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From the Financial Instability Hypothesis to the theory of Capital Market Inflation: a structural interpretation of the sub-prime crisis

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Abstract

The aim of this paper is to develop a structural explanation of the sub-prime mortgage crisis, grounded on the combination of two apparently incompatible financial theories: the *Financial Instability Hypothesis* by Hyman P. Minsky and the theory of *Capital Market Inflation* by Jan Toporowski. The theoretical analysis - presented in the first part of the paper - will then be reproduced in a Stock Flow Consistent model, to test its coherence, both logical and with respect to stylized facts in the U.S. economy.

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1 Introduction

The aim of this paper is to develop a structural explanation of the sub-prime mortgage crisis that hit the U.S. economy in 2007. We are aware that several valid interpretations have already been provided. However we believe our paper can still offer an original contribution. First, for its theoretical content. Our work is indeed grounded on existing economic theories, which are at the same time the object of a theoretical analysis, and the main tool in the investigation of the origin of the crisis. We believe that this is fundamental both not to over-estimate the most contingent aspects of the problem at stake, and to attempt contributing to the evolution of the theoretical debate. In trying to do so we rely mainly on the works of two distinct scholars: Hyman P. Minsky and Jan Toporowski. The theories of the two authors appear, at a first look, contrasting. However our thesis is that, not only the Financial Instability Hypothesis (Minsky, 1986), and more generally the 'financial Keynesianism'[1] of Minsky, can be combined with the the theory of Capital Market Inflation (Toporowski, 2000), but jointly, the two theories can provide a structural explanation of the crisis

Second, as we develop a Stock Flow Consistent model (see Godley and Lavoie, 2007), which includes some aspects of novelty, as regards the portfolio choice of firms and the intra-sectoral dynamics. The reason to use this class of model is twofold. On the one hand it allows for a consistency check of our analysis, since its logical and accounting implications are made explicit through the model. On the other hand we believe that this type of models can represent an useful and structured locus where different theories - albeit in a simplified[2] version - can be compared: 'a potential [...] common ground for all heterodox schools' (Lavoie, 2008).

The outline of the paper is as follows. At first we provide a review of some of the main interpretations of the crisis within the heterodox[3] approach, and we identify some gap in the literature. Then we revert to the analysis of Minsky and Toporowski - which we consider more complete in their investigation of the interactions between the real and the financial markets - and we offer a rapid overview of the theories of the two authors. In doing so we enter the current

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[1]This, according to Papadimitriou and Wray (1997), was the definition preferred by Minsky, for his own work, rather than post-Keynesian. With it we refer to Minsky's whole economic theory, seen as an interpretation of the *The General Theory*, of John Maynard Keynes, highlighting the financial aspects.

[2]The SFC, as an aggregated macro model can clearly reproduce only a stylized, thus simplified, version of an argumentative economic analysis. For example, as shown by Michell and Toporowski (2012), they can hardly account for complex intra-sectoral dynamics.

[3]Used in the paper to define broadly the schools of thought belonging to the Marxist and Keynesian traditions (the "Keynesian synthesis" and its descendants, are here considered pertaining to neoclassical economics).

debate over the coherence between the Financial Instability Hypothesis and the sub-prime crisis. Then in section 3 we recall the main features of the crisis, and some of the peculiarities of the U.S. economy, to underline the similarities between our analysis and the economic events investigated. In sections 4 and 5 we present a model aiming to reproduce the dynamics individuated in the theoretical investigation. Five numerical simulations are run in order to elucidate the causal links of our stylized economy. Finally section 6 summarizes the main conclusions and results of this work.

2   Some interpretation of the crisis

Since the burst of the sub-prime financial crisis, several authors tried to identify its roots and causes. In this section we provide an overview of some of the main contributions, within the heterodox schools of thought. The taxonomic approach utilized, divides the literature according to the causal elements stressed in the developed explanations. We identified three main focuses: i) distributive problems, ii) international dimension, iii) theoretical roots. We are aware that this classification might be considered superficial[4] under a theoretical perspective. Works with different theoretical foundations are, indeed, assimilated according to their conclusions. However a critical theoretical approach, would have required a significantly larger portion of our paper than the one that - for reason of space - we here devote to this[5] review of the literature. The reader should bear in mind that no theoretical equivalence is assumed to exist (nor neglected) within the identified categories.

One of the subjects over which heterodox economists most differ from their orthodox colleagues, is the importance they give to income distribution[6], in particular in its functional dimension. The rising inequality of the U.S. society, has been considered as the ultimate determinant of the crisis, by several authors. The core of their interpretations is shared: the decrease in wage income forced households to get more and more indebted in order to maintain their level of consumption. This cumulative process is evident in the empirical investigation

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[4]However it could be argued that this classification is in line with the approach that Lawson (2005) suggested to use in identifying the different heterodox traditions, 'The individual heterodox traditions are rendered distinct from each other by their particular substantive orientations, concerns and emphases, not by theoretical claims or results, empirical findings, methodological principles or policy stances' (*ibidem*, p.20). Clearly applied to a very specific subject, this methodology does not tell us anything about a possible classification of the traditions.

[5]A further and concise literature review on the coherence between the FIH and the sub-prime crisis is presented in sections 2.1.2.

[6]This is not technologically determined as in the marginal productivity theory, whereas depends on the relative strength of conflicting groups of interests, determined by political, institutional, and historical forces.

by Zezza (2011), who bases his analysis on the Levy model, a macro econometric model developed on the Stock Flow Consistent[7] approach. The author shows the unsustainable path taken by the U.S. economy, starting from the second half of 1980. Indeed the level of indebtedness of private sector with respect to income grew up to an unsustainable level and ultimately caused the crisis. While there is agreement over the essence of this analysis, the theoretical approaches and the methodologies used, differ sensibly among the authors. The financialization of the economy is central in the analysis by Lapavitsas (2009b). The author shows some of the main features of financialized capitalism, characterized - in his view - by numerous imbalances which made the system unstable. Among them distribution plays an important role, and it is presented by the author with an original (Marxist) perspective. He refers to 'financial expropriation', meant as 'the systematic extraction of financial profits out of wages and salaries' (Lapavitsas, 2009a, p.1). An alternative Marxist interpretation of the crisis recalls and updates the law of tendency for the rate of profit to fall (e.g. Perri, 2011). Finally within the Marxist interpretations of the crisis, we believe it is worthy to cite the analysis by Giacché (2009). The individuation of the causes of the crisis, is derived directly from a selection of Marx's works. What the author shows, is that credit, according to Marx, is used to stretch the reproduction scheme beyond its limits, leading to a crisis of overproduction[8]. This dynamic according to Giacché occurred also in the U.S. house market, in the 2007.

The explanations of the crisis presented so far - irrespectively on their approach[9] - present a theoretical difficulty, if considered under a post-Keynesian perspective. The aggregate demand in the U.S. seemed to be driven by consumption, while at the same time income distribution was shifted in favor of profits. This appears to be incoherent with the post-Keynesian (and in particular to a Kaleckian) tradition in which the saving propensity of wage earners is typically assumed to be lower than the one of capitalists. The solution for this puzzle can be individuated in Onaran et al. (2011), who develops a macro model (in the line of neo-Kaleckian tradition) used for an econometric analysis to investigate the effects of the increasing importance of the financial sector in the U.S. economy. The redistribution of income in their analysis, is inextricably linked with the financialization of the economy, and has multiple facets. To the classical dichotomy between wage and profit, the authors add a further one between non-rentier profits and rentier income. The latter seems to be charac-

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[7]For an analysis and literature review on this class of model see chapter Caverzasi and Godin (2012) and primarily Godley and Lavoie (2007).

[8]'As soon as a stoppage takes place, as a result of delayed returns, glutted markets, or fallen prices, a superabundance of industrial capital becomes available, but in form in which it cannot perform its functions. Huge quantities of commodity-capital, but unsaleable. Huge quantities of fixed capital, but largely idle due to stagnant production' (Marx, The Capital Vol. III, Ch. 30).

[9]Either Marxist or post-Keynesian.

terized by high propensity to consume and together with capital gains - realized through debt - increased consumption, depressed investment and set the stage for the crisis.

The second element which recurs often in the heterodox analysis of the crisis is the international dimension. For example Bibow (2010) identifies the global imbalances, and the role of US households as consumers of last resort, as the main determinant of the crisis. An articulated analysis is presented by Duménil and Levy (2011), which develops a historical perspective to show the metamorphosis of the capitalist economic system. Their conclusion is that the Neoliberalism together with the U.S. global hegemony, are to be considered the roots of the sub prime crisis. The combination of these two factors resulted in those features of the economic system - such as deregulated and globalized financial markets, U.S. trade deficits, slow accumulation and private indebtedness - which led to an unsustainable situation. Another historical perspective, centered around the U.S. hegemonic power is the one presented by Varoufakis (2011). The author does not focus on the sub prime events, he puts forward a larger analysis over the Global Financial Crisis - triggered by the sub prime - as a systemic crisis of the economic system settled by the U.S. and in which the other countries pay a tribute in the form of capital flows. The proposal for a way out is the creation of a Global Surplus Recycling Mechanism (GSRM) to redirect that tribute to more constructive ends.

The third category is represented by the authors, which focused their analysis on the theoretical economic debate. The investigation, in these cases, is shifted from the practical - either structural or trend related - causes of the crisis, to their theoretical roots. Roncaglia (2010) blames the orthodox economics - referring to the *Washington Consensus* - to have solicited for the deregulation which led the economy towards the crisis. A similar opinion is the one put forward by Chiang (2010), in his wider critique of neoliberalism. The same perspective, but with a more stringent focus, is used by Pasinetti (2011), which identifies in the Modigliani - Miller theorem the corner stone - or the 'major culprit' in his view - of the neoclassical approach to the financial markets, where the absence of regulation is seen as determinant for efficiency. In the analysis of Crotty (2009), the new institutional setting - defined in the paper as New Financial Architecture (NFA) - that emerged from the 1980s, is the real cause of the crisis. The author believes that the theoretical ground of this architecture is rather weak, being based on the assumption of equilibrium in the financial markets. The crucial elements composing the NFA, are numerous[10], and led to a highly leveraged, hence highly fragile, financial sector. The sub-prime crisis,

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[10]Crotty identifies seven main aspects. Among which, perverse incentives, which contaminated the financial system at any level from the loan sellers, to the bank packaging loans into securities, up to the rating agencies; financial instruments too complex to be priced correctly; off balance sheet assets. Deep integration of financial system which allowed for the contagion.

hence is seen as a trigger of the financial crisis.

A different perspective is presented by Bhaduri (2011), who blames a super-ficial[11] Keynesian policy approach - which he defines as "conservative Keyne-sianism" - for focusing exclusively on stimulating the aggregate demand, and for not paying attention to liquidity preferences as signal of uncertainty. This led to a debt finance consumption boom, coupled with a financial evolution which led to Ponzi finance, and to the subsequent crisis.

We want to cite the analysis of Lavoie (2009) last in this section, because it offers a link to the next part of our paper. The author at the end of his introductory book on post-Keynesian economics, recalls the main aspects of the crisis, (which are read in light of the theories illustrated in the book). So the expansion of credit - which was the counterpart of household indebtedness - is coherent with an endogenous money theory. While financialization is described as a lower propensity to save out of profit, which leads to an increase in economic activity and to higher profits. Higher profits in turn cause high stock-market price, the subsequent wealth effect made household spend more. The possibil-ity of an increase in consumption was guaranteed by the deregulated financial system which made the access to credit easy, and allowed household to get over indebted. Other post-Keynesian interpretations of the sub prime crisis refer to the Financial Instability Hypothesis. They will be presented in the following section together with a short description of the theory.

Albeit we find several of the analysis presented in this section valid, and in some cases enlightening about the peculiarities of the U.S. economy, we be-lieve that some aspects of the crisis could be further investigated. Following Toporowski (2009) we refer to the national accounting[12], to make our point clearer. A very trivial manipulation allows to reach the following identities.

$$Y - C \equiv S \tag{a}$$

$$S \equiv S_H + S_F \tag{b}$$

$$S_H + S_F \equiv I + (G - T) + (X - M) \tag{c}$$

$$S_F \equiv I - S_H + (G - T) + (X - M) \tag{d}$$

Identity (c) simply tells us that private savings (of both households and firms) must equate investment plus government deficit and trade surplus. Once we move household saving to the right hand side, we obtain identity (d), which - as trivial as it is - with minor differences, was at the center of Josef Steindl's

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[11]Where the reading of the General Theory is limited to the first three chapters, while Ch. 12 - where radical uncertainty is presented - and Ch. 17 - which treats portfolio choices - are ignored.

[12]The GDP is given by the sum respectively of consumption, investment, government deficit and trading surplus, $Y = C + I + (G - T) + (X - M)$.

theory[13] of 'enforced indebtedness'. An exhaustive summary of the theory is beyond the scope of this paper here it is sufficient to remind that according to Steindl the saving decisions of households have a direct impact on the level of indebtedness of firms: the more households save, the more firms get indebted. This dynamic seemed[14] reversed in the events that led to the crisis of 2007, the financial position of firms was stable and the enforced indebtedness apparently hit the household sector.

$$S_H \equiv I - S_F + (G - T) + (X - M) \qquad \text{(e)}$$

With respect to this analysis we have individuated some gaps in the above literature review, that we would like to fill with our work. Two aspects seem to have been overlooked. First, we believe that firms' savings (S_F), played a key role in the decrease of households savings[15] (S_H). Second, we found that little or no explanation is given to the reasons why the crisis erupted specifically in the real estate market. Indeed most of the paper of the first category (those analyzing the effects of income distribution) focuses mainly on the role of (C) in identity (a) and on the determinants of a low level of (S_H). Furthermore the majority of the authors - even when a wider analysis was provided[16] - explains which were the forces that made the economy unstable, and set the stage for the crisis. As we said the structural elements, which cause this destabilizing pressure to unburden in the sub-prime market do not appear to be enough analyzed. This refers not only - as obvious - to the works investigating the theoretical foundation, bu also to some of the analysis included into the other two categories, as for example in the cases of Zezza (2011) and Varoufakis (2011). In the following sections, referring to the works of Minsky and Toporowski, we will investigate both, the behavior of firms' savings (and its role in the crisis), and the reason why the destabilizing pressure unleashed in the real estate market.

2.1 The FIH, and the crisis

The importance of the work of Minsky, is universally recognized within the heterodox (especially post-Keynesian) tradition, for its capacity to shed lights over

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[13] See Steindl (1990).

[14] We are not assuming a direct causal link, in which the high indebtment of households was directly determined by the low indebtment of firms. It is still possible to identify the causal link theorized by Steindl in the events leading to the crisis (low saving and high consumption by households determined a low level of indebtment for firms). We are trying to underline how the focus of the indebtment dynamic was shift from firms to households. The determinants of this shifts are investigated through the paper.

[15] This is what we mean above saying that the dynamic individuated by Steindl of enforced indebtedness seemed to be reversed.

[16] As in Duménil and Levy (2011); Lapavitsas (2009b), which accounted for the roles of (I) and ($X - M$).

the dynamics of the financial system, and over their influences on the business cycle. Furthermore his analysis made a substantial comeback with the latest crisis, even besides the heterodox academic world. However the extent to which the Financial Instability Hypothesis can provide an explanation to the sub-prime crisis, is at the center of a debate as we will show in the next section. Our point of view is that, on the one hand the analysis of Minsky embodies aspects, strictly linked to the economic reality he was witnessing. These 'contingent' features result in the incompatibility of several of the main conclusions of the author (as his investment theory) with present economic events. However, on the other hand, we strongly believe, that the theoretical analysis of Minsky goes far beyond its most contingent aspects, and as an analytical framework it allows to identify both, the structural elements of nowadays crisis, and their causes.

We want to stress that the methodological approach we follow does not consist in an explanation of a set of economic events (in this case the sub-prime crisis), basing our analysis on a closed theoretical system (the FIH) in a deductive manner, somehow "forcing" reality into the theoretical framework of Minsky. On the contrary, we believe that in general, it is of little use to detach economic analysis from the institutional and social settings characterizing the economy in which the events under analysis occurred. Thus, since by the time Minsky conceived his theories, some of these settings have changed, it is important to take into account their main aspects of novelty; in particular - as it will be shown in the following sections - those referring to the premises of the FIH, which could therefore affect its conclusions. This is why we refer to the analysis of Toporowski, because we believe that his theory of Capital Market Inflation sheds lights on the dynamics characterizing nowadays financial markets, and on their influences on the real side of the economy.

The following section briefly reviews the Financial Instability Hypothesis. An exegetical analysis of the work of Minsky is at the core of our paper [17]. The paper identifies twelve elements which we considered representing the essence of the analysis of Minsky[18]. Since the following analysis rely heavily on our previous work, to avoid repetitions, we cross-refer to that paper for a more exhaustive analysis of the FIH, and for the aspects of our theoretical interpretation which might appear not sufficiently investigated in this paper.

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[17]For a more complete analysis of the contribute of Minsky see Caverzasi and Dos Santos (2012).

[18]The elements are: the nature of the economy (characterized by a "money-now for more-money-later" dynamic), the units considered, the means to reach the units' goals, the importance of time dimension, complex financial institutions, micro-characterization, the intercorrelation between balance sheets, fundamental uncertainty, the centrality of investments, non perfectly competitive markets, the role of money.

2.1.1 Outlines of the FIH

The Financial Instability Hypothesis is an endogenous theory of business cycle, centered around the analysis of the financial structure of the economy. Minsky derived it from a personal interpretation of The General Theory, which largely overcomes the focus on aggregate demand typical of the conservative Keynesian approach (recalling the aforementioned definition by Badhuri). In a nutshell the theory states that within the economy, there are forces that during a period of tranquillity[19] lead the system towards instability ('stability is destabilizing' Minsky, 1985). The interpretations of the work of Minsky, usually focus on the analysis of firms' investment and financing[20] decisions. Real capital accumulation is indeed of quintessential importance in the analysis of Minsky. Because both, it drives aggregate demand, and - determining the level of profits, in a Kaleckian fashion - it allows to validate financial commitments. In this analysis firms, under uncertainty, choose the level of investment comparing two[21] elements. On the one side the expected stream of returns diminished by a discretional margin, which represents a "cushion of safety" (see Kregel, 2008) to protect firms against the possibility of wrong forecasting and of not being able to repay the debt (*borrower's risk*). On the other side the cost of the capital asset. The latter - whenever firms have to resort to external finance - increases together with the extent of the loans, since banks claim a premium against the possibility that the borrower defaults on its debt (*lender's risk*). Broadly speaking the bigger the loan, the higher the possibility[22] of default, the subsequent losses, and therefore the required risk premium.

Hence an investment decision directly leads to a stream of revenues and a stream of financial commitments. As long as revenues exceed commitments, the economy is stable. Vice-versa a crisis can occur. This led Minsky to formulate, his famous taxonomy of financial positions, in which he distinguishes among, hedge, speculative and Ponzi units. In the first case[23], in any moment firms' expected money inflow exceeds their financial commitments. In the second case revenues are enough to repay interest but not the part of the principal supposed to be paid. Hence it becomes necessary to roll over the debt. Finally Ponzi units are those needing to borrow further money, or to sell assets, since revenues are lower than interest payment. The stability of the economy depends

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[19]Intended as a more or less stable growth.

[20]Referring to the national accounting manipulation in section 2, the FIH focuses on the role of I and S_F, which is supposed to decrease during a boom.

[21]This double focus is expressed by Minsky, through a two price theory which recall the Tobin's q, from which it differs for two main reasons. First, Minsky take into account the source of finance, since he dismiss the Modigliani Miller theorem. Second, he takes into account uncertainty.

[22]This immediately recalls Kalecki's *principle of increasing risk*, (see Kalecki, 1937).

[23]Here we refer to the exposition of Minsky (1992) elsewhere the taxonomy was presented in slightly different terms by the author.

on the relative presence of each of this type of units, the more the hedge units the more stable will be the economy. Indeed a further important element of this analysis is the intercorrelation between balance sheets which makes units reciprocally dependent. According to Minsky after a prolonged period of tranquillity units' expectations - both firms' and banks' - tend to become more and more optimistic, the margins of safety narrow, and speculative and Ponzi finance become consuetudinary. Then something happens, this could be for example an increase in interest rate - due to tighter monetary policy or endogenous forces - or a change in expectations. Speculative and Ponzi units are no longer able to meet their financial commitments. Therefore either they default or sell assets. This leads to debt deflation and crisis, which spreads because of the balance sheets intercorrelation.

2.1.2   Was it a Minsky moment?

The expression "Minsky moment", is broadly used to define a situation in which units (traditionally firms) - which got over-indebted, due to the optimism caused by a prolonged period of tranquility - need to sell their assets to pay their financial commitments. This, if government does not intervene, can clearly cause a Fisherian debt-deflation, and lead to a generalized economic crisis. One of the most influential post-Keynesian economist, Paul Davidson (2008) openly questioned the possibility to define the sub-prime crisis as a Minsky moment. The author identifies, in the shift of the economy from hedge to Ponzi-finance, a necessary precondition for a Minsky moment to take place. This could not have occurred in the crisis of 2007, since - according to Davidson's explanation - the taxonomy of financial positions simply cannot be applied to the housing market. Speculative finance is based on a premeditated decision of rolling over a debt, an eventuality which - according to the author - was excluded by the specific contractual forms[24] of that market. The explanation of Davidson for the crisis is that it was the result of an attempt to securitize illiquid assets, allowed by the deregulation of financial markets realized through the repeal of the Glass-Steagall act.

Another prominent post-Keynesian scholar, Jan Kregel, reaches the same conclusion, albeit under a complete different perspective. Kregel (2008) recognizes the presence of a Ponzi scheme in the sub-prime mortgage market, due to the 'likelihood that the cash commitments can only be met by increased bor-

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[24]His thesis relies on the consideration that speculative finance necessitates a premeditated decision of rolling over a debt, and this would be a non sense, since the sub-prime mortgage contracts include a strong penalty in this case. And, even in the case the borrower was unaware of it, or had he accepted it, a second mortgage would not have been granted to a sub-prime borrower.

rowing or refinancing at some future date' (p.14 *ibidem*). However in his view it was not the result of endogenous forces, as in the analysis of Minsky. Whereas it was determined by a structural change of the financial system, which caused the detachment of the issuer of the debt, the evaluator of the credit worthiness and the units running the *lender's risk*. Banks indeed are no more responsible for the evaluation[25] of the risk, since their profits are assured by the sale of securitized mortgages, and do not depend any more on the interest rate inflow from the loan. This led to the Ponzi scheme which caused the sub-prime crisis. Wray (2012) too states that the crisis is the result of a structural change in the U.S. economy, and therefore dismisses the possibility of "black swans". However he puts forward a Minskyan interpretation of what happened. His idea is that the excess of optimism - motivated by the belief in the Great Moderation - led to undertake riskier and riskier financial practices heading the economy toward the crisis. 'So, it is completely appropriate to give credit to Minsky's foresight' (*ibidem*, p.4).

Other authors suggest what we could define as a "same scenario different location" perspective: a Minsky moment occurred albeit not where Minsky theorized it would have happened. For example Dymski (2010) enters this debate acknowledging the importance of the contribution of Minsky in the understanding of the features of the crisis. However he recognizes that what happened in the 2007, had peculiarities which made it differ from the dynamic depicted in the FIH. Dymski identifies three original elements - new banking regulation, inclusion and consequent financial exploitation of minorities in the real estate market, and U.S. current account deficit - which were absent at the time Minsky developed his hypothesis and not included into his theory. Also Bellofiore and Halevi (2009), offer a Minskyan interpretation of the crisis 'sub condicione'. Similarly to Dymski, they identify the elements of novelty which need to be taken into account to update the FIH and to make it coherent with the new form of capitalism that emerged in the U.S. in the second half of 1990s. This 'new capitalism' (as defined by the authors) is described through a historical perspective putting emphasis on the metamorphosis of the economic system, in which industry and labor became subordinated to finance. Hence for the Financial Instability Hypothesis to "survive" in this new capitalism, it is necessary to take into account some key elements of novelty. First, contrary to the one described by the FIH, the boom did not occur in relation to real investment. Second, aggregate demand was no more dependent on aggregate investment, because of the rise of debt finance consumption. Last, the increase in prices associated with the boom, was independent by wages, and determined by raw materials' price. Albeit these significant transformations, the two authors believe that 'A Minsky

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[25]Furthermore the profits of the rating agency - responsible for the evaluation of the risk - do not depend directly on the actual solvency of the borrower.

dynamics has, indeed, occurred but elsewhere and with a different set of modalities compared to those envisaged by the author' (Bellofiore and Halevi, 2009, p.16).

We believe that this controversy, wether this crisis is indeed a Minsky moment or not, is deeply linked to the interpretational issue we recall above. If the FIH is slavishly taken as originally presented by Minsky, in particular with respect to his investment theory and overlapped to a summary of the main events which characterized the sub-prime crisis, it will undoubtedly emerge a certain amount of circumstances and peculiarities over which the evolution of the crisis deviates from the dynamic depicted in the FIH, since - as underlined by most of the authors of our literature review - the crisis did not take place in relation with the financing of real investment. The conclusion would be that it was not - at least not exactly - a Minsky moment (as in the analysis of Davidson).

Our perspective differs substantially. We believe that the analysis of Minsky goes far beyond his theory of investment and that it is possible to use his analysis as a framework to understand how the financial system can overcome its limits and how this can affect the real economy (as Bellofiore and Halevi, 2009; Wray, 2012, appear to have done).

What clearly emerges, from the above literature review (as well as from the one about the causes of the crisis in section 2), is that it is possible to identify a certain degree of consensus around the idea that major structural changes occurred in the U.S. economy since the 80s. This metamorphosis - which has been commonly referred-to with the term *financialization* - created the new environment from which the crisis emerged. In the next paragraphs we will try to demonstrate that, even considering the aspects of the financialization, which appears to be mostly in contradiction with the FIH, it would still be possible to use the analytical framework developed by Minsky to understand the 2007 crisis.

Before doing so however, we want to recall that Minsky as well, identified a new phase in the american capitalism[26], which he defined, 'money manager capitalism' (see Minsky, 1996). This was characterized by the following elements:

> '1) Almost all business is organized through corporations. 2) Dominant proportions of the liabilities of corporations are held by financial institutions[...]. 3) This involves the intrusion of a new layer of intermediation, by pension and mutual funds, into the financial structure. 4) Pension and mutual funds are bound only by contract as to what assets they can own and what activities they can engage in. 5) The stated aim of the of fund managers is to maximize the

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[26]The preceding stages he identifies are: 'commercial capitalism; industrial capitalism and wild cat financing; financial capitalism and state financing; paternalistic, managerial and welfare capitalism'(p. 362 Minsky, 1996).

value of the investments of the holders of its liabilities. 6) The performance of a fund and of a fund managers is measured by the total revenue on assets[: dividends, interests and capital gains](*ibidem*, p. 363).

Some of these points recall *shareholder value orientation*, which is at the heart of the analysis of several authors (see Onaran et al., 2011; van Treeck, 2009). Once more Minsky proved to be an acute observer[27] of the economic reality, however this did not lead him to reconsider the dynamics of the FIH which focuses on the external financing of real investment mainly in the form of debt. This theory had been developed during a different era of the U.S. capitalism. An era in which the dependency of firms from bank loans for the financing of investment, was still elevated. A major feature of the financialization of the economy is the shift of the source of financing, from loans to equity and this has a significative impact on the results of the FIH. In a coauthored paper Minsky observed that 'The greater the ratio of equity to debt financing the greater the chance that firm will be a hedge financing unit' Delli Gatti et al. (1994). However he never updated the FIH in light of this observation, and of the new stylized facts on investment financing in a financialized economy. Probably this is why, his analysis left the space for some critique (see the empirical part of Lavoie and Seccareccia, 2001), and some doubt about the possibility of defining the crisis started in the 2007 as a Minsky moment.

2.2 A different but complementary perspective: the CMI

What emerges from our analysis of the FIH is that its most contingent features represent a major difficulty in the attempt of applying it to the actual economic situation, due to the structural change that characterized the economy and led to a new form of capitalism (a process we defined as financialization). Unlike Minsky, Jan Toporowski derived his theory of Capital Market Inflation (see Toporowski, 2000, Part 1), directly from an insightful observation of the financial markets during this new phase of capitalism. His theory moreover includes the quintessential aspects of novelty of the financial system, missing in the FIH, and therefore represents a fundamental support for our theoretical analysis. In this section we present a rapid overview of the theory.

The theory of Capital Market Inflation (CMI now on), could be defined as a theory of structural disequilibrium in the financial sector in its relation with the real side of the economy. The starting point of the CMI is a critique to

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[27]However the first of this point does not correspond to reality, since small and medium enterprises still account for most of the private jobs in the U.S. and to one third of the exports United States International Trade Commission (2010).

conventional financial theories. According to Toporowski the modern portfolio theory, the capital asset price models, the arbitrage pricing models and the efficient market hypothesis, focus exclusively on elements which are important only when net inflows of money into the securities market are negligible. The author distinguishes between *substitution* and *inflow* effects, stating that standard theories neglect the latter. The securities market - in the view of Toporowski - is not characterized by equilibrium and the equality between supply and demand is only notional. When the demand of securities exceed supply, prices rise. The increase in the level of prices, leads to capital gains for the holders of the assets. This in turn, stimulates further demand - new net inflow - from units willing to take part into the capital gains, with a given level of supply. The speculative demand hence increases together with prices, in a self reinforcing dynamic.

> The excess is then taken up by a higher turnover of the available stocks and higher stock prices, as brokers and investors are obliged to offer higher prices in order to persuade holders of stocks to sell. (p.33 Toporowski, 2000)

The reactions of the financial market to this inflationary pressures, are determined by some of its peculiarities. Different assets have different characteristics, hence the increase in demand will inflate mostly the price of those assets without a face value, typically equities. Furthermore the main issuer in the financial markets are, financial institutions, governments and corporations. Government have budget restrictions, while financial institutions are mainly intermediaries, which buy and issue, mostly between them. Hence corporations - through equity emission - is the sector, which account for most of the excess of demand for securities. Furthermore the author identifies three sets of prices in the financial markets: *notional price* - the price advertised by brokers in the market, *actual price* - the price at which securities are actually exchanged in the market - and *effective price* - the price of newly issued equities. The flow of funds from the financial market to the firms occurs through effective prices, which only in a second moment - if firms issue new equities - inflates as well. According to Toporowski, the outcome of this forces, was that corporations - in the attempt of taking advantage of the inflated financial markets - issued equities, beyond their financial needs and became overcapitalized. In the analysis of the author we can identify several factors explaining this behavior. First, firms discovered they could easily obtain cheap external finance, issuing a security whose return is represented in part by dividends and in part by capital gains, which - unlike the interest paid on liabilities - does not represent an outflow of money for the company. Secondly, what could have been a natural deterrent against an excess issue of equities, namely the loss of control over the company, does not represent a problem anymore. The inflow of money takes place mainly through financial intermediaries - like funds - whose managers hardly take part in the adminis-

tration of the company. Third the new remunerations criteria, which switched from profit-related, to share price-related, and often paid through stock-options, represented an incentive for managers to follow this path[28]. Finally the exceptional inflow of capital deriving first from the rise of a privatized welfare system - which led to the pension funds - and then from the inflow of foreign capital from countries with a surplus in trade balance, fueled further this dynamic.

Hence corporations got overcapitalized, but what was that extraordinary inflow of money used for? The most common uses of the excess capital were the decrease of debt, the acquisition of short term financial assets - so to maintain liquidity - and balance sheets restructuring, among which the acquisition of companies represented a safer way to enlarge business compared to entrepreneurial activity.

> Industrial regeneration is a dream of engineers, from which companies are awoken by their finance directors to face the irrefutable realities of balance sheet restructuring as the only financially viable way forward for all companies (p.151 Toporowski, 2009).

The easy access to funds and the high profits in the financial markets led corporations to direct their investments toward financial rather than real capital, as shown for example by Orhangazi (2008).

2.2.1 The CMI and the FMI: main difficulties

The conclusions of the CMI are, at a first sight, devastating for the FIH. A direct consequence of the overcapitalization processes, described by Toporowski, is indeed the decrease of firms' recourse to banks credit as a source of external finance. While for Minsky 'the relevant paradigm is a system with a City or a Wall Street where asset holdings as well as current transactions are financed by debts (Minsky, 1975, p.70)'. That paradigm, so described, is no more consistent with economic reality.

The financial fragility of the FIH, is usually[29] measured by the financial leverage ratio. This is commonly computed or as stock of debt over stock of assets (D/A), or stock of debt over stock of equity (D/E), or as debt over internal finance (L/Fu, where Fu represents retained earnings and L new flow of loans). Whichever the measure used, the CMI demonstrates how the leverage ratio felt, since the increase in the issue of equity reduced both loans and the stock of debt. More specifically, referring to the second of these measures (D/E), since - as shown by the CMI - the inflation of capital markets led to both an

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[28]Hence also in the analysis of Toporowski recurs the idea of shareholder value orientation.

[29]Minsky himself referred to this ratio, e.g. 'The greater the leverage an investing unit uses, i.e., the greater the ratio of debt to internal financing, the greater are such excess contractual cash-flow commitments' (Minsky, 1975, p.108).

increase in the value of equity and a decrease in debt, the leverage ratio would dramatically fall.

A further element of weakness of the FIH, emerging from the analysis of Toporowski, refers to its relation with the business cycle. The financial fragility (and therefore the leverage of firms) in the FIH is pro-cyclical. A booming economy, allows for the validation of investment and financing decisions, hence expectations become increasingly optimistic. These are shared between firms and banks. The latter therefore are willing to grant the credit required by the former, since both try to take advantage from the positive economic situation. However Toporowski shows that the indebtment level of firms is on the contrary anti-cyclical, so it is leverage, since both decrease during the upswing phases of the economic cycle. In particular the reduction of leverage is accelerated by the double effect of an increase in the value of equities on the one side, and a decrease of debt on the other side; '[...] when an economic boom provides them with plentiful sales revenue, firms actually reduce their debt financing, and even replace it with equity (common stock) as the stock market flourishes (p.27 Toporowski, 2000)'. These aspects of the CMI seem bound to invalidate the FIH, which according to Toporowski 'may still be valid if equity is regarded like debt as a liability of firms' (*ibidem*).

With respect to the last part of section 2 of our paper, Toporowski, shows that the structural changes determined by the financialization of the economy, had a direct impact on S_F, which increased. How this can be be linked to the analysis by Minsky, and with the sub-prime crisis is the theoretical dilemma that we will try to solve in the next section of the paper, combining the theoretical framework of Minsky with the CMI of Toporowski. In doing so we believe we will fill the gaps identified in our literature review.

2.2.2 The FIH and CMI combined: a structural interpretation of the crisis

In the theory of CMI, next to firm, the other sector over which the dynamic of overcapitalization had a deep impact, is the bank sector. Toporowski observes how since the 1970s banks went through - and in part were forced through - major changes. They had indeed lost their best customers, namely companies, which started financing capital accumulation through retained profits, whose liquidity was then topped up via equity emission. This indirect equity-financing of investment broke the bank-firm relation which was at the core of capitalist societies, up to their financialization. Banks therefore started focusing their profit seeking efforts into other activities, such as 'fee-related business in derivatives and debt obligations markets, and towards lending into the property market and to other risky customers that banks had hitherto treated with much more caution' (*ibidem*). Referring to section 2, we could say that banks' business

shifted from S_F to S_H. The repeal of the Glass-Steagall in 1999, can therefore be seen as a institutionalization[30] of this change.

This analysis of banks by Toporowski can represent a bridge between his CMI and the FIH. We believe that the two theories are somehow complementary and, if combined, can provide for a structural explanation of the crisis. Not only overcoming its most contingent aspects, but identifying as well the endogenous forces which made it unburden in the real estate market.

Something that is often underestimated[31] in the analysis of the FIH, is the fundamental role played by the bank sector. Banks - used by Minsky to refer generally to financial institutions - in the FIH, are arguably one of the major determinant of the economic trends. This derives from their capacity of creating money[32]. They ultimately decide the extent by which the cost of an investment can overcome the internal sources of finance, providing for the needed credit. Hence - whereas not directly determining them - they fuel the business cycles, supplying the credit during booms, and cutting it during recession (the infamous *credit crunch*). Banks indeed in the FIH are the units which allow firms - and the economic system - to undertake increasingly fragile positions. It is important to bear in mind that this behavior of banks, is not irrational, simply they live in the same economic environment of firms, with which they share the 'expectational climate' (p.255 Minsky, 1986). Due to radical uncertainty - a further key element[33] of the analysis of Minsky - the euphoric expectations pushing firms to expand their business during booms, is the same optimism motivating banks to expand credit.

But their importance, in the FIH does not rely exclusively on the centrality of their role for the economy. In the analysis of Minsky, banks are indeed very active agents 'They actively solicit borrowing customers, undertake financing commitments, build connections with business and other bankers, and seek out funds' (pp.256-257 Minsky, 1986). Furthermore, in a Schumpeterian[34]. way, banks are considered innovative agents, able to expand credit - with a given amount of reserves - and overcome limitations imposed by financial authorities, thanks to *liability management*. These peculiarities make banks the engine guiding the economy toward an unsustainable path.

The idea we are proposing is that banks are the *endogenous destabilizer*[35], of the FIH, and - once they shifted their business as described by the CMI -

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[30]Minsky 1986, ch. 10 notices that the distinction between commercial banks and other financial institutions had already become mainly notional, since 1960s.

[31]Notable exceptions are represented by Nasica (2010) and Wray (1992).

[32]On endogeneity of money in Minsky see Wray (1992).

[33]See Caverzasi and Godin (2012) for a more detailed analysis on this issue.

[34]For precise reference see the note 8, (Schumpeter, 1951, p.153).

[35]This definition belong to Minsky, which entitled a section of his chapter on banks *'Banking as an endogenous destabilizer: the central bank as the lender of last resort'* (pp.279 Minsky, 1986).

the destabilizing tensions, described by Minsky, unburdened in some of their new core businesses[36] as securitization and the real estate[37]. The "investment decision" to be financed was no more the increase in the productive capital of firms, whereas the purchase of dwellings by households. The substantial growth in the level of credit granted by banks to households, was made possible by the inflation in the price of assets (as described by the CMI), against which households could increasingly borrow. This dynamic was stretched beyond its limits because banks were eager to expand their profits in one of their new core businesses, and - just as described by the FIH - they let the cushions of safety for this type of borrowing, become increasingly narrow ultimately encouraged by the 'euphoric expectations' arising from radical uncertainty . The expected stream of profits of the FIH, was substituted by the expected capital gains. This dynamic was therefore particularly toxic, since totally detached from the creation of entrepreneurial profits, which in the analysis of Minsky are essential for the validation[38] of financial commitments. It is important to notice how radical uncertainty and the subsequent pro-cyclical expectations did not affect the financial position of corporations since - due to over-capitalization - their position was steadily "hedge".

Furthermore the active and innovative behavior of banks, highlighted by the FIH, played a particularly relevant role in the crisis of the 2007, since the proliferation of new financial instruments, stimulated the expansion of credit and discouraged prudential behaviors, since the risk was spread by banks. This made the *lender's risk* perceived be practically negligible, and boosted the destabilizing dynamic. Households saw their financial positions getting increasingly fragile. Up to the moment in which the weight of speculative and Ponzi (households) units became unsustainable, and the crisis[39] inevitable. The over indebtedness of the borrowers, the erosion of margins of safety, which took place in the U.S. before the 2007 (see section 3.1), are the results of these destabilizing behaviors, and led to the sub prime crisis.

Our point of view relies on the consideration (motivated in Caverzasi and Dos Santos (2012)) that the Financial Instability Hypothesis is an outcome of the peculiar economic analysis of Minsky, inspired by a personal interpretation of *The Gen-*

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[36] A rather similar perspective is put forward by (Dymski, 2010, p.245). However the author identifies exclusively in the deregulation the cause of the shift of banks' business, not taking into account the role of firms.

[37] Although starting from the sub-prime crisis, their importance is slowly decreasing, mortgage related loans, still two and a half time higher than commercial and industrial loans, among the assets of the U.S. Commercial banks (Federal Reserve, 2012).

[38] Hence the observation of Kregel (2008), which underlined how the Ponzi scheme in the real estate market did not emerge from an endogenous process, finds its explanation - according to our analysis - in this peculiarity of the business banks were financing.

[39] "It" (i.e. the Great Depression) did not happen again in the U.S. only because, as shown by Minsky (1982), the FED had already learned the lesson, and intervened pumping liquidity in the system.

eral Theory. This 'Minskyan economics', is still valid even if the focus of banks changes. The role of uncertainty, the intercorrelation between balance sheets - which determines cash flows and can cause the spread of the crisis - the endogenous money theory, the taxonomy of financial position and the destabilizing stability represent some significant examples of major components of the theory of Minsky which would still be valid in this "updated version".

Reverting to the analysis of Steindl, we believe that the asset inflation made loans more easily available for households (allowing S_H to grow) while - through overcapitalization - made firms less dependent on banks' loans, favoring a decrease in S_F. This led banks to shift their business focus from firms to households and contributed to the rise of S_H. The money inflow deriving from debt was used by households to purchase assets and consumption goods, creating a dynamic in which S_F was kept low while S_H increased. Hence - albeit the causal link of the *enforced indebtedness* described by Steindl did not really reversed - the new financing behavior contributed to start a dynamic which led households to get increasingly indebted.

3 Empirical evidences

This section is subdivided into two parts. In the first we develop a rapid overview of the crisis. Clearly the empirical analysis in this case finds correspondence mainly with the work of Minsky, which between the two authors central for our paper, is the one whose work focused mainly on the financial crisis.

The second part of the section is, on the contrary, dedicated to the empirical evidence supporting the theory of Capital Market Inflation of Toporowski.

3.1 The crisis

Where did all start? In this section we try to retrace the main events that characterized the sub-prime mortgage crisis, with the aim of contextualizing the theoretical analysis of the previous sections. Therefore some of the major correspondences between this overview and the theoretical analysis above, are made explicit through the text.

The steep growth in the housing price in the USA started at the end of twentieth century. The decade between 1996 and 2006 witnessed a constant increase in the price of houses, whose value between 1997 and 2006 rose by 124% (according to the Case-Shiller Index). Financial institutions, with the aim of exploiting at most these dynamics, dramatically decreased their credit standard. The average Loans-to-Value[40] ratio reached its peak of 94% in 2005 and the subprime mortgages which used to represent an exception - 8% of total

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[40]See Duca et al. (2011) for a more accurate analysis on this measure.

mortgages in 2003 - became almost consuetudinary, reaching the climax of one fifth of new originated mortgages[41] in 2005 and 2006. Referring to the FIH, this could be defined as *reduction of the margin of safety.*

The fragility of the system was enhanced by the diffusion of mortgages refinancing, which became a common practice to finance consumption. This naturally resulted in an expansion of credit by financial institutions which had its counterpart in the indebtedness level of households, which faced a severe increase. Debt over disposal income ratio[42] reached 137% in 2007. This run to indebtedness was motivated by expectations for capital gains - shared by banks and households -, which was based on the observation that the house price had been almost constantly increasing since 1940 (*destabilizing stability* and *shared expectational climate* as Minsky put it). This dynamic was fueled by several factors, among the others we will analyze below, the low interest rate set by the FED played an important role. Between the end of 2001 and november 2004 the interest rate was indeed held below 2%.

Then the burst. Households started defaulting on their mortgages. The interest rate increased passing from 1% in 2004 to 5.25% in 2006, house price stopped growing, refinancing became more difficult and the bubble bursted. The house price collapsed by 20%, between 2006 and 2008. By the middle of 2008 around one fourth of sub-prime adjustable rate mortgages were either delinquent or in foreclosure. The timeline of the crisis is rather dramatic. From the end of 2006 first mortgage lenders, then hedge funds and finally banks[43] filed for bankruptcy. The contagion soon spread to the other side of the atlantic. So as american, also european banks faced huge losses due to sub prime mortgages (this *balance sheets intercorrelation* is an important element in the FIH).

A further element which played an important role in this drama is the low level of regulation of the financial sector. The Gramm-Leach-Billey Act in 1999 repealed the Glass-Steagall Act, hence canceling the distinction between commercial and investment banks. Furthermore both the booming period and the propagation of the crisis were favored by the diffusion of relative new financial practices. Lavoie (2009) individuates four main steps in the evolution of mortgage related financial innovations. First mortgages became securities, (Mortgage Back Securities, MBS) and as such they can be sold, allowing to externalize the risk they carry. Then commercial paper (asset-backed commercial paper - ABCP) were issued by financial institutions willing to buy the MBS. A further step was represented by the CDO (Collateralized Debt Obligation). Mortgage-backed securities were divided into tranches according to their riski-

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[41]See Joint Center for Housing Studies of Harvard University (2008).

[42]Data from Federal Reserve Board and Bureau of Economic Analysis.

[43]In December 2006: Ownit Mortgage Solutions failed. August the first, Bear Stearns' edge funds, Enhanced Fund and the High-Grade Fund filed for bankruptcy. As Lehman Brothers did on September 2008 did (U.S. Congress, 2008).

ness and potential returns and then (mainly the lower rated ones) grouped in CDOs. This 'financial packaging' - the so called structured finance - allowed to create nebulous financial products, able to receive safe ratings, albeit being highly risky. Finally the infamous credit default swaps (CDS) allowed to get an insurance in case a security defaults. All these innovations (in section 2.2.2 we recall the peculiarities of *banks as very active and innovative economic agents* in the FIH) were thought to make the market more efficient providing for liquidity and spreading the risk, based on the belief that a spread risk was a less harmful risk. However reality showed that they played a major role in both the phases of the crisis: the bubble and the contagion. Indeed the big losses of the sub prime bubble infected the financial markets and then the real side of the economy. The Dow Jones Industrial Average faced a 54% loss: from an all time record 14164 october 2007, to 6457 in the first trimester of 2009. While unemployment rate increased from 4.7 january 2007, to 9.7 same month of 2010.

3.2   U.S. trends

Further stylized facts of interest for our analysis regards the trends of the U.S. economy from the 1980s. This period witnessed the rise of a new form of capitalism, a dynamic defined by many author as financialization (as seen in section 2). A defining feature of the CMI, and therefore of our analysis, is the shift of banks' business. This is glaring in figure 1, which shows that the ratio of real estate loans over commercial and industrial loans in commercial banks' balance sheets from 1947 until now in the U.S. economy. From the end of World War 2, the amount of commercial and industrial loans was systematically higher than those related to real estate. The situation reversed starting from the 80s, and reaching its pick in 2010, when the latter were three times higher than the former.

A central element of our analysis is the over capitalization of firms theorized by Toporowski, in its CMI. Data are once more reveling as calculated by Bates et al. (2009), the average cash-to-assets ratio more than doubled between 1980 and 2006, passing from 10.5% to 23.2%. The overcapitalization in the CMI was coupled with a decrease in real investment with respect to financial investment. This can be seen in figure 2, taken from Orhangazi (2008), which shows financial assets as a percentage of tangible assets, between 1952 and 2003 in non financial corporations. The trend is positive all over the period considered, whereas it became sensibly steeper, starting from the 80s'. Finally as shown by the graph, in the beginning of the 21st century the amount of financial assets, overtook tangible ones.

Furthermore as shown by Zezza (2009), the U.S. economy was recently characterized by a detachment between increase of indebtment and investment. The
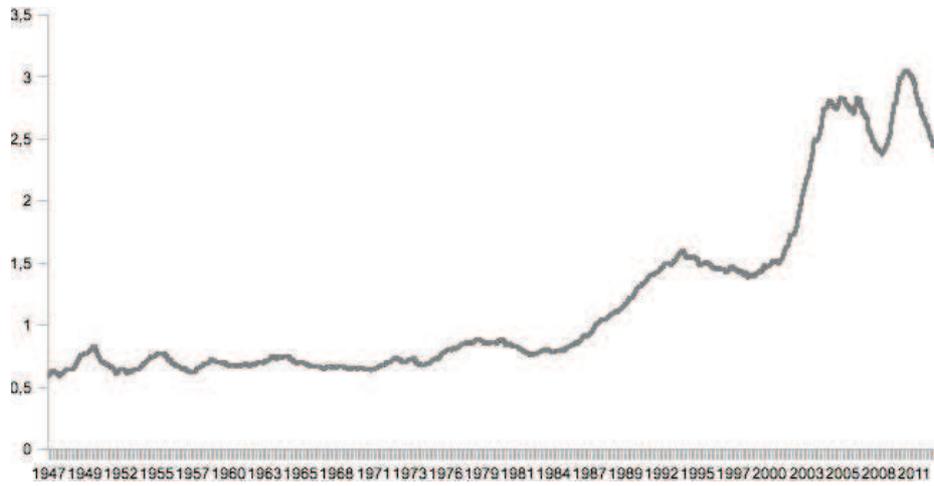
Figure 1: Real Estate over Commercial and Financial Loans, U.S. commercial banks. Source: FED.
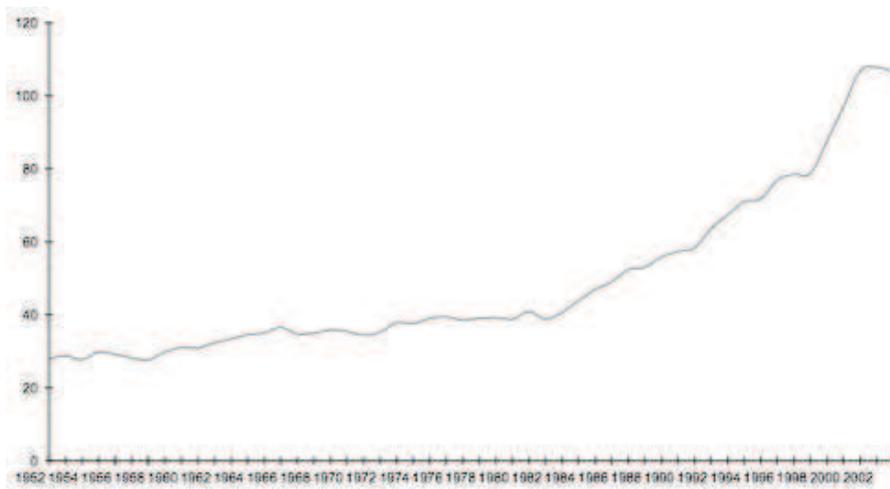

Figure 2: Financial assets as a percentage of tangible assets. Source: Orhangazi (2008).

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explanation of the author - 'firms borrowed to invest in financial assets -to buy back their own equities or get equity shares in other businesses' (*ibidem* p. 17) - is in line with the CMI and therefore with our analysis.

4 From the theories to matrices and equations

We believe that models, do not represent an alternative to the literal theoretical analysis. Since the reproduction of economic theories into mathematical formula and equations unavoidably implies a certain degree of simplification and cannot but provide for a stylized version of a theoretical analysis. However we believe that models can still represent a useful tool for economic analysis. First, we agree with John Kay when states that 'Economic models are no more, or less, than potentially illuminating abstractions' (Kay, 2011, p.7). Because - precisely for their simplifying nature - they force to look at the essence of a theory, and this can help to individuate its key elements and causal links. Furthermore, founding an economic debate exclusively on a dialectical analysis, may lead to misinterpretations and problems in individuating a common yard stick to compare different perspectives.

Therefore we consider modelization, and in particular - within the heterodox tradition - the Stock Flow Consistent models (SFC now on), as a valuable tool for our analysis. The reason is that this type of models combines a rigorous and structured accounting framework, with a virtually complete freedom in deciding the structure of the economy, the level of aggregation and the behavioral equations. Furthermore in the last years an increasing number (see Caverzasi and Godin (2012) for a literature review on the most recent contributions) of heterodox economists - from different traditions - have started using this methodology, which therefore has already started becoming a sort of arena for theoretical debate. Finally we believe that the SFC approach is particularly fit to reproduce the theories of Minsky, as claimed by Dos Santos (2005), because they make explicit the intercorrelation between balance sheets, the deriving flows and, therefore the links between the financial[44] and the real side of the economy.

The aim of our model is to reproduce the economic dynamic depicted above and deriving from the combination of the Financial Instability Hypothesis, by Hyman P. Minsky and the theory of Capital Market Inflation, by Jan Toporowski. The model is then used to draw different scenarios, to investigate the possibility of different kind of crisis.

Before proceeding with the explanation of the model, we try - in the next

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[44]In the words of Minsky 'An ultimate reality in a capitalist economy is the set of interrelated balance sheets among the various units. Items in the balance sheets set up cash flows' (Minsky, 1975, p. 6).

section - to motivate our choice for an aggregated SFC macro model.

4.1   Why this approach?

The model belongs to the class of macro models known by the name Stock Flow Consistent, pioneered by James Tobin and developed by Wynne Godley. The approach consists of two components. First, an accounting part reproduces the structure of the economy. The balance sheet, the flow of funds and the stock revaluations are reproduced through a matrix approach in which precise rules guarantee the respect of budget constraints, both for each sector and for the economy as a whole. Second, the decisions of the agents are modeled through behavioral equations, which determine the transactions of the economy, within the limits imposed by the accounting framework and by its implied flows. The accounting consistency per se and the limitations that it imposes to the rationality of economic agents represent the solid foundation of this modeling approach (see Lavoie and Godley, 2001-2002, pp. 307-308).

As shown in the second chapter of this thesis, there are different ways of using the SFC. Here we rely on a numerical simulation to solve the model, and to see how the economy behaves and reacts to a change in parameters. We are aware that the foundations of the SFC model do not completely screen them from the so called Lucas critique. The assumption of invariant parameters in the behavioral equations is undoubtedly unrealistic, especially if the intent would be to reproduce an economy in all its elements and processes (for an attempt to develop the SFC in this directions see Seppecher, 2012). However we believe that macro models embodying this unrealistic assumption, can still represent a useful instrument in economic analysis. As noted by Macedo e Silva and Dos Santos (2011), they can show whether a regime is economically or socially unsustainable (for a successful example see Godley, 1999) and which are the changes needed for a desirable growth. Furthermore, if calibrated on past data, they can offer a structured explanation of observed events.

We totally agree with Godley and Cripps (and with Dos Santos and Zezza, 2008, from whom we toke this quote) when state that the SFC 'logic can help to organize information in a way that enables us to learn as much from it as possible. That is what we mean by macroeconomic theory (...)' (Godley and Cripps, 1983, p. 44). The relevance of this approach to macroeconomics was made evident by the eruption of the financial crisis, which came as a surprise for the overwhelming majority of economists. We believe some passage of Besley and Hennessy (2009) is emblematic in this regard. The letter addressed to the Queen of England resumes the results of the forum held by the British Academy to answer to the famous question raised by the Queen herself 'Why didn't anybody notice?'.

Everyone seemed to be doing their own job properly on its own

merit.[...] The failure was to see how collectively this added up to a series of interconnected imbalances [...] Individual risks may rightly have been viewed as small, but the risk to the system as a whole was vast. So in summary [...] the failure to foresee the timing, extent and severity of the crisis [...] was principally a failure of the collective imagination of many bright people, [...] to understand the risks to the system as a whole (Besley and Hennessy, 2009, p.3).

Organizing informations at macro level, as suggested by Godley, might have helped to *'stimulate the imagination'* over the possible impacts of observed phenomena on the economic system as a whole.

Our opinion is that it is impossible to cope with the complexity of the economic system, relying on a unique point of view, as bright one can be, and as lively his imagination. Hence by no means we are dismissing the importance of microeconomics or agent based macroeconomics. What we are advocating here is the necessity to rely on multiple perspectives, to understand at best, a multidimensional subject as economics. Our model is developed along one of these perspectives: macro and with stock flow consistency as foundation.

4.2   The model

The aim of the model is to represent the aforementioned theoretical analysis, in order to obtain a neat understanding of the the causal links involved, rather than to reproduce a specific economic event in details. Therefore we tried to eliminate all the elements not directly taking part into the dynamics depicted in section 2.2.2. The major simplifying assumptions refer to the sectors and to the assets. First, we model a closed economy with no government sector nor central banks. Second, we assume a pure credit economy, where deposits is the most liquid assets.

Exposing the model, we follow the functional ordering of its components. First, we introduce the three matrices, representing the accounting framework of the economy. This, besides providing for a rapid but clear overview of our hypothetical economy, allows to show the main hypothesis over its structural composition. Second, we present the behavioral equations, which reproduce the main theoretical assumptions of the model.

Each of the two component contains one aspect of novelty, which we believe represents an evolution (perhaps a small one), for this class of models. First, the matrices include a intra-sectoral dynamic in the firms sector. This is due to the assumption that firms as an aggregated sector purchase part of the equity they issue. Second, the Tobinesque portfolio approach, usually applied exclusively to the households sector (or sectors, if households are divided for example between workers and rentiers) is enlarged to the firms. This - as it will be shown more

in detail in presenting the equations - led to the development of an original approach to investment decision of firms, which we believe being in line with the broad literature over financialization and in particular with the analysis of Toporowski (as well as with an interpretation of Minsky, centered around Chapter 17 of the General Theory).

4.2.1 The matrices

As shown by table 1 - *aggregate balance sheet* (table 1) - households can hold their wealth either in deposits, houses or equities, while their liabilities are the loans granted by banks. The firms sector includes one of the main aspects of novelty of our model, as it reproduces an intra-sector dynamic. This is represented in the equities row, which shows that the amount of equity - representing a liability of firms - is diminished by the value of the equities held within the sector $(p_e E_f)$. Loans to banks are the other liability of the sector, while deposits and real capital, together with equities, are the assets. Clearly the deposits and the loans of the two first sectors are, respectively, bank's liabilities and assets.

From table 2 we can see the *current transactions* of the economy. Households'

Table1 Aggregate Balance Sheet				
	Households	Firms	Banks	Tot
Deposits	$+D_h$	$+D_f$	$-D$	0
Loans	$-L_h$	$-L_f$	$+L$	0
Capital		$+K$		$+K$
Houses	$+p_h \cdot H$			$+p_h \cdot H$
Equities	$+p_e \cdot E_h$	$-p_e \cdot E + (p_e \cdot E_f)$		0
Net worth	Vh	Vf	Vb	V
(+) sign before a variable denotes an asset, (-) sign denotes a liability.				

Table 1: Aggregate Balance Sheet

income is made out of wages on the one hand, and of dividends and interests on the other hand. The difference between these sources of income and the consumption decision, gives the savings of the sector (Sh). Firms produce consumption and investment goods, respectively sold to households and firms. Next to this entrepreneurial income, they receive interests on deposits and pay an interests for loans. A fraction of profits (Fu) is retained, while the rest is distributed either to households or within the firm sector. The result of this latter internal dynamic is more easily understandable considering the capital column of the sector. The outflow of money represented by firms dividends $(-Fd)$ is partially kept within the sector (Fd_f) according to the proportion of equities

held by firms. The latter together with retained earnings (Fu) will represent the internal source of finance used for the portfolio choices, shown in table 3 . Finally banks distribute all their profits (Fb) to households. A further assumption emerges from this table, since the capital account is increased exclusively by the real investment $(p \cdot \Delta K)$. The stock of houses is given, since the analysis of the real estate sector market is beyond[45] the scope of this paper.

With respect to 3 it is important to notice that no flow of funds is determined

Table 2 Current Transactions					
	Households	Firms		Banks	Tot
		Current	Capital		0
Consumption	$-C$	$+C$			0
Investment		$+I$	$-I$		0
Wages	$+W$	$-W$			0
Int. on Deposits	$+id \cdot D_{h,-1}$	$+id \cdot D_{f,-1}$		$-id \cdot D_{-1}$	0
Int. on Loans	$-il \cdot L_{h,-1}$	$-il \cdot L_{f,-1}$		$+il \cdot L_{-1}$	0
Div. firms	$+Fd_h$	$-Fd$	$+Fd_f$		0
Div. banks	$+Fb$			$-Fb$	0
Ret. earnings		$-Fu$	$+Fu$		0
Totals	Sh	0	$-I + Fu + Fd_f$	0	0

(+) sign denotes receipt, (-) sign denotes a payment.

Table 2: Current Transactions

by the house market. We assumed the stock of houses held by households does not change, when demand for houses varies, only the house price changes, clearing the market. The effect on wealth due to a capital gain or loss, is accounted for in the 'net worth' line, which is made explicit in the behavioral equation, we present later on. The inflow of money that households receive as loans from the banks can therefore be used, together with savings, to purchase new equities, increase deposits, or for consumption in case savings are negative. The flows of the firm sector are once again characterized by the internal dynamics since part of the newly issued equities are bought by firms (ΔE_f). Firms can use the money, deriving from retained earnings, loans and newly issued equities, either for financial (deposits and equities) or real investment. The banks' flows of funds is straightforwards: the increase in loans is balanced by the increase in deposits.

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[45]See Zezza (2008) for a SFC model, including a more sophisticated analysis of the real estate market.

Table 3 Aggregate Balance Sheets: Flow of Funds

	Households	Firms	Banks	Tot
Current Saving	Sh	$Fu + Fd_f$	0	$+SAV$
Δ Deposits	$-\Delta D_h$	$-\Delta D_f$	$+\Delta D$	0
Δ Loans	$+\Delta L_h$	$+\Delta L_f$	$-\Delta L$	0
Δ Capital		$-I$		$-I$
Δ Houses				
Δ Equities	$-p_e \cdot \Delta E_h$	$+p_e \cdot (\Delta E - \Delta E_f)$		0
Total	0	0	0	0
Δ Net worth	Vh	Vf	Vb	0

(+) sign denotes sources of funds, (-) sign denotes uses of funds.

Table 3: Flow of Funds

4.2.2 The behavioral equations

As mentioned before, firms produce consumption and capital goods. We assume short-term expectations are always right, and firms produce the quantity demanded, so to simplify away inventories. Equations from 1 to 9 are rather standard. The total output (Y) is given by investment and consumption. DK is the depreciation of capital. The profits that firms make out of their sales (F), are either retained (Fu), or distributed, according to the exogenous parameter mu. The dividends not distributed to households, remain within the sector (equation 7). Capital gains are computed on the basis equities held in previous period. Finally, u is a proxy for capital utilization, given by the output capital ratio, taken at its lagged value.

$$Y = C + I \tag{1}$$

$$DK = \delta \cdot K_{-1} \tag{2}$$

$$Fn = Y - wb \tag{3}$$

$$F = C + I - W - il \cdot L_{f,-1} + id \cdot D_{f,-1} \tag{4}$$

$$Fd = F \cdot \mu \tag{5}$$

$$Fu = F \cdot (1 - \mu) \tag{6}$$

$$Fd_f = Fd - Fd_h \tag{7}$$

$$CG_f = \Delta p_e \cdot E_{f,-1} \tag{8}$$

$$u = Y / K_{-1} \tag{9}$$

The main aspect of originality of our model relies on the way firms decide to increase their assets. This process consists of three steps. First, firms - according to the expected rate of return of total assets (r_a^e), both real and

financial - choose the amount (I_A) by which they want to increase the assets they hold (A_f). With (r_a) representing the planned rate of increase of wealth. Since, following Minsky, every investment decision implies a financing[46] decision - or as Minsky puts it 'A decision to invest [...] is always a decision about a liability structure' (Minsky, 1986, p.192) - the second step is represented by the individuation of the source of finance. The value of planned total investment not covered by internal finance (retained earnings and profits distributed within the sector), is covered in part by loans and in part by the emission of new equities (respectively L_f^d and E^s). The number of issued equities depends on the extent of needed external finance that firms want to cover this way. This is computed by firms referring to previous period equity price $(p_{e,-1})$. Loans are a residual, determined by the difference between the total increase in assets, the internal funds and the inflow of money deriving by new equities emission. This is computed at the actual equity price (p_e), which as we will see later, is market clearing. In this second step, represented by equations 17 and 18, we tried to reproduce a peculiarity of the CMI by Toporowski: the issue of equities increases with the capital gains of the previous period, as firms try to take advantage of the dynamics of increasing prices in the financial markets. A direct impact is the reduction in the level of debt of firms, described by the CMI, as on of the consequences of overcapitalization. The dependence of the number of equities issued on considerations over capital gains (and not only on financing needs, as customary) can lead to a situation in which the value of equities issued overcomes the value of real investment. This can be considered as a loyal reproduction of overcapitalization as shown by Michell and Toporowski (2012).

$$A_f = D_{f,-1} + K_{f,-1} + E_{f,-1} + IF + \Delta L_f + p_e \cdot \Delta E_s + CG_f - DK \quad (10)$$

$$IF = Fu + Fd_f \quad (11)$$

$$g_k = \gamma_0 + \gamma_1 \cdot r_a^e \quad (12)$$

$$r_a = (Fu + Fd_f + CG_f)/A_{f,-1} \quad (13)$$

$$r_a^e = (Fu^e + Fd_f^e + CG_f^e))/A_{f,-1} + \rho \cdot (r_{a,-1} - r_{a,-1}^e) \quad (14)$$

$$r_k = (Fu)/K_{-1} \quad (15)$$

$$I_A = A_{f,-1} \cdot (1 + g_k) \quad (16)$$

$$E^s = [\xi \cdot (I_A - IF) + \omega \cdot CGE_{-1}]/p_{e,-1} \quad (17)$$

$$L_f^d = (I_A - IF - p_e \cdot E^s) \quad (18)$$

The third step represents a further contribution of our model. Once a new level of desired financial wealth has been identified (A_f^*), firms use it - as shown in

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[46]This might appear obvious, however the identification and impact of the source of finance is usually overlooked by the models accepting the Modigliani-Miller Theorem.

equations 22, 23, 24 -, to make a Tobinesque portfolio choice[47] between real capital (K^d), equities (ne_f^d), and deposits, according to the rate[48] of returns of each asset. Deposits work as buffer stocks, so that any excess in wealth above the desired level takes the form of deposits (D_f). It is important to notice that the desired amount of each of two assets does not correspond to the demand (K and ne_f), since firms have to respect two constraints. On the one hand we assumed the level of real capital cannot diminish below its depreciation, hence the investment level will at least equal DK (*scenarios 1.1 and 1.2*). This assumption is motivated by the structure of the economy, since even assuming that a firm is willing to dismiss its capital assets, the latter will be bought by other firms; thus at the aggregated level there will be a zero-sum dynamics. On the other hand, firms face a budget constraint, which ensures that the sum of the assets demanded does not overcome its financial wealth (*scenarios 2.1 and*

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[47]See Brainard and Tobin (1968).

[48]The parameters $\gamma_{i,j}$ obey to required constraint: according to *Adding up constraint* $\gamma_{1,0} + \gamma_{2,0} = 0$, while following the *symmetry constraint*, $\gamma_{1,2} = \gamma_{2,1}$.

2.2).

$$A_f^* = A_{f,-1} + I_A \tag{19}$$

$$re_f^e = (CG_f^e + Fd_f^e)/ne_{f,-1} + \rho \cdot (re_{f,-1} - re_{f,-1}^e) \tag{20}$$

$$rk_f^e = Fu^e/K_{-1} + \rho \cdot (rk_{f,-1} - rk_{f,-1}^e) \tag{21}$$

$$K^d = (\gamma_{1,0} - \gamma_{1,1} \cdot id - \gamma_{1,2} \cdot re_f^e + \gamma_{1,3} rk^e) \cdot A_f^* \tag{22}$$

$$ne_f^d = (\gamma_{2,0} - \gamma_{2,1} \cdot id + \gamma_{2,2} \cdot re_f^e - \gamma_{2,3} rk^e) \cdot A_f^* \tag{23}$$

$$D^d = (\gamma_{3,0} + \gamma_{3,1} \cdot id - \gamma_{3,2} \cdot re_f^e - \gamma_{3,3} rk^e) \cdot A_f^* \tag{24}$$

$$D_f = A_f - K^d - ne_f^d \tag{25}$$

$$E_f^d = ne_f^d/pe \tag{26}$$

$$I = K - K_{-1} + DK \tag{27}$$

$$if \tag{scenario1.1}$$

$$K_f^d \geq K_{-1} \cdot (1 - \delta) \tag{28}$$

$$\Rightarrow K_f = K^d \tag{29}$$

$$if \tag{scenario1.2}$$

$$K_f^d < K_{-1} \cdot (1 - \delta) \tag{30}$$

$$\Rightarrow K_f = K_{-1} \cdot (1 - \delta) \tag{31}$$

$$if \tag{scenario2.1}$$

$$A_f^* - K_f^d > ne_f^d \tag{32}$$

$$\Rightarrow ne_f = ne_f^d \tag{33}$$

$$\Rightarrow D_f^d = A_f - K_f^d - ne_f^d \tag{34}$$

$$if \tag{scenario2.2}$$

$$A_f^* - K^d \leq ne_f^d \tag{35}$$

$$\Rightarrow ne_f = A_f - K_f^d \tag{36}$$

$$\Rightarrow D_f^d = 0 \tag{37}$$

We are aware that the application of the Tobinesque approach of portfolio choice to the investment decision of firms is unusual, and that several authors proposed valid investment functions to capture the spirit of the FIH (see among the others Dos Santos, 2005; Fazzari et al., 2001). However our choice is grounded on the conviction that this approach captures - at least partially[49] - the spirit of chapter 17 of *The General Theory*, in which Keynes presents his theory[50] of asset value and asset choice. As shown in the first part of this thesis, that chapter is central in Minsky's interpretation of the work of Keynes. Indeed, in

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[49]A significant lack of our model in this sense is represented by the absence of considerations about liquidity.

[50]See Macedo e Silva (2008-9), for a thorough analysis, of Keynes and finance.

the *financial Keynesianism* of Minsky, portfolio choices, have a direct effect on the determination of investment.

> 'The scale of investment will fluctuate for "reasons quite distinct" [which] revolve around portfolio preferences, financing conditions, and uncertainty' (Minsky, 1975, p.66, quotation marks present in the original version)

Moreover, this Tobinesque approach embodies a further element of Minsky's analysis linked to financing decision, which is usually overlooked by the Formal Minskyian Literature[51]: 'To finance investment in excess of I_I (internal funds) it is necessary either to run down holdings of financial assets that are superfluous to operations or to engage in external finance' (Minsky, 1986, p.213). This source of finance, which is at the core of the (Fisherian) capital assets deflation typical of a Minskyian crisis, is represented in our model by the possibility to allocate the (planned) financial wealth among assets, and to diminish the amount of a specific assets, held by firms (still respecting budget constraints).

This approach is particularly fit for our analysis since the application of portfolio choices to firms investment decisions, is also in line with the analysis of Toporowski, as shown by the author himself (see for example Toporowski, 2008), referring to Chapter 17 of Keynes' *General Theory*.

More generally, we believe that the broad literature on financialization showed how the distinction between financial and non financial firms is becoming increasingly ephemeral (at least for corporations). As shown by Orhangazi (2008) the percentage of financial assets over tangible assets in the balance sheets of the non-financial corporate sector, rose form around 30% in 1953 to 110% circa in 2003. It seems therefore natural to apply the portfolio approach to the decision process of firms.

Households

The wages received by households are a given percentage of GDP. As stated above, they consume a share of their wage and financial income, the latter made of dividends by banks (Fb_h) and firms (Fd_h) and by net interest rates flows ($id \cdot D_{h,-1} - il \cdot L_{h,-1}$). Furthermore, their consumption also depends positively on the capital gains and the net wealth of the previous period[52] (realized through loans). The dividends they receive from the firms are determined by the ratio of equities they hold over total equities.

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[51]Definition taken by Dos Santos (2005).

[52]We are aware, this depiction of consumption decision of households does not take into account important distributional aspects typical for example of the Kaleckian tradition. However the inclusion of distributional aspects would open the model to a large amount of both complications and needed theoretical considerations, and would therefore be worth a further paper.

The other equations are straightforward, with Shg representing 'gross savings': saving plus new inflow of loans. The peculiar assumptions regarding this sector are shown in equation 48. Households flow of loans is assumed to be determined by the supply decision of banks (equation 72). We are aware that this is a strong assumption. The idea we want to capture is that households' demand for loans is elastic, and its realization is at last determined by banks, which deciding their level of exposure determine the amount of credit they provide (as shown below) This is meant to capture the banking *endogenous destabilizing* behavior, analyzed in section 2.2.2.

$$W = (1 - \pi) \cdot Y \tag{38}$$

$$C = (1 - s) \cdot (W^e + Y_r^e) + \alpha_1 \cdot Vh_{-1} + \alpha_2 \cdot CG_{h,-1} + \alpha_3 \Delta L_h \tag{39}$$

$$Yr = id \cdot D_{h,-1} + Fd_h + Fb - il \cdot L_{h,-1} \tag{40}$$

$$Fd_h = \eta_1 \cdot Fd \tag{41}$$

$$\eta_1 = E_{h,-1}/E_{-1} \tag{42}$$

$$CG_h = CGE_h + CGH_h \tag{43}$$

$$Sh = -C + W + id \cdot D_{h,-1} - il \cdot L_{h,-1} + Fd_h + Fb \tag{44}$$

$$Shg = -C + W + id \cdot D_{h,-1} - il \cdot L_{h,-1} + Fd_h + Fb + \Delta L_h \tag{45}$$

$$Vf_h = dh_{-1} + nhh_{-1} + nhe_{-1} + shg + cgh \tag{46}$$

$$V_h = Vf_h - L_h \tag{47}$$

$$\Delta L_h = L_h^d = L_h^s \tag{48}$$

As we already said, households are assumed to choose how to allocate their expected financial wealth (Vf_h^e) among houses, equities and deposits (which once more is also used as a buffer stock). The Tobinesque portfolio choice for the households, is specular to the one of firms, except for the assets. Hence, in this case the constraints over the depreciation of real capital are absent. The deposits as a buffer stock and the rules followed in the determination of the parameters are, on the contrary, still valid. The following equations are standard, representing the capital gains (CGi) and rate of returns (ri) on each assets ($i = d, e, h$).

$$Vf_h^e = Vf_{h,-1} + sh^e + \Delta L_h + CG^e \tag{49}$$

$$sh^e = ch - (Y_r^e - W^e) \tag{50}$$

$$re_h^e = (CGE^e + Fd_h^e)/E_h + \rho \cdot (re_{h,-1} - re_{h,-1}^e) \tag{51}$$

$$rh_h^e = CGH^e/H + \rho \cdot (rh_{-1} - rh_{-1}^e) \tag{52}$$

$$ne_h^d = (\lambda_{1,0} - \lambda_{1,1} \cdot id - \lambda_{1,2} \cdot rh^e + \lambda_{1,3} \cdot re_h^e) \cdot Vf_h^e \tag{53}$$

$$nh^d = (\lambda_{2,0} - \lambda_{2,1} \cdot id + \lambda_{2,2} \cdot rh^e - \lambda_{2,3} \cdot re_h^e) \cdot Vf_h^e \tag{54}$$

$$D^d = (\lambda_{3,0} + \lambda_{3,1} \cdot id - \lambda_{3,2} \cdot rh^e - \lambda_{3,3} \cdot re_h^e) \cdot Vf_h^e \tag{55}$$

$$D_h = Vf_h - ph \cdot H^d - pe \cdot E_h^d \tag{56}$$

$$E_h^d = ne^d/pe \tag{57}$$

$$H^d = nh^d/ph \tag{58}$$

$$rh = CGH_h/H \tag{59}$$

$$re = (CGE + Fd)/E \tag{60}$$

$$re_h = (CGE + Fd_h)/E_h \tag{61}$$

$$CGH_h = \Delta ph \cdot H \tag{62}$$

$$CGE_h = \Delta pe \cdot E_{h,-1} \tag{63}$$

$$CGE = \Delta pe \cdot E_{-1} \tag{64}$$

$$H^s = \bar{H} \tag{65}$$

$$\Delta D_h = D_h - D_{h,-1} \tag{66}$$

Banks

Interest rate on loans is determined as a mark up on the interest rate paid on deposits. Coherently with our theoretical analysis banks play an active role in their relation with households. While granting the required credit to firms(L_f^d), they determine the level of loans to households according to the inflow of profits they want to achieve. Ultimately banks profits (Fb)are determined by both the interest rate differential (assumed as exogenous) and their leverage (lev). Hence a target level of profit corresponds to a target leverage. The equation 72 tells us that banks expand their loans to households in order to reach their target leverage (lev^*), taking into account their expected total liabilities (D^e), the starting period stock of loans, and the flow of loans supplied to firms (ΔL_f). The higher the rate of growth of their profits, the more optimistic are banks, which are willing to expend their leverage, in the expectation of higher profits. This is a further element of the model, representing the destabilizing forces identified in the theoretical analysis of the paper. The capacity of banks to increase their leverage reflects the *'liability management'*, of the analysis of Minsky '[...] borrower's and lender's risk sets limits upon the rapidity with

which the opportunities for profits through liability management are exploited'
(Minsky, 1986, p.235)

$$D = D^d \tag{67}$$

$$D^d = D_h + D_f \tag{68}$$

$$Fb = il \cdot L_{-1} - id \cdot D_{-1} \tag{69}$$

$$il = id \cdot (1 + \sigma) \tag{70}$$

$$L^s = L_f^d + L_h^s \tag{71}$$

$$L_h^s = D^e \cdot lev^* - L_{-1} - \Delta L_f \tag{72}$$

$$lev^* = lev_{-1} + \zeta \cdot (fb - fb_{-1})/fb_{-1} \tag{73}$$

$$lev_t = L/D \tag{74}$$

Final equations are self-explanatory and show the way in which prices are determined (market clearing) and the way in which expectations are formulated for all the cases not made explicit before in this paper. We assumed that the units formulate their expectations as an average (based on the previous ten observations), plus a correction mechanism linked to the gap between the expected and realized values of the previous period.

Price determination

$$ph = \frac{nh^d}{H} \tag{75}$$

$$pe = \frac{ne_f^d + ne_h^d}{E^s} \tag{76}$$

$$E^s = \Delta E^s + E_{-1} \tag{77}$$

Expectations

$$X^e = \bar{X} + \upsilon \cdot (X_{-1}^e - X_{-1}) \tag{78}$$

4.3 Some analytical considerations

The aim of the model was to represent the theoretical analysis developed in the previous sections of the paper, in which the works of Hyman P. Minsky and Jan Toporowski were combined to account for a structural explanation of the crisis. Both these try to explain the instability of capitalism. Not surprisingly the results obtained with the model are highly unstable. However, it is possible to identify a steady state used as base ground for numerical simulation analysis, whose results will be presented in the following sections.

Three variables play a central role in the reproduction of financial crisis, either more in line with the FIH or with the CMI, and will be therefore the object of our simulation. The first variable is ω, which determines how the emission of stocks increases together with capital gains on equities. Hence ω, is the key variable to represent the over capitalization of firms, theorized by the CMI. The second variable is ζ, which indicates the increase in the target leverage of banks determined by the rate of growth of their profit. When ζ increases the indebtment level of households should rise. The last variable is ξ: the percentage of needed external finance, covered with equities. The lower is ξ, the higher the indebtment of firms will be and the model should produce a traditional (meant as an increase in the indebtment level of firms) Minsky crisis.

5   Simulations

The methodology we follow is in line with the branch of the SFC literature (see Caverzasi and Godin (2012) for a detailed analysis of the use of this class of model) based on simulations: first, a steady state is identified, then the system is "shocked", with a parametrical change to assess how the economy reacts. In the steady state all the variables linked to our key parameters are zero. Indeed in the steady state, all the variables have the same value they had in the previous period, hence capital gains and rate of growth are equal to zero, ω and ζ are therefore deactivated. Furthermore the value of investment, which is at its minimum level (equal to capital depreciation) matches internal funds and no external finance is therefore needed, hence the effect of ξ is null.

As a consequence we had to run a prior simulation to move the economy from the steady state and to "activate" the key variables. This is our *baseline* simulation.

5.1   Baseline

The baseline scenario consists in an increase in the consumption of households with respect to the previous period wealth ($\alpha 1$). This - activating the dynamics of the model - allows to identify the main features of our simulated economy. The increase in consumption raises GDP in all its components. Higher consumption determines higher profits and makes real investment more attractive for firms. Furthermore, since profits increase the inflow from firms' assets overcomes the outflows. Firms decrease their loans and thus their leverage decreases. This has its counterpart in an increase in the loans of households, whose leverage augments. It is important to notice that the graphic "Leverage" (computed here as loans over assets) in figure 3 shows changes in the leverage level (liabilities over assets) of both sectors with respect to its steady state level. The starting
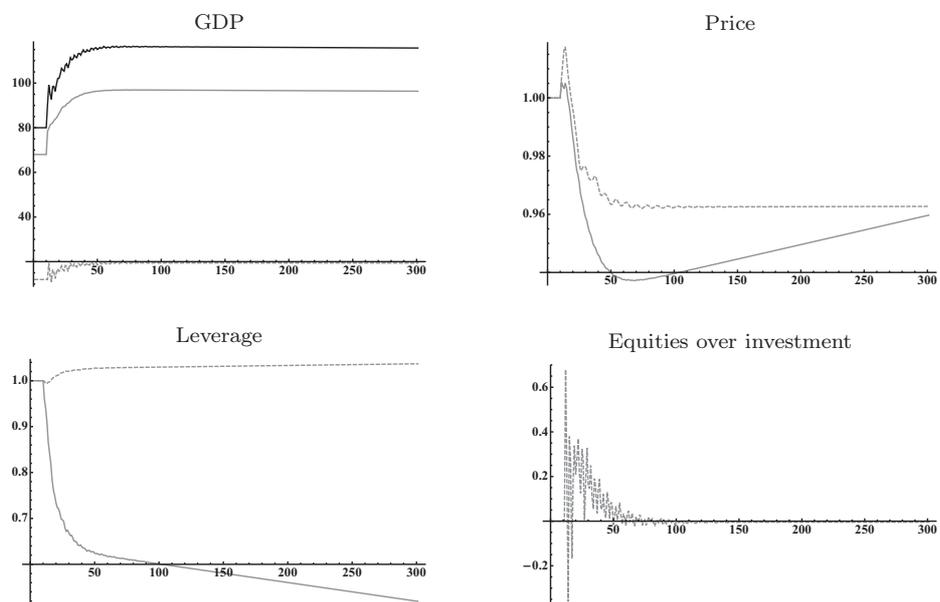
Figure 3: *Simulations.* Baseline Scenario: GDP (black = total, continuous = consumption, dotted = investment), change in the level of prices (continuous = equities, dotted = house), leverage (loans over assets; continuous = firms, dotted = households), equities over investment.

levels differ, so the nominal changes are equivalent in magnitude, albeit this is not evident from the graph. This dynamic reproduces the 'enforced indebtment' of households from the theoretical part of this paper. Consumption after fifty periods circa stabilizes at a higher level. Hence, the increase in households loans is used to purchase further assets. This is why both the leverage and the assets over liabilities of households, tend to become flatter. Prices rise with the shock following the higher income linked with increased consumption. They subsequently fall, since households save less, and their wealth diminishes. Then the price of equities grows after the fiftieth period, because firms - experiencing higher profits - issue less equities to cover their increased investment decisions which stabilized. Indeed, the last graph of figure 3 shows that equities over investment becomes negative, even though for a very little amount. To sum up, the main result of our model is the enforced indebtedness of households, resulting from an increased level of firms profits. It is important to pay attention that the key variables of our model are not yet activated, so that it should not surprise, that in this first simulation we obtain results opposite to part of our theoretical analysis (i.e. overcapitalization).

5.2 Simulation 1

In this first simulation, starting from the baseline (hence from an increase in consumption) we activate ω from equation 17, which represents the tendency of firms to increase the issue of equities, when capital gain rises (as theorized in the CMI). The results are very unstable and the model "explodes" before reaching three hundreds periods.

The GDP follows the same path as in the baseline, until the wealth effect from capital gains become predominant. Prices decrease, once again due to the lower savings of households. Although price of equities are highly volatile, since the emission of stock depends on the capital gains from the previous period. The dynamic is one the following. If in the previous period capital gains were high firms tend to issue more equities, this causes the price of equities to decrease, capital gains consequently fall dramatically and firms issue only the amount of equities needed for investment. The low level of equities issued determines an increase in their price and consequent capital gains. This speculative dynamics is highly destabilizing and - through income effects - also affects the real economy. Firms' leverage initially decreases as in the baseline scenario. It then increases along with the augmented investment decision of firms. Then for one hundred periods circa (50 to 150) presents a decreasing trend, in line with the CMI. However from period 150 it explodes. This steep increase is due to the fact that when capital gains happen to be significantly negative, the amount of external finance covered with equities decreases and firms get indebted. The dynamics is clearly unstable and the model soon "explodes". Our model therefore seems
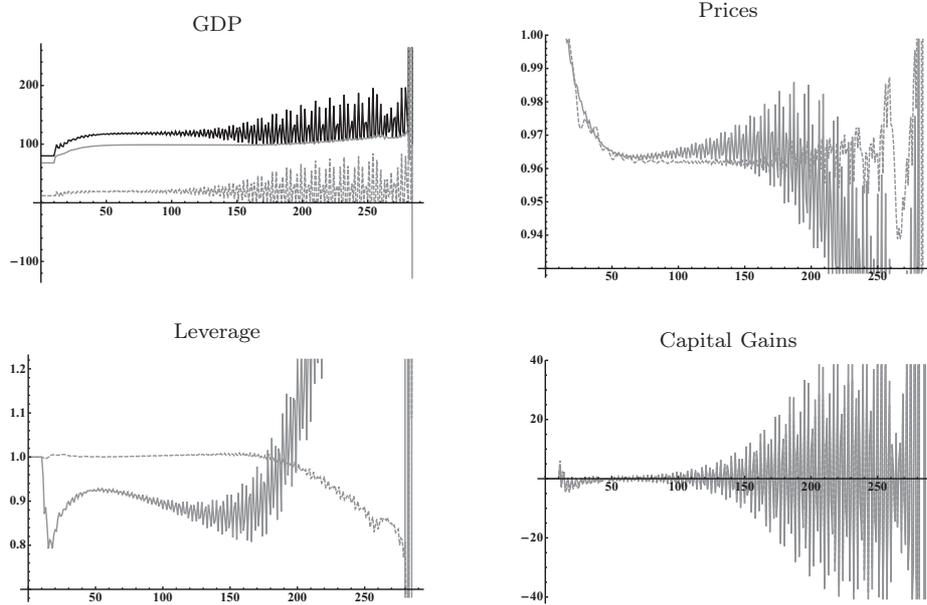
Figure 4: *Simulations.* Scenario 1: GDP, price (continuous = equities, dotted = house), leverage (continuous = firms, dotted = households), capital gains (continuous = equities, dotted = house).

to have reproduced the dynamics described from the CMI only for a limited period. This runs from the stabilization of the economy (more less period 50) to the speculative explosion (around period 150). To be fair with the analysis of Toporowski, it must be underlined how in the CMI, capital gains affect the decision to issue new equities, only when positive. Over capitalization is indeed the result of an attempt to take advantage of booming financial markets. In our case, the issue of equities is affected by capital gains also when they are negative. This determines a speculative dynamics, which negatively affects firms' financial position.

5.3   Simulation 2

In this second scenario, we activated ζ, the variable linking the loans that the banks sector grants to households, to the rate of growth of banks' profits. In order to do so, we imposed a 10% initial shock to lev^* (the leverage that banks choose in order to obtain the desired level of profits). There was no need for the consumption shock, which was therefore eliminated. An increase in the desired level of profits by banks, pushes them to expand their business increasing credit. Since firms decide autonomously their flow of debt, banks - as described in the the CMI and in our analysis - revert to the other customer, namely
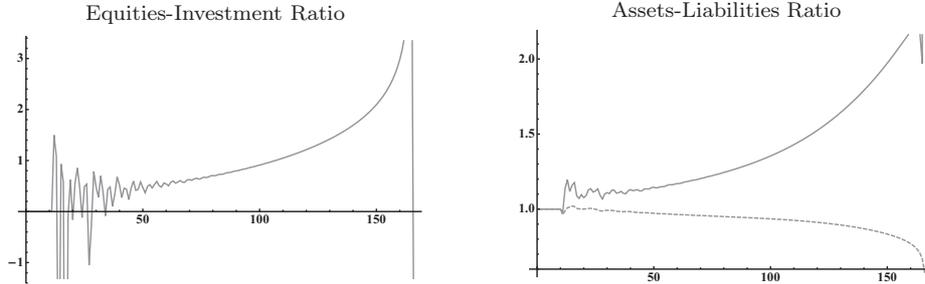
Figure 5: *Simulations.* Scenario 2: equities over investment ratio, assets over liabilities ratio (continuous firms, dotted households).

households. This determines an increase in the credit granted to households, these loans are used to purchase assets, whose price therefore increases. The result is an asset inflation, which in turn affects the real side of the economy through wealth effects and therefore consumption rises. Firms, on the contrary, witness an improvement of their financial position. As we said, the price of equities increases, and since firms issue equities looking at previous period price, they issue stocks in excess of their financial needs. This causes a dynamic of overcapitalization, as shown by the first graph in figure 5. It is interesting to notice how, albeit the dynamic of overcapitalization, the assets over liability ratio of firms tends to increase. The reason relies on the fact that the increase in liabilities due to an higher equity emission is more then compensated by the combination of lower indebtment together with the capital gains on the stock of equities retained as assets on the other hand. Nothing in the economy counters the dynamics depicted in this scenario, which therefore presents an explosive behavior caused by a threshold effect on the value of assets. The dynamics depicted in this scenario presents interesting results in the representation of the consequences of banks' behavior as described in our theoretical analysis. Banks shift their business toward households, whose increased indebtment is used to purchase assets, creating debt financed bubbles. These results are coherent with the economic events leading to the sub-prime crisis, and with the representation of banks in the CMI. Furthermore, as stated above, active banks are - in our opinion - coherent with the analysis of Minsky.

5.4   Simulation 3

The third simulation combines the previous two, therefore is probably the most loyal to our theoretical analysis. As in simulation 2 the dynamic starts with a 10% shock in lev^*, which activates ζ. A further shock (equivalent to the one in simulation 1) is imposed on ω. Therefore, on the one hand firms tend to issue more equities when they witness capital gains in the previous period,

and on the other hand, banks expand their loans to households according to the rate of growth of the profit of their own sector. The dynamics in this
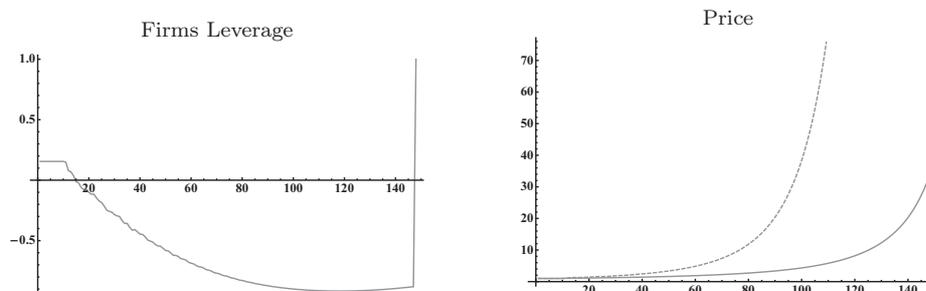

Figure 6: *Simulations.* Scenario 3: firms' Leverage, price (continuous = equities, dotted = house).

simulation presents numerous similarities with the analysis of section 2.2.2, and gives support to our theoretical analysis. The two shocks combined have a positive effect on the financial position of firms. Indeed firms finance their investment decisions with an increasing issue of equities. However, contrarily to simulation 1, the increment in the equities issued, does not lead to a fall in their price, because - as in simulation 2 - households use the inflow of money received as loans, to purchase assets. This makes the volatility of simulation 1 disappear. Due to their lower dependence on loans as a source of external finance, firms see their leverage diminish, as theorized by the CMI. Banks, in order to maintain their desired level of profits, expand the credit granted to households. As a consequence the households sector gets increasingly indebted, as in the "enforced indebtedness" we described above. Furthermore the asset inflation determined by the augmented loans to households, has a deeper effect on the house price compared to equities, since the latter - opposite to houses - constantly increase in number. So what the simulation[53] appears to suggest is that the crisis unburdened in the house sector for specific reasons. On the one hand, as we already mentioned because banks shifted their core customer from firms to households. On the other hand, because of the peculiarity of the assets among which households could allocate the inflow of money deriving from the increased indebtment. Once houses become an asset, referring to a portfolio-choice approach as we did, it appears highly likely that the assets inflation, described by the CMI, has a greater impact on the price of houses than on that of equities, since the supply of the latter can increase more easily with demand.

[53]We are aware that this is linked to the unrealistic assumption of a fixed number of houses. However, we believe this is not completely incoherent with reality, if one compares the characteristics of houses and equities as assets. Houses are indeed much less liquid and their supply presents much more stringent constraints. Therefore a fixed number of houses appears as reasonable simplification when they are compared to equities.

In this simulation indeed the described dynamics determines a bubble into the house sector coherent with what observed during the sub-prime crisis (see graph "Price" in figure 6) and which causes the 'explosion' of our model.

5.5 Simulation 4

The last simulation aims to reproduce a "traditional Minskyan crisis" (linked to the debt financing of investment by firms). Once again it was necessary to move the economy from the steady state, imposing the same consumption shock, as in the baseline and in scenario 1. Then the value of ξ, from equation 17, was decreased from 0.75 to 0.075. This allowed to make the role of newly issued equities marginal, as a result loans cover almost entirely (92.5%) the need for external finance.
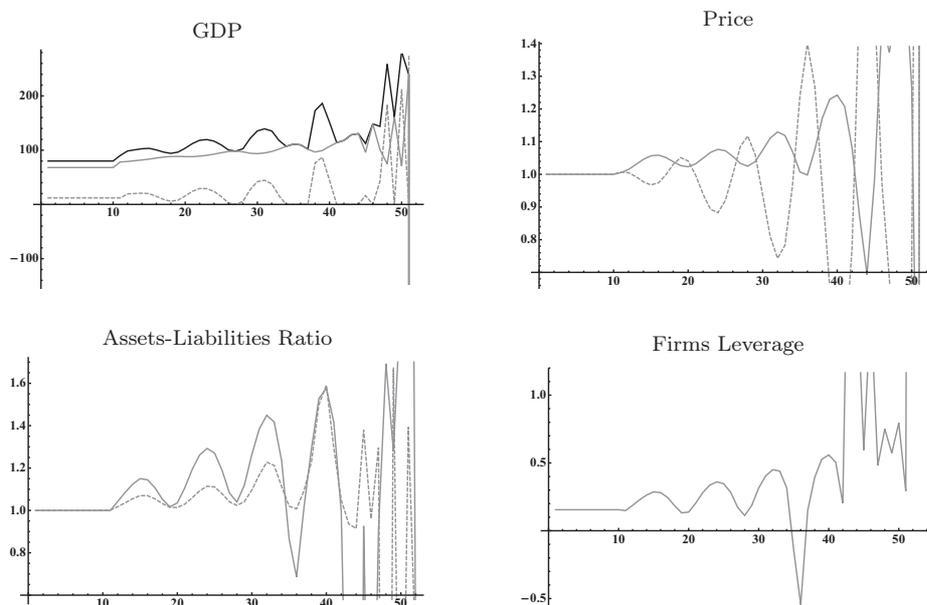

Figure 7: *Simulations*. Scenario 4: GDP (black = total, gray = consumption, dotted = investment), price (continuous = equities, dotted = house), leverage (continuous = firms, dotted = households), firms leverage (continuous = equities, dotted = house).

As shown by the last graph of figure 7 (Firms Leverage), it is possible to identify an increasing trend in the leverage of firms. However this dynamics is secondary in the simulation, and the model does not lead to a tradition Minsky crisis. The results of this simulation which appear to be of primary interest, lie outside of our theoretical analysis and depend on the application of the portfolio approach to two distinctive sectors, which compete on a portion of the assets composing their portfolio choice (equities). First of all, capital

gains alternate among the two assets (equities and houses). This clearly reflects mainly the portfolio decisions of households, which their preference shift from the two assets according to their rate of returns. Similarly, since real capital enters in the portfolio choice of firms, the investment decision follows a trend similar to the price of houses (anti cyclical with respect to equities). Real capital is alternative to equities in the portfolio choice of firms, as houses is in the portfolio choice of households. Second, the dynamics of capital gains determine the path of GDP. The changes in the total level of output (black line in the first graph of figure 7) are mainly determined by investment, which we just saw depending on portfolio choices. Furthermore changes in consumption level are specular, whereas smaller in magnitude, to those of investment: when investment increases, consumption diminishes. This shows a very interesting feature of this model: the presence of a transfer of wealth between the two sectors (firms and households). When consumption increases, profits rises, and so do dividends, hence equities become more attractive than houses. The price of equities grows while on the contrary the price of houses falls. This has a depressive effect on households' consumption, since their wealth diminishes with the price of houses. The capital gain dynamic is highly explosive, also because it is not mitigated by the significant increase in the issue of equities present in previous simulations.

6   Conclusion

The ultimate goal of the paper was to develop a structural explanation for the 2007 sub-prime mortgage crisis. In order to do so we developed a theoretical analysis based on the work of Hyman P. Minsky and Jan Toporowski. The paper enters the debate about the coherence between the analysis of Minsky and the recent crisis. Our idea is that the endogenous forces leading the economy from stability to instability - described by Minsky - can be identified also in the sub-prime crisis, if the attention is shifted from the role of firms to the one of banks, which we considered as "the endogenous destabilizer" of the FIH. This idea finds its roots in the analysis of Toporowski who underlines how the new peculiarities of the financial system led banks to shift their core business away from investment financing.

Our theoretical analysis was then reproduced through a Stock Flow Consistent model, which embodies important aspects of novelty. First, an intra-sectoral dynamic in the firms sector is made explicit. Firms are indeed at the same time the issuer and one of the purchaser of equities. Second, the Tobinesque portfolio choice approach, is applied also to the firms sector, allowing to capture important elements of our theoretical analysis, as well as of the broad financialization literature.

Finally five simulations were run to investigate the behavior of the model. The first four simulations represent different aspects of our analysis as well as peculiarities of the theories we referred to. Their outcomes are satisfactory and in line with the conclusions of the theoretical part of the paper. In particular the last simulation of this subgroup (simulation 3) gave interesting results on the combined roles of portfolio choices and assets' peculiarities, which enriched the findings of our investigations of the structural causes of the crisis. The fifth and last simulation failed to reproduce neatly a Minskyan crisis, however it embodies important outcomes under a modeling perspective, since it clearly shows the consequences of the choice of enlarging the portfolio approach to firms.

The most interesting characteristic of the model probably relies in its aspect of novelty which should be further investigated in future works, in particular with respect to assets deflation and to the distributional effects of the financial dynamics.

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