causes and consequences of financial crises and their policy implications.

Keywords: financial instability, financial fluctuations, subprime crisis, Minsky, speculative units

JEL: B50, E32, E44, G28

1. Introduction

This paper aims to bridge the gap between well-known facts on the so-called "Minsky moments" and "Minsky meltdowns" and existing theory by revisiting Minsky's "financial instability hypothesis" in the light of the subprime financial crisis. Since the emphasis is on the bridge, 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. We interpret stylized facts exhibited by recent financial crises through an elementary model of financial fluctuations. The model builds on Minsky contributions but introduces a few crucial modifications.

Both Keynes and Minsky have been accused of "implicit theorizing" (see Leontiev, 1937, on Keynes, and Tobin, 1989, on Minsky). This criticism claims that in Keynes (particularly in the *General Theory*) and in Minsky (in the "financial instability hypothesis") the theoretical axioms are not clearly spelled out and their implications for explanation and prediction are insufficiently argued. We have to take seriously this criticism but we argue that we should draw from it conclusions quite different (Toporowski, 2005). Implicit theorizing is typical of new revolutionary theories (in the sense of Kuhn). After the first intuition of a new paradigm the underlying theory is made fully rigorous and explicit only through the systematic work of generations of scholars. The real issue at stake is thus whether Minsky's vision is worth developing or not. I believe that Minsky's FIH captures better than alternative visions a few crucial features of financial capitalism and that it has not yet exhausted its potential of inspiration. The attempt at clarifying and developing the FIH may still be very rewarding. What follows is the attempt of advancing a very small step in this direction in the light of recent financial crises with special emphasis on the subprime one.

The approach here developed is at variance with a few consolidated principles of the mainstream approach 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 (see Vercelli 1991). 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. This depends on the postulate of economic phenomena regularity underlying mainstream economics and justifying its reductionist focus on stable equilibria, ignoring disequilibrium, instability, bounded rationality and strong uncertainty (Vercelli 2005). Minsky's vision is able to cope with financial crisis because he clearly rejects the regularist 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).

In the second section we briefly examine the well-known Minskyan classification of financial units in three categories (hedge, speculative, and Ponzi). A constructive criticism leads us to suggest a different, classification that allows a continuous measure of units financial conditions. The field of all possible continuous measures of financial conditions may be decomposed into six sub-fields that define categories of financial conditions having a clear relation with Minsky's taxonomy. In the following two sections I 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 and eventually, under given conditions, to a Minsky meltdown. In the third section we discuss the financial conditions of single units, 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 its policy implications. Sixth section concludes.

3. The classification of financial units: the shortcomings of Minsky's trinity and a suggested alternative

The financial conditions of economic units affect their decisions in a crucial way. Therefore, in order to understand units' behaviour, we have to analyze how their financial conditions change over time, and this requires a previous definition of units' relevant financial conditions. Minsky was thus right in starting his numerous versions of the FIH on a classification of units' financial conditions. His well-known trinitarian 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 *c*urrent excess (or net) financial inflows m_{it} i.e. by 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) $$m_{it} = y_{it} - e_{it}$$

The index of solvency of unit i at time t is given by the capitalized expected net inflows:

(2) $$m_{it}^{*} = E\left(\sum_{s=1}^{n} \frac{m_{it+s}}{(1+r)^{t+s}}\right)$$

where n designates the time horizon of the unit's decision strategy and r the nominal rate of interest (for the sake of simplicity, throughout this paper we use the nominal rate of interest as discount factor).

As is well known, the basic distinction introduced by Minsky is between hedge and speculative units. A hedge unit is characterized by

(3) $$m_{it} > 0 \qquad \text{for every } t$$

and

(4) $$m_{it}^{*} > 0 .$$

A hedge financial unit is characterized by realized financial outflows inferior to realized financial inflows and therefore it 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

(5) $$m_{it} < 0 \qquad \text{for } t < s < n \ (s \text{ small}), \quad m_{it} > 0 \qquad \text{for } s < t \leq n,$$

and (4). A Ponzi unit is characterized instead by

(6) $m_{it} < 0$ for $t < n\text{-}1$, $m_{it} >> 0$ for $t = n$

and (4). Speculative and Ponzi financial units have problems of liquidity in the current period since their financial outflows exceed their financial inflows. Speculative financial units expect that these liquidity problems will characterize only the early periods of their decision time horizon while they expect a surplus of outflows in subsequent periods assuring their solvency. The Ponzi units on the contrary expect their liquidity problems to persist in all the future periods within their time horizon but 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. Minsky suggests a second criterion of distinction: speculative units can repay maturing interests but not principal in all *t*, while Ponzi units cannot repay even the maturing interest 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 and of our analysis in this paper, 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 one and vice versa.

Minsky’s classification of financial units has been, and still is, a source of inspiration for the analysis of financial crises, as its use by Minsky and some of the followers is full of interesting historical and institutional details. From the analytical point of view, however, this trinitarian classification is wanting and is likely to have hindered quantitative-oriented and model-based developments of the FIH. The first and foremost problem is that all the units in the taxonomy, even the Ponzi units, are considered as solvent as they satisfy condition (4). The idea behind this choice is probably based on the common view that an insolvent unit is bound to bankrupt and that a bust unit is not an interesting object of economic analysis, although it remains a particularly interesting object for corporate law. 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 get out of troubles through a prompt adoption of extraordinary measures, such as the sell-off of illiquid and strategic assets, to realize a radical downsizing or redirection of its activity. Second, in any case, even the bankruptcy (in legal sense) of a unit, for a long time does not discontinue its economic and financial consequences, as is obvious in the case of big banks and businesses. As we have observed during the subprime crisis, the role of virtually insolvent units may be particularly important in a financial crisis when many units become in sequence virtually insolvent, but there is a climate of opinion particularly favorable to their rescue. 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 discontinuous nature. Its underlying indexes are simply characterized by two-valued magnitudes. The liquidity index m_{it} may be positive (hedge units) or negative (speculative and Ponzi units). In the real world, however, units are characterized by different degrees of liquidity or illiquidity. Analogously, the index of solvency may by only either positive, when the unit is solvent, or negative, when it is virtually insolvent. 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 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 insolvent as soon as its net worth becomes negative.

In order to overcome the shortcomings of Minsky's taxonomy we suggest a continuous classification of units' financial conditions based on a modified continuous measures of liquidity and solvency that we have considered above. 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

(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 by the unit *i*; 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.

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, within a given time horizon *n*:

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

We may thus define the following condition of financial sustainability:

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

For the sake of simplicity we call k_t *current financial ratio* and k_{it}^* *intertemporal financial ratio*. These two indexes are expressed as ratios, rather than differences as in Minsky, because in this way we can represent all the possible financial conditions in a Cartesian diagram of coordinates k_{it} and k_{it}^* within a box 1x1 or in the immediate proximity of its borders. We have to draw an horizontal line starting from k_{it} = 1 that we call *liquidity line* as units have liquidity problems when they trespass it (i.e. for values of k_{it} > 1). Analogously, we draw a vertical line at $k_{it}^* = 1$ as beyond it units get virtually insolvent. 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 ternary classification for the dynamic analysis of financial fluctuations. However, if we wish, we may keep in touch with Minsky's classification (see table 1). The units underneath the liquidity line to the left of the solvency line may be defined as hedge units in the language of Minsky, while the solvent units above the liquidity line may be defined as speculative or Ponzi units.

In order to use this Cartesian (and conceptual) space for the study of financial fluctuations we need a further essential ingredient. We assume that units, in order to minimize the risk of bankruptcy, choose a margin of safety, i.e. a maximum value of the intertemporal ratio, sufficiently lower than 1, beyond which a unit does not want to go. Let's call the safety margin $0.5 < \mu < 1$. We have thus to introduce a further vertical line at the left of the solvency barrier that represents the 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 have both liquidity problems and solvency problems. Units in field 4 are *hedge units* because they do not have liquidity problems but perceive that they may have solvency problems in the future as their safety margin is too small. Finally we have to consider the units in financial distress. We can distinguish between *highly distressed financial units* being both illiquid and virtually insolvent, 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 financial conditions of economic units keeps an affinity with Minsky's threefold classification but eliminates some of its shortcomings.

4. The financial instability hypothesis revisited: single units

In order to study the dynamics of financial units in the space defined by k_{it} and k_{it}^{*} we need further assumptions. First of all, each unit prefers higher returns ceteris paribus. We assume in addition that financial returns are positively correlated with the financial leverage within the desired margin of safety so that speculative units show a positive correlation between returns and 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 the market and mass psychology. Under the preceding assumptions there is a tendency to a clockwise cycle. 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 an excess of inflows they revise their expectations in such a way to reduce further their perceived risk of insolvency. Units in field 2 increase their returns by increasing their leverage until they reach the margin of safety. 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 week, the financial unit may cross the solvency barrier and become virtually insolvent (field 5). After this barrier, the behaviour 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 another firm. If the unit is able and lucky, it may rapidly shift in field 6 and immediately after in field 4, starting a new financial cycle. In any case there is a sudden and huge reduction of outflows that reduces the inflows of other units that are pushed to trespass the solvency barrier. Under conditions that we will discuss in the following section this may trigger a chain reaction often called Minsky meltdown.

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

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

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

where α_i, $\beta_i > 0$ represent speeds of adjustment of the unit *i* and a dot over a variable indicates the derivative with respect to time.[1] The rationale of the relation (10) is straightforward. Whenever the intertemporal ratio has a value inferior to the safety margin of a financial unit, the current 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 trespassed, the unit tries to come back in the safe area by trying to improve its liquidity and reduce its leverage. The foundations of the equation (3), after three decades of rational expectations, requires a more careful justification.[2] A useful explanation is in terms of extrapolative expectations. When units observe a realized ratio greater than 1 (because of excess outflows over inflows) they expect that this will happen also in the immediately subsequent periods so that the likely subsequent shift towards excess inflows has a lower weight because of discounting), and vice versa. These expectations are not as irrational as they seem at first sight as they are substantially consistent with the 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 margin of safety rather than in a complication of the process of expectations formation that would be unlikely to give better results. Of course we can choose a more sophisticated hypothesis of expectations formation but we believe that at the level of

[1] The specification of this model is based on Vercelli (2000) and Sordi and Vercelli (2006). However, differently from both, the model is here expressed in continuous time. In addition, differently from (Vercelli 2000), shocks are not explicitly modelled; however, differently from Sordi and Vercelli (2006), they are taken into consideration in qualitative terms and play a crucial, although accessory, role in the restatement of the financial instability hypothesis here suggested (see section 4).

[2] Sethi (1992) argues convincingly that the financial instability hypothesis advanced by Minsky is not compatible with the rational expectations hypothesis but is consistent with a more sophisticated hypothesis of rationality in the behaviour of decision makers.

abstraction of this model such an hypothesis is sufficiently realistic to account for the essential features of the phenomenon under study.

A simple inspection of the phase diagrams 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 ω_i (see fig. 2).We have infinite possible orbits around the centre ω_i. The initial conditions determine on which orbit moves the representative point. A shock shifts the representative point on a different orbit that may be external or internal to the original orbit (see, e.g., Gandolfo, 1971). A shock that increases, ceteris paribus, k^*_{it} or k_{it} shifts the representative point to an external orbit, and viceversa. 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 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 ω_i would be associated in the short run 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} that would trespass the safety margin. More in general the higher points on the vertical of the safety margin are transitory disequilibrium points.

The conservative nature of the model has been considered implausible in economics in other contexts (see, e.g., Desai, 1973, and for an early defence Vercelli, 1981). We use it here as a fit representation of what we believe to be a stylized fact: the interaction between liquidity and solvency conditions of financial units brings about persistent fluctuations that do not have an intrinsic tendency to change through time. We claim that these changes, that no doubt are observed in the empirical evidence, depend on different factors that we are going to analyze in the following section.

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. We define the financial fragility of a unit as the degree of its financial vulnerability that we measure as the minimal size of the shock that produces its virtual bankruptcy. In geometric terms, the degree of financial fragility is given by the distance between the representative point and the insolvency line (plus an infinitesimal magnitude).

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 and decisions of financial units themselves and of policy authorities that, for the sake of simplicity, have not been explicitly modelled here. These fluctuations are often, but not necessarily, correlated with the macroeconomic cycle as the boom produces unexpected increases in inflows and the crisis unexpected reduction in 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 which trespass the threshold μ_i into the zone characterized by virtual insolvency (i.e. where $k_{it}^* > 1$). 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_{it} and k_{it}^*, 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 financial crises the number of insolvent units and their size is such that the safety margins progressively breaks down unless the debt-deflation process is promptly aborted by massive policy measures (see section 5).

4. The financial instability hypothesis 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_{it} and k_{it}^*. This is a necessary pre-requisite for analysing how the aggregate of financial units behaves. However, such a model focused on an isolated financial unit so that its dynamic behaviour has been studied, so far, 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 described in the former section disappears 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. This representative point is not meant to blur 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.

Therefore, 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^*. We wish to emphasize that this process of aggregation is not only 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, 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:

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

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

where $\alpha > 0$, $\beta > 0$ represent average adjustment coefficients and Δ the time derivative of the subsequent variable. 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), apart from a likely greater regularity produced by aggregating correlated individual behaviours. 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 (see fig. 2).

So far, neither the micro nor the aggregate versions of the model have explained 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 current and intertemporal financial ratios, and the ensuing increase of financial fragility. In order to account for financial instability we have to introduce 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 fig. 3). As a combined consequence of these two effects the 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. This implies that in consequence of further shocks many units happen to cross the solvency barrier and become virtually insolvent. In our version of the financial instability hypothesis, as in that of Minsky, units' euphoria plays thus a crucial 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 a Minsky moment and a Minsky meltdown. We have a Minsky moment when the representative point is trapped in the field 3 characterized by both liquidity and solvency problems. This phase of the financial cycle is in any case a delicate one. Most units try do deleverage all at the same time: this reduces the price of assets and increases the need to deleverage 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 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 in September-October 2008.

The definition of Minsky moment here suggested clarifies 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 mathematical concept of dynamic instability. Since long, we have suggested an interpretation of financial fragility as a variant of the mathematical concept of structural instability. To be more precise, we interpreted it as a case of what we have called ε-instability: a disturbance of 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 the 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 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 alive Minsky moments 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 the 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 anticyclical 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. No doubt, the consideration of stocks is essential to refine the analysis but we believe that the overall picture and its implications remain in their essence surprisingly unscathed. Since we focus mainly on Minsky moments let's consider only liquid reserves L as it seems reasonable to assume that the liquidation of illiquid or strategic assets is a last-resort move ratio for a distressed unit. They have to be added to the net value of the units that we have calculated so far just by capitalizing its expected cash flows. The effect of the addition of liquid reserves in geometric terms is that of shifting the solvency line to the right, the more so the higher is the stock of liquid reserves. This reduces *ceteris paribus* the financial fragility of the units. As is obvious, the higher the liquid reserves of the 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 (say, no more than 10-20%). Thus liquid reserves may play a significant role when the lack of liquidity is not particularly serious but they are depleted at an amazing speed when the unit approaches or, worse, trespasses 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) is well-founded.

To stabilize the economy we may add a further safety margin: a liquidity constraint, i.e. a cap to the maximum value of the imbalance between outflows and inflows. This translates in graphic terms in a horizontal line above the liquidity line and sufficiently close to it (see fig.4). This would act as a ceiling to the financial cycle and would be a very efficient means of prevention of financial instability. If voluntary, however, also this 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. The illiquidity cap would impose on financial enterprises a maximum value of k_t to be respected to avoid sanctions. 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. This would considerably reduce the length and gravity of a Minsky moment that could even be altogether avoided under sufficiently severe constraints. In order to understand the role of a leverage cap, we observe that, as soon as a unit trespasses 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 cumulates all the time while the unit moves in quadrant 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

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

. Let's assume that the unit i trespasses the liquidity line at time τ and that finances deficits by borrowing. The stock of debt H_{it}, of the financial unit i at time t, for $t > \tau$ is thus given by

$$(15) \quad H_{it} = H_{i\tau} + \int_{\tau}^{h} D_{it} dt \qquad\qquad t > \tau, h > \tau.$$

It is easy to see from fig. 4 that the additional debt expressed in logarithms increases continuously in fields 2 and 3. It is interesting to observe that the stock of debt increases, though at a diminishing rate also during a Minsky moment. 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 suggests a third 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 moments and making a Minsky meltdown extremely unlikely. Prevention of Minsky moments must intervene 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 less efficacious because buffer stocks are typically used too late when they are easily depleted.

6. Concluding remarks

This paper tried to clarify and, to some extent, develop the FIH in the light of recent financial crises and in particular of the subprime crisis. To this end 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. 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 and a fairly sound characterization of a Minsky meltdown, two neologisms that played a crucial role in the recent debate in specialized mass media and among practitioners on the determinants and consequences of the subprime crisis. Finally, we drew from our restatement of the FIH a few policy implications. As Minsky often repeated, the only effective stabilization measures are those that intervene much before the first stress symptoms emerge. All the other extemporaneous stabilization measures, though often unavoidable, may ease the situation in the short period while sowing the seeds of higher instability in the future.

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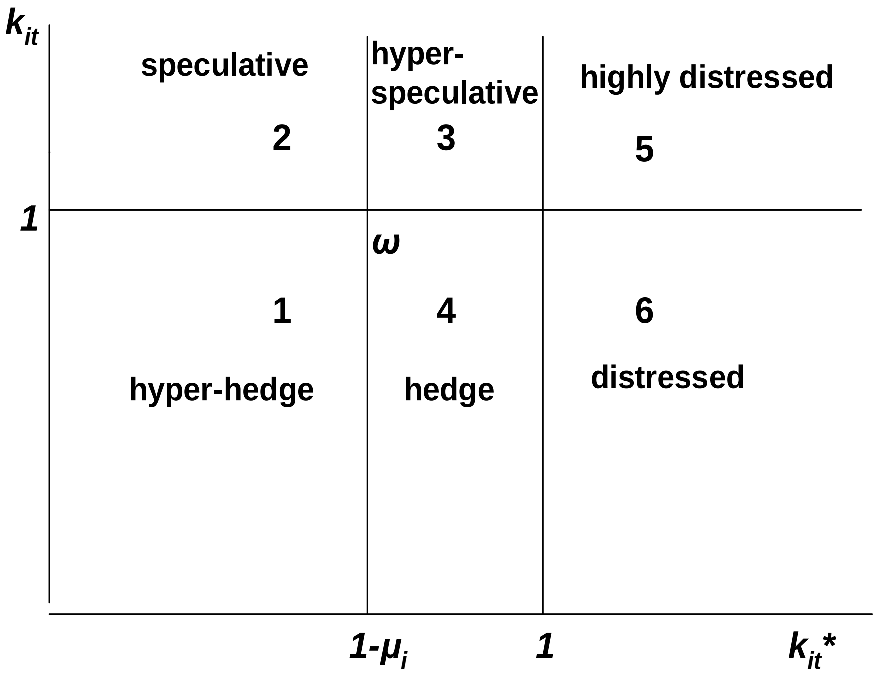

k_{it}
speculative
hyper-
speculative
highly distressed
2
3
5
1
ω
1
4
6
hyper-hedge
hedge
distressed
$1-\mu_i$
1
k_{it}*

Fig.1

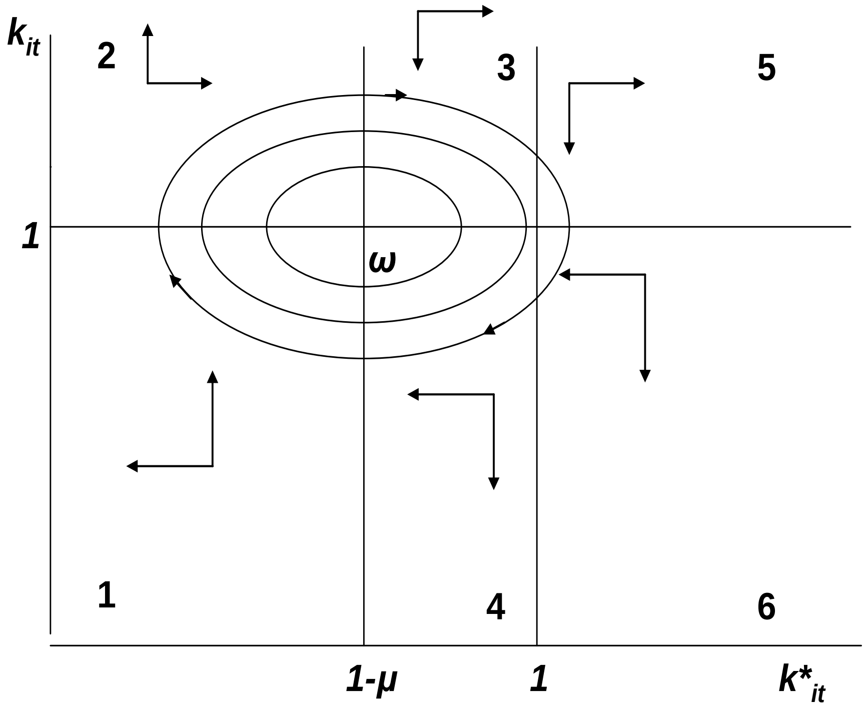

Fig.2

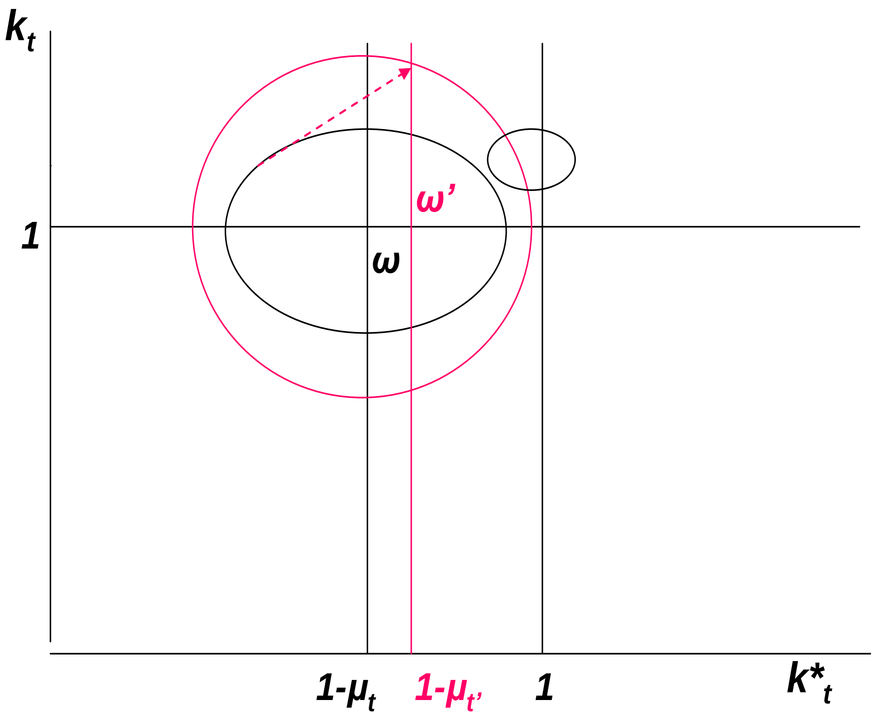

Fig.3

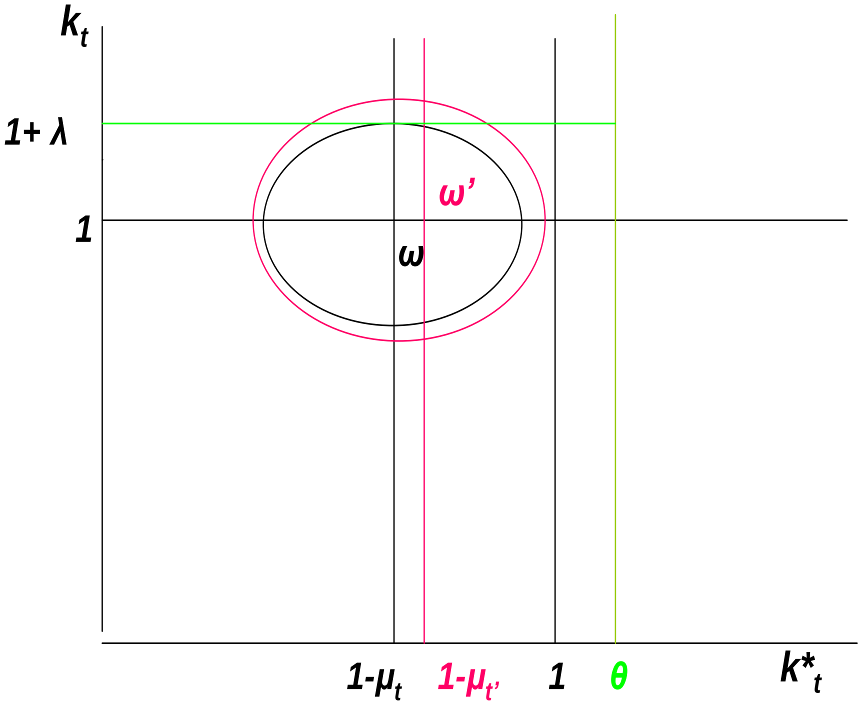

fig.4

Table 1: Relationship with Minsky's trinity: rules of translation

	This paper	Minsky
	$k_{it} = e_{it} / y_{it}$ $k_{it}^{*} = E\left(\sum_{s=1}^{n} \frac{k_{it+s}}{(1+r)^{t+s}}\right)$	$m_{it} = y_{it} - e_{it}$ $m_{it}^{*} = E\left(\sum_{s=1}^{n} \frac{m_{it+s}}{(1+r)^{t+s}}\right)$
Hedge unit	$k_{it} < 1$, for every t $k_{it}^{*} < 1$, $1 \leq t \leq n$	$m_{it} > 1$, for every t $m_{it}^{*} > 0$, $1 \leq t \leq n$
Speculative unit	$k_{it} > 1$, for $t<s<n-1$, s small $k_{it}^{*} < 1$ $1 \leq t \leq n$	$m_{it} < 0$, for $t<s<n-1$, s small $m_{it}^{*} > 0$ $1 \leq t \leq n$
Ponzi unit	$k_{it} > 1$ for $t < n-1$ $k_{it}^{*} > 1$ $1 \leq t \leq n-1$	$m_{it} < 0$, for $t < n-1$ $m_{it} >> 0$ for $t = n$ $m_{it}^{*} < 0$, $1 \leq t \leq n-1$