***Profits, Confidence and Public Deficits :***

***Modeling Minsky's Institutional Dynamics***

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***Introduction***

Starting in the middle of the fifties, and for the next forty years, Hyman P. Minsky developed an original business cycle theory based on an endogenous and financial conception of economic fluctuations, and more specifically, on the "financial instability hypothesis"[1]. This hypothesis relates to two types of phenomena characterizing the changes in "financially sophisticated economies". The first phenomenon refers to an endogenous process of transition toward greater financial fragilization of the economy. The second characterizes the transition from a financially fragile situation to a situation of recession and then of large amplitude economic crisis.

The complexity and the richness of Minsky's analysis, associated with an almost total lack of formalization of the financial instability hypothesis, have not facilitated the understanding of his approach, largely explaining the comparative disregard with which his theory of fluctuations has been considered until recently. As Tobin underlines, 'Minsky does not provide a rigorous formal model, and without one readers cannot judge whether an undamped endogenous cycle follows from the assumptions or not' (1989, p. 106). The emphasis placed on the institutional aspects of economic activity and the utilization of phrases such as 'financial fragility', which economists consider as vague or unclear, have raised the question as to whether Minsky's analytical construct is well founded and led to consider it as 'beyond the reach of mere algebra.' [2]

Admittedly the absence of modeling has sometimes made the consistency of Minsky's arguments seem difficult to check. Indeed the implications of the interaction that takes place between real and financial factors are closely dependent on the specification of the dynamic structure of Minsky's 'financially sophisticated economies', the shapes of the functions and the values of the parameters describing them, all aspects that appear difficult to take into account without the support of at least some sort of formalization. In the past ten years some scholars have sized up the

[1] See H.P. Minsky, 1982, 1986.

[2] Quoted from Taylor and O'Connel (1985 p. 871). See, for example, Friedman and Laibson (1989, p. 139) for whom 'Minsky's hypothesis is typically stated with less than explicit grounding in the theory of economic behavior.'.

problem and endeavored to propose formalized interpretations of the financial instability hypothesis.

With this aim in view, they have been using analytical methods derived from mathematical work on linear dynamical systems (Taylor et O'Connel, 1985, Lavoie, 1986), and, more recently on nonlinear and chaotic dynamical systems (e.g. Delli Gatti, Gallegati and Gardini 1993a, 1993b Delli Gatti and Gallegati 2000, Skott 1994, Franke and Semmler 1992, Keen 1995, Arena and Raybaut 2000). The main characteristic of these models is that they embed financial structure variables (such as indebtedness ratios) into standard Keynesian macroeconomic frameworks. Under certain circumstances, these models produce fluctuations analogous to those imagined but not modeled by Minsky. Financial factors are indeed capable, in systems that are otherwise stable, to be at the origin of unstable endogenous dynamics. Exclusively divergent in linear models, such dynamics can be more complex in non-linear models and lead to periodical or a-periodic trajectories (limit cycles or deterministic chaos).

However, a closer examination of Minsky's analysis leads to consider these nonlinear models with a critical eye or at least to suggest a substantial enrichment of their assumptions. Indeed, these models neglect another essential aspect of the financial instability hypothesis, an aspect we propose to call "institutional dynamics". The latter characterizes the influence of institutional mechanisms and of the interventions of public authorities on the dynamics of market economies.

For Minsky the various institutional mechanisms that are present in contemporary market economies play a central role in the unfolding of economic fluctuations. Their function is to slow down and adjust the dynamic process at the origin of the economy's endogenous and 'incoherent' behavior. Two types of institutional agents exert a crucial influence on the dynamics of market economies: financial institutions (especially commercial banks), on the one hand, and public authorities, on the other.

This paper is centered upon the role of public authorities[3]. In Minsky's approach, stabilizing economic activity is essentially the concern of the government, via its fiscal policy, and of the central bank, through its role as lender of last resort. Minsky indeed views budget deficits and interventions by the central bank as lender-of-last-

[3] For an analysis of the role of commercial banks in Minsky's theory of fluctuations, see for instance Nasica (1997) or Nasica (2000), chapter 7, p. 171-181.

resort as extremely effective instruments for stabilizing economic fluctuations. Even if full employment is not achieved, these instruments help limit the drop in income and in liquidity during economic recessions and during the onset of a financial crisis.

In this perspective, the aim of this paper is to present a model which extends and completes recent models of financial instability by explicitly examining the influence of the institutional dynamics on the relation between finance, investment and economic fluctuations. The paper is organized as follows. First, the Minskian foundations of the proposed analytical framework are highlighted (Section 1). Second, the dynamical properties of the model are studied, drawing the inferences of a stabilization policy (Section 2).

## 1. *Some Minskian foundations*

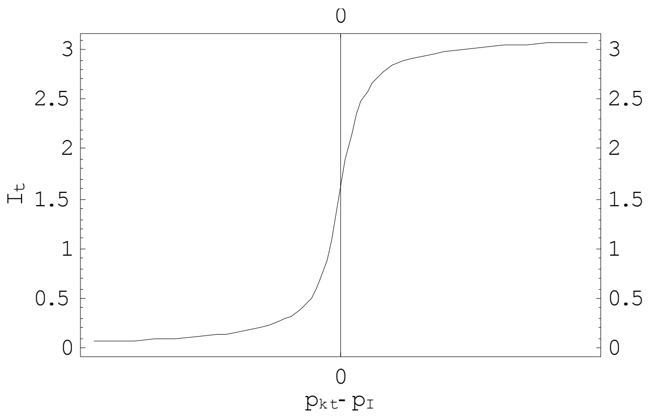
As is well known Minsky's theory of endogenous and financial instability is mainly based on his "financial theory of investment". The latter is founded on the 'two-price' approach :

> "There are really two systems of prices in a capitalist economy – one for current output and the other for capital assets. When the price level of capital assets is high relative to the price level of current output, conditions are favorable for investment; when the price level of capital assets is low relative to the price level of current output, then conditions are not favorable for investment, and a recession – or a depression – is indicated." (Minsky, 1986, p. 143).

Investment decisions are thus depicted by a Minskian investment function :

$$I_t = h\left(p_{k_t} - p_{I_t}\right) \qquad (0.1)$$

where $p_{kt}$ and $p_{It}$ stand respectively for the price of capital assets and of current production. Function $h(.)$ is increasing, continuous and positive in $y_t = p_{k_t} - p_{I_t}$, satisfying $\lim_{y\to-\infty} h(y) = 0^+$ and $\lim_{y\to+\infty} h'(y) = 0$. This investment function shapes as follows:




The first price system, that of current production (i.e. the supply price of investment output), is not directly related to money but is determined by the interactions between supply of and demand for output and labor in the context of particular institutional arrangements. In accordance with the post-Keynesian theory, the output price level is a mark-up on costs. In the aggregate, the main out-of-pocket costs that need to be recovered are wage costs. Thus, the price of current production will move as labor costs move and as the ability of the suppliers of investment outputs to maintain discipline in determining mark ups changes. We assume in this paper that labor costs and mark ups are constant so that the price of current output is; hence we write $p_{It} = \widehat{p}_I$ .

The second price system refers to the prices of capital assets and reflects the views of agents dealing in such assets with regard to the levels of gross profit flows. These prices thus reflect the expectations of market participants about the future of the economy, i.e. future achievements of its various actors and future performances of financial markets. For Minsky, such future conditions are uncertain and cannot be appraised in terms of probabilistic risk. As a result, current asset prices mirror both portfolio managers' views on the future evolution of aggregate profits and the margins of safety they require.

For simplicity reasons, the inter-temporal framework we retain is rather sketchy since we consider that present investment decisions in period $t$ relate only on discounted expected profits for the next period, $\Pi^e_{t+1}$.Therefore, we have

$$p_{k_t} = \frac{\Pi^e_{t+1}}{1 + i_t} \tag{0.2}$$

where $i_t$ is the discount rate that entrepreneurs apply to their expected profits.

Expectations dynamics is described by the following adaptive motion:

$$\Pi^e_{t+1} = \Pi^e_t + \alpha\left(\Pi_t - \Pi^e_t\right) \tag{0.3}$$

where $0 \leq \alpha \leq 1$.

The adaptive framework used here provides a rather simplified but relevant representation of Minsky's expectations analysis. It describes, as the author does, a sequential economy where, as agents make mistakes, they will be required to correct them over time, on the basis of what their actual observations are.

The discount rate used by business men is not constant, but endogenous and is given by:

$$i_t = i^* + ax_t + b\varphi_t \tag{0.4}$$

where, $i^*$ is the risk less interest rate determined by the central bank policy, $\varphi_t$ refers to the borrower's risk and $x_t$ is an indicator of the state of confidence; and where $a < 0$ and $b > 0$ are two parameters.

Central bank policy, borrower's risk and state of confidence play a central role in Minsky's theory of investment. The characteristics of each of these variables and the way they influence the discount rate (and thus the price of capital assets) may briefly be recalled.

Let us begin by the central bank. In Minsky's approach, one of the main purposes of this institution is to offset debt-deflation phenomena or the different forms of financial instability that market economies have been experiencing, especially since the middle of the 1980s. In the case of the United States, which Minsky gives precedence to, one obviously thinks of the financial market crash of October 1987, the Federal Savings and Loans Insurance Corporation (FSLIC) debacle and the collapse of the junk bond market. Through their sheer scale and the difficulties experienced in correcting them, these different examples indicate that the stability of the current financial system cannot be based exclusively on government fiscal policy.

According to Minsky, these phenomena also underline the need for an extended interpretation of the role of lender of last resort. This is why he distinguishes three aspects of this type of intervention (Minsky, 1986). First, when funds are lacking in the money market (a situation generally synonymous with substantial falls in the value of the claims agents exchange for liquidity), the central bank must intervene by increasing the amount of money in circulation. Second, during the financial restructuring period that follows a crisis, the central bank must take care to favor recourse to long-term rather than short-term borrowing by acting accordingly on interest rates. Finally, the central bank is responsible for guiding the development of the financial system, both through regulations and banking system surveillance, in order to restrain speculative banking (excessive reliance on liability management in particular).

There is no denying that, in the last twenty years, the endogenous aspect of central bank policy has been considerably reinforced, in accordance with the approach advocated by Minsky. Its function as lender-of-last-resort has extended constantly to new institutions and new instruments. At the end of the 1960s the Fed intervened to sustain the municipal bonds market. In 1970 it acted in order to avoid the collapse of the commercial paper market. In the 1980s it stepped in during the foreign debt crisis, the Continental Illinois bankruptcy crisis and the financial market crash. In the 1990s, it orchestrated the bailout of Long-Term Capital Management. In each of these events the Fed (believed, as it was, to be following a monetarist policy) provided liquidity and was compelled to validate to some extent many risky financial practices.

For simplicity reasons, in the model we focus only upon one type of lender of last resort intervention by the central bank: the stabilization of the price of capital assets (the value of the claims agents exchange for liquidity) by modifying the amount of money in circulation and thus the degree of liquidity of the economy. This role of the central bank is captured indirectly via the interest rate $i^*$ that is supposed to depend negatively of the amount of money in circulation.[4]

[4] This is a rather simplified view of Minsky's analysis. In the latter the way commercial banks react to profit opportunities and to the policy conducted by the central bank can prevent the latter from

The second term $b\varphi$ stands for the influence of the borrower's risk on the discount rate. The fact that the parameter b is positive means that the greater is the borrower's risk, the greater the discount rate (i) that the firms apply to their expected profits. This notion of borrower's risk needs being clarified. As noted by Minsky himself (1975, p. 106), it was introduced by Keynes (CW VII, 1973, p. 144). Yet, reference to the principle of increasing risk first brought to light by Kalecki (1937) is even more clear[5]. In Minsky's version of the investment function, the borrower's risk is related to the fact that beyond the amount that can be self-financed, investment implies financial costs that are inescapable, whereas the cash flows generated by production are unquestionably uncertain[6]. Therefore 'the borrower's risk will increase as the weight of external or liquidity diminishing financing increases' (1986, p. 191).

In other words, the greater is the $(I_t - \rho\Pi_t)$ gap (where $\rho$ is the rate of retention of profits), the greater the borrower's risk (the smaller the margin of safety for managers and equity owners). The dynamics of the borrower's risk is thus depicted by the following equation[7]:

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setting the interest rate at the level it deems desirable. Indeed the evolution of this rate depends strongly on the succession of phases of institutional stability and instability induced by the active behaviour of the commercial banks (For a more complete approach, see Nasica, 1997).

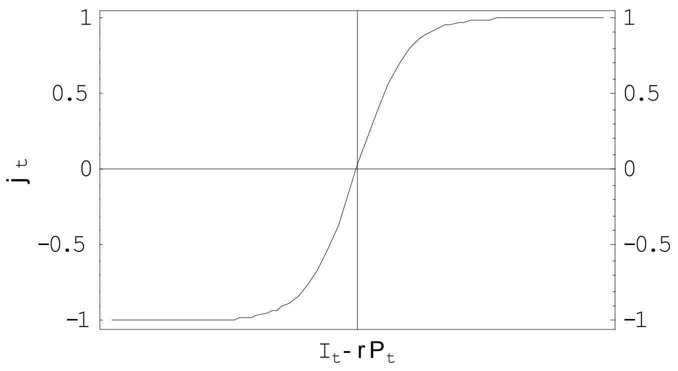
[5] According to this principle, the marginal risk of investing in fixed capital goods increases with the size of their acquisition. Kalecki gives two reasons for this increase. First, the more he invests, the greater the risk of failure to which the entrepreneur's wealth is exposed. The second reason relates to the illiquidity risk that arises when increasing quantities of capital are invested in industrial facilities that cannot be readily reconverted into liquidity without generating capital losses.

[6] To finance an amount of investment that is greater than his own resources, the borrower is confronted with the following options: to run down his holdings of financial assets or to engage in external finance. However, a reduction in financial asset holdings diminishes the margin of safety for managers and equity owners. If, instead, new issues of common shares are undertaken, the issue price will need to be attractive, which may mean that existing shareholders will feel their equity interest is being diluted. Finally, if the firm resorts to issuing debt – in the form of bonds, bank loans or short-term securities – the share of future cash flows devoted to reimbursements will increase.

1[7] It can be shown that the first derivative of retained profits with respect of investment is smaller than unity in a neighborhood of the stationary state of the model (See Annex 1). In this perspective, the financial gap $I_t - \rho\Pi_t$ is procyclical, and in accordance with Minsky's financial instability hypothesis, the borrower's risk will increase during an investment boom.

$$\varphi_t = \Phi\left(I_t - \rho\Pi_t\right) \qquad (0.5)$$

where function $\Phi$ shapes as follows:




The last variable, $x_t$, influencing the discount rate is an indicator of the state of the degree of optimism or pessimism of entrepreneurs, i.e. of the state of confidence. Since it is assumed in relation (0.4) that a < 0, the higher (smaller) is the confidence, the smaller (higher) the discount rate applied to expected returns.

This variable $x_t$ captures the role played by changes in long-term expectations in the emergence and recurrence of economic fluctuations. This role is of utmost importance according to many post Keynesian authors. Kregel, for instance, considers that the invariability of long-term expectations would be contrary to the very idea of dynamic analysis.[8].

However, far from being pure psychological and subjective phenomena, these expectations "are partly formed on the basis of the operation of the economy and partly on the imagination of agents, they are composed both of endogenous and exogenous elements" (Kregel 1995, p. 218). In the same perspective, Minsky conceives the modifications of the state of confidence as based both on 'objective' endogenous economic magnitudes and on aspects determined in a conventional or 'subjective' way.

[8] For Kregel (1976) considering long-period expectations as given is synonymous with reasoning in terms of a static and not a dynamic equilibrium.

This is the reason why the motion of $x_t$ can be modeled by the following relation :

$$x_{t+1} = \theta x_t + (1-\theta)(\Pi_t - \Pi_t^e) \tag{0.6}$$

with $0 < \theta < 1$.

The term $(1-\theta)(\Pi_t - \Pi_t^e)$ indicates the influence of objective factors, represented here by profit expectations errors. Such an influence is highlighted by Minsky (1986 p. 193-194). In his approach, when investment and past decisions to invest are on the whole validated (i.e. when, $\Pi_t \geq \Pi_t^e$), confidence of economic agents is reinforced. Indeed actual leverage of the aggregate balance sheet structure will be smaller than expected. Consequently investors will come upon sounder balance sheets than predicted, meaning that there will be an 'unused borrowing power', and subsequent financing conditions will become more favorable (1986, p. 194). In Minsky's model, this leads to an increase in the maximum level of indebtedness that agents deem prudent, to a rise of investment and to a boom.
Conversely, when actual profits are smaller than expected ones ($\Pi_t < \Pi_t^e$), confidence declines: indebtedness ratios formerly judged prudent are henceforth considered dangerous. Adoption by businesses and by financial institutions of various defensive measures then contributes to diminishing the level of investment, thereby causing a recession and, possibly, economic depression.

The term $\theta x_t$ refers to the role played by subjective elements in the formation of the state of confidence. It captures the idea that agents can, to some extent, modify their long term expectations independently of how their realized outcomes fit in with their expectations, i.e. independently of economic fundamentals[9]. According to Minsky, the longer the period during which no financial crisis occurs, the more economic agents are confident about the future and the more these agents will be likely to raise their estimates of the maximum level of indebtedness to which it is prudent to agree[10].

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9 For a close modelling of expectations dynamics see for instance Franke and Semmler (1992).

10 This approach is akin to that developed by Guttentag and Herring (1984). These authors term "disaster myopia" hypothesis the tendency for subjective probabilities of the recurrence of a disaster (such as a financial crisis) to fall below actual probabilities during periods in which no major shocks occur. In their model, as in Minsky's analysis of endogenous financial fragility, such a hypothesis explains why capital positions tend to decline and creditors become more vulnerable to shocks that

Let us finally suppose that total consumption is determined by $C_t = c[W + (1-\rho)\Pi_t]$, where $W$ refers to exogenous total wages, $c$ is the propensity to consume and $\rho$ is the rate of retained profits. Then, the macroeconomic linkage relation given by Kalecki's (1971) accounting identity writes:

$$\Pi_t = \frac{I_t + D_t - (1-c)W}{(1-c(1-\rho))} \quad \textbf{(0.7)}$$

where, $D_t = G_t - T_t$, stands for the public budget deficit.

Consequently, a deficit, by upholding aggregate demand when private investment flags, establishes a lower limit, a floor, for profits.

According to Minsky, such stabilization of actual and expected profits is crucial to ensuring the continuity of the economic system. It is utilized in particular to maintain the viability of debt structures and therefore the level of private investment. In fact 'once rational bankers and business men learn from experience that actual profits do not fall when private investment declines, they will modify their preferred portfolios to take advantage of the stability of profits' (Minsky, 1992, p. 12).

The importance of "Big Government" (that is a public sector that constitutes a significant share of aggregate demand) in economic dynamics is so fundamental for Minsky that he divides the performance of the US economy into two periods: a "small government" era from the end of the Civil War to the Depression and a "big government" era dating from World War II (Minsky 1986). He provides a detailed analysis of how the deficit of "Big Government" was crucial in maintaining profits during the 1974-75 recession (1986, chapter 2). He points that the annualized rate of contraction of the economy during the first two quarters of 1975 rivaled that of the worst rate of decline during the Great Depression. But big government's deficits prevented profits from declining and set the stage for recovery in the second part of the year[11].

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imperil their solvency.

[11] For a more detailed analysis of Minsky's view about stabilization policies see Dymski and Pollin (1993).

For Minsky, the government reacts in an endogenous fashion to the behavior of private agents. This implies that the budget policy is very sensitive to variations in investment:

> 'policy will be stabilizing if a shortfall of private investment quickly leads to a government deficit, and a burst of investment quickly leads to a budget surplus' (Fazzari and Minsky, 1984, p. 107).

This negative relation between budget deficit and private investment is explicitly taken into account in our model. Accordingly, we assume

$$D_t = \gamma(I)(C_t + I_t) \tag{0.8}$$

where $\gamma$ is a continuous, decreasing function of $I_t$, satisfying $-\sigma \leq \gamma(I) \leq \sigma$, with $0 \leq \sigma < 1$. The budget deficit-merchant GDP ratio $\gamma$ is not exogenous but negatively related to investment. In this perspective, $\gamma'(I)$ can be seen as the degree of flexibility of the budget deficit constraint $\gamma(I)$. The rest of the paper is devoted to the analysis of the role played by $\gamma'$ on the dynamics of the economy.

## *2. Profits expectations, confidence and economic stabilization*

From the previous discussion we derive two first order differences equations in $\Pi_t^e$ and $x_t$ describing the dynamics of expected profits and of the state of confidence. Accordingly, combining relations (0.1), (0.2), (0.4) and (0.5) we obtain:

$$I_t - h\left(\frac{\Pi_{t+1}^e}{1 + ax_t + b\Phi(I_t - \rho\Pi_t)} - \hat{p}_I\right) = 0 \tag{0.9}$$

This expression determines implicitly the level of investment as a function of the level of expected profits $\Pi_{t+1}^e$ for $t+1$ and of the current state of confidence $x_t$. That is:

$$I_t = g\left(\Pi_{t+1}^e, x_t\right) \tag{0.10}$$

Substituting (0.10) into the definition of current profits given by Kalecki's relation, the adaptive dynamics of expectations writes as

$$\Pi^e_{t+1} - (1-\alpha)\Pi^e_t - \alpha\left\{\frac{g(\Pi^e_{t+1}, x_t) + W\left[c(1+\gamma\left(g(\Pi^e_{t+1}, x_t)\right) - 1\right]}{1 - c(1-\rho)\left[1+\gamma\left(g(\Pi^e_{t+1}, x_t)\right)\right]}\right\} = 0 \qquad (0.11)$$

This implicit first order difference equation in $\Pi^e_{t+1}$, $\Pi^e_t$, $x_t$ determines the dynamics of expected profits $\Pi^e_{t+1}$. Hence, we have [12]:

$$\Pi^e_{t+1} = f\left(\Pi^e_t, x_t\right) \qquad (0.12)$$

Similarly, substituting (0.7), (0.8), (0.10) and (0.12) into (0.6) we obtain a first order difference equation which gives the dynamics of the state of confidence $x_t$:

$$x_{t+1} = \theta x_t + (1-\theta)\left(\frac{\Psi(\Pi^e_t, x_t) + W\left[c(1+\gamma\left(\Psi(\Pi^e_t, x_t)\right) - 1\right]}{1 - c(1-\rho)\left[1+\gamma\left(\Psi(\Pi^e_t, x_t)\right)\right]} - \Pi^e_t\right) \qquad (0.13)$$

where $\Psi\left(\Pi^e_t, x_t\right) = g\left(f(\Pi^e_{t+1}, x_t), x_t\right)$.

It is therefore possible to characterize the stationary state $(\overline{\Pi}^e, \overline{x})$ of system (0.12)-(0.13). The following proposition obtains.

***Proposition 1***

Assume that parameters $\rho, i^*, \hat{p}_I$ satisfy $h(0) = \rho(1+i^*)\hat{p}_I$, then the dynamical system (0.12)-(0.13) admits one stationary state such as $\overline{p}_k = \hat{p}_I$ and $I_t = \overline{I}$.
This "Nirvana" stationary state, is also characterized by perfect foresights, $\overline{\Pi}^e = \overline{\Pi}$, and no risk, $\overline{\varphi} = 0$. Consequently, agents are neither optimistic nor pessimistic, that is to say $\overline{x} = 0$. Then, we have, $\overline{\Pi}^e = \overline{\Pi} = \hat{p}_I(1+i^*)$.

***(See proof in Annex 2)***

Let us now consider the dynamical properties of the model in a neighborhood of this stationary point. As will be shown, these dynamical properties are closely dependent

12 Assuming that the implicit function theorem applies.

on the values of $\gamma'(.)$ which captures the degree of flexibility of the counter-cyclical public deficits constraint; the following result obtains [13] :

***Proposition 2***

The stationary state is locally asymptotically stable if and only if the public deficits constraint is counter-cyclical enough. That is to say if:

$$\gamma_I'(.) < \Xi \qquad \textbf{(0.14)}$$

where $\gamma_I'(.) < 0$, and $\Xi = \dfrac{[1-c(1-\rho)]\left[(1-c(1-\rho))\tilde{\Gamma}-1\right]}{c\rho(W+(1-\rho)\overline{\Pi})}$.

***(See proof in Annex 3)***

Therefore, according to proposition 2, an efficient stabilization policy should be associated with a flexible counter cyclical deficit constraint. This result is along the same lines as Minsky's argument on the role played by institutional thwarting systems[14]. From this standpoint, this finding argues in favor of the implementation of an institutional design allowing large deficits in periods of economic slumps; leaving budget deficits cuts off and possible surpluses to periods of sustained expansion. A result that echoes recent debates and proposals on budget deficits rules in the EMU.

These analytical findings are finally illustrated with the following numerical example.

In this example, the investment function, the borrower's risk function and budget deficit constraint are specified by:

$$h\left(p_{k_t}-\widehat{p}_I\right) = Arc\tan\left[p_{k_t}-\widehat{p}_I\right]+\frac{\pi}{2}$$

$$\Phi\left(I_t-\rho\Pi_t\right) = Tanh\left[I_t-\rho\Pi_t\right]$$

$$\gamma(I_t) = -\sigma Tanh\left[I_t-\overline{I}\right]$$

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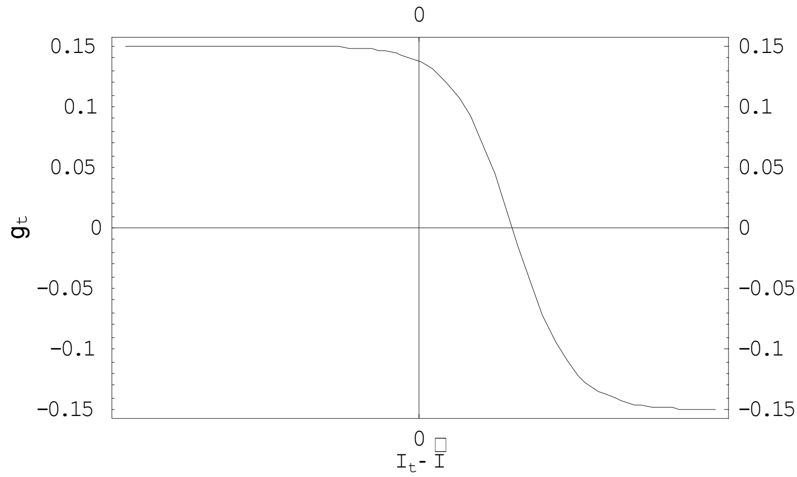
13 Notice that since $Det(J^*) > 0$, the model can admit two complex eigenvalues, which may generate, for the relevant set of parameters, endogenous cycles. This issue will not be dealt with in this paper.

14 See e.g. Ferri and Minsky (1992).

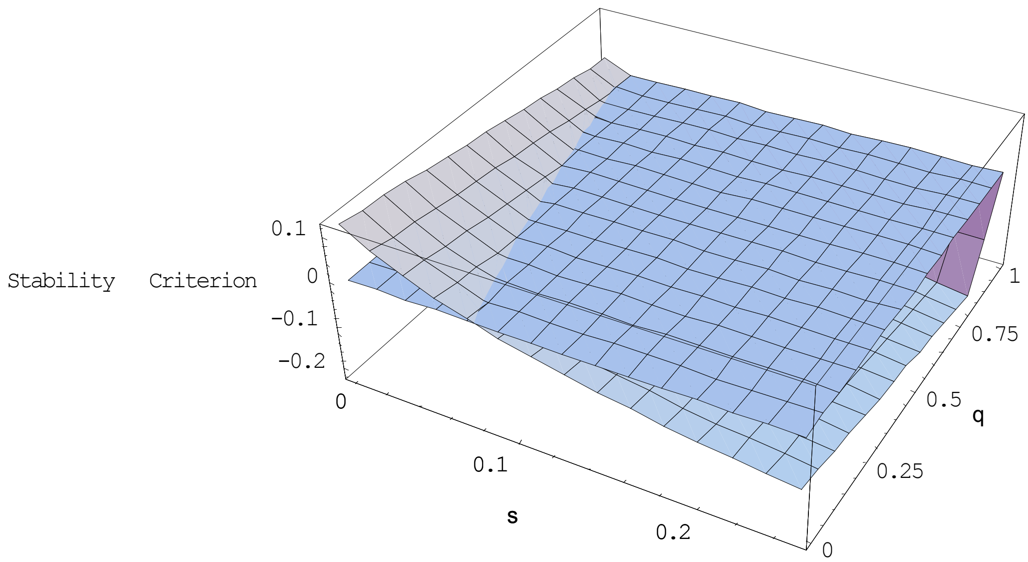
This latter function shapes as follows for $\sigma = .15$:




Wages are normalized to unity, $\hat{p}_I = \dfrac{h(0)}{\rho(1+i^*)}$, and the other values of parameters are:

$$\left\{a, b, \alpha, \rho, c, i^*\right\} = \{-.25, .75, .15, .8, .8, .05\}$$

Then, for $0 \leq \sigma \leq .25$ and $0 < \theta < 1$, the following graphics illustrating proposition 2 obtain:

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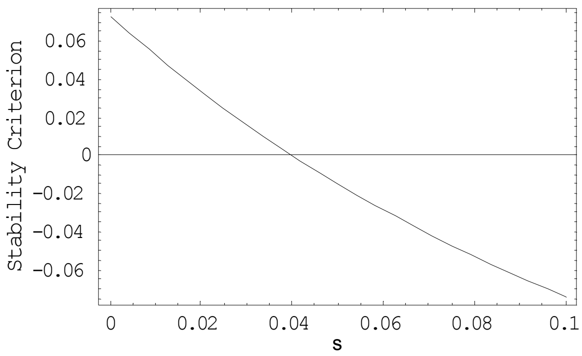
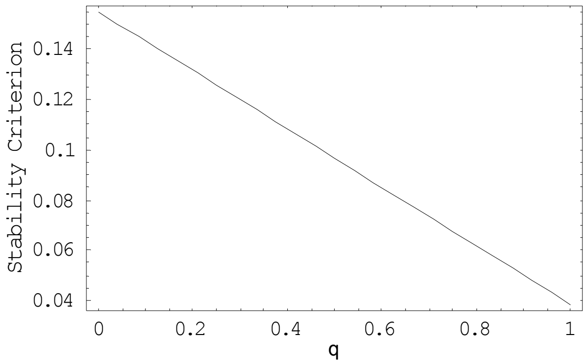



$\theta = .5$ **and** $\sigma$ **variable**




$\theta$ **variable and** $\sigma = 0$

As we may recall, the economy is locally stable (unstable), when the criterion is negative (positive).[15] Thus, it clearly appears that is exists a threshold value of $\sigma$ , $\tilde{\sigma}$ . When $\sigma < \tilde{\sigma}$ , the economy is unstable and stable otherwise.

### *Concluding remarks*

The aim of this paper was to propose a formalized version of Minsky's conception of institutional dynamics. The originality of our approach consisted in taking into account not only the financial aspects but also the institutional dimension of the financial instability hypothesis since this issue has received scant treatment in recent formalizations. With this aim in view, we considered the role of the government, via its budget policy, and of the central bank, through its role as lender of last resort. The analysis of the dynamical properties of the model shows that the economy is unstable when the budget policy is not very sensitive to variations in private investment. On the contrary, when, the counter cyclical deficit constraint is flexible enough, the economy is stabilized.

The model could obviously be extended to take into consideration other important aspects of Minsky's writings, such as the existence of endogenous financial cycles or the ambivalence of institutional thwarting systems.[16] However, our main result,

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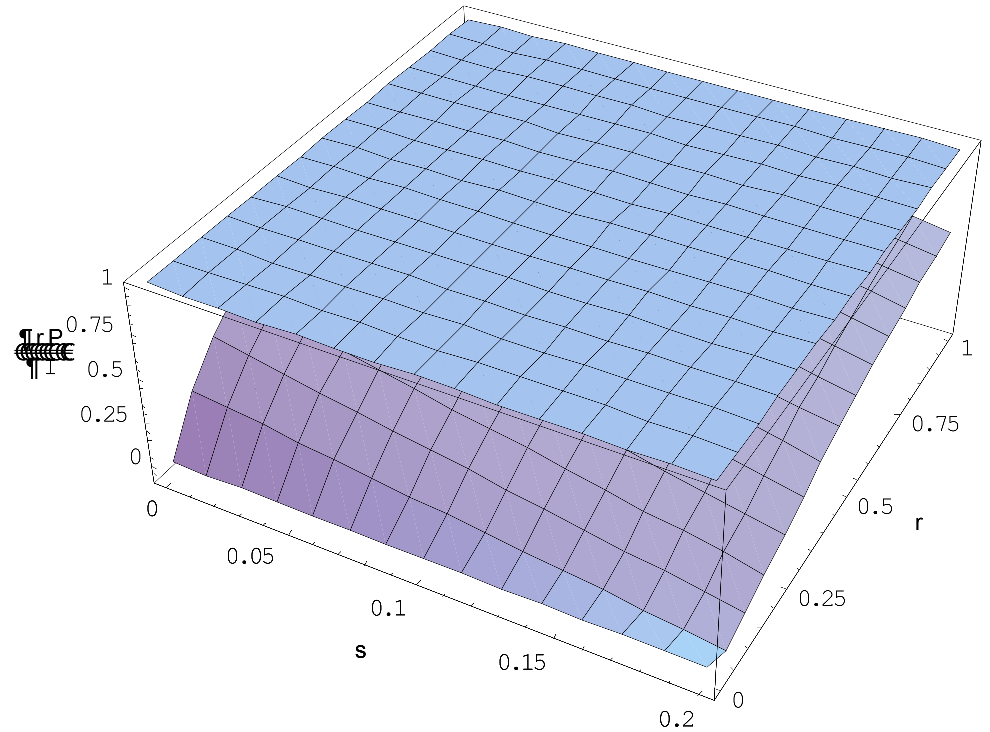
15 The criterion plotted here is $\left|Tr(J^*)\right| - 1 - Det(J^*) < 0$ . It can be shown in these examples that the first condition $\left|Det(J^*)\right| < 1$ is always satisfied for the retained set of parameters.

16 The impact of an institutional structure is not immutable: its capacity to stabilize the amplitude of economic fluctuations and to constrain market agents to undertake only moderately risky actions varies greatly over time. This means that some institutional interventions and mechanisms that were

initially stabilizing may turn into factors of instability and inefficiency. To be persuaded of this, one need only recall the Savings and Loans debacle and the powerlessness of the FSLIC when confronted with problems of financial instability in the 1980s. Looking back, this example shows that regulation and an initially effective intervention arrangement can begin to backfire if decision-makers at the policy and institutional level do not take adequate account of the behaviour of market participants in response to the institutional changes they are up against. About this point, see for instance Nasica (1999).

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It appears that in a neighbourhod of the stationary state, the first derivative of retained profits with respect of investment is smaller than unity. (See Annex) In this perspective, the financial gap (I-ρΠ) is procyclical, and in accordance with Minsky's financial instability hypothesis the borrower's risk will increase during an investment boom.

**r = 0.75**

0.75

**SSS2**

1.17187 0.8- 1.5708 s

**Plot SSS2, s, 0, 0.5 , AxesLabel ® , "¶rP/¶I"**

namely that an efficient stabilization policy requires the implementation of an institutional set-up allowing large deficits in periods of economic slumps; leaving budget deficits cuts off and surpluses to periods of sustained expansion, is fully consistent with the way Minsky considers that public authorities may "stabilize an unstable economy".

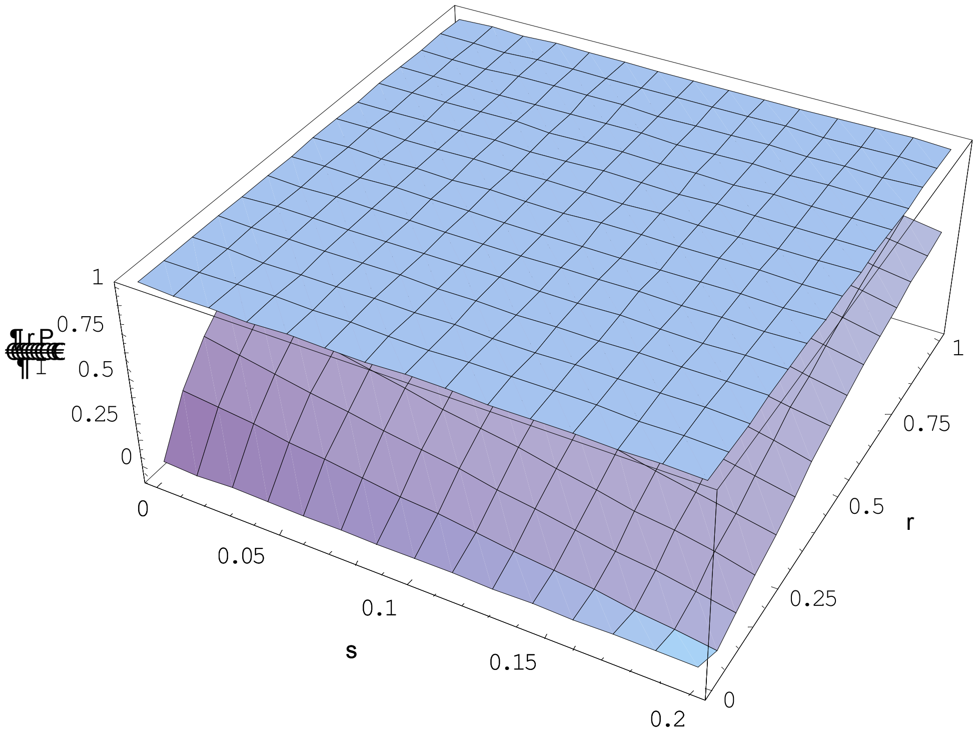
...Graphics ..

## *Annex 1 a complement on the borrower's risk*

The first derivative of retained profits with respect of investment is given by the following expression:

[illegible]

In the figure below, this derivative evaluated in a neighborhood of the stationary state is plotted for the different relevant values of the rate of retention of profits $\rho$ and of the degree of flexibility of the counter-cyclical public deficits constraint, $\sigma$. We get:




It clearly appears that in a neighborhood of the stationary state, the first derivative of retained profits with respect of investment is smaller than unity. (See Annex) In this perspective, the financial gap $I - \rho\Pi$ is pro-cyclical, and in accordance with Minsky's financial instability hypothesis the borrower's risk will increase during an investment boom.

### *Annex 2 proof of proposition 1*

-First, for $\overline{\Pi}^e \neq 0$ and $\overline{\Pi} \neq 0$, relation (0.11) evaluated at a stationary state directly implies:

$$\overline{\Pi}^e = \overline{\Pi}$$

Substituting this result into (0.13) evaluated at a stationary state, gives $\overline{x} = 0$.

-Second, using the fact that at the stationary state $\overline{\varphi} = 0$, we have $\overline{i} = i^*$. In addition, since $\overline{p}_k = \widehat{p}_I$ at a stationary state, we get:

$$\overline{\Pi} = (1 + i^*)\widehat{p}_I$$

-Finally, notice that $\overline{p}_k = \widehat{p}_I$ means that $\overline{I} = h(0)$, while $\overline{\varphi} = 0$ means that $\overline{I} = \rho\overline{\Pi}$. Thus, condition $h(0) = \rho(1 + i^*)\widehat{p}_I$ is required for consistency reasons

### *Annex 3 proof of proposition 2*

The modulus of the two eigenvalues of the $2 \times 2$ Jacobian matrix $J^*$ of the dynamical system, evaluated at the stationary state, lie inside the unit circle if and only :

$$\left| Det(J^*) \right| < 1 \tag{0.15}$$

$$\left| Tr(J^*) \right| - 1 - Det(J^*) < 0 \tag{0.16}$$

The elements of $J^*$ evaluated at the stationary state are the following:

$$J^*_{11} = \frac{1 - \alpha}{1 - \dfrac{\alpha(1 + i^*)h'(0)\Gamma}{(1 + i^*)^2 + b\overline{\Pi}(1 - \rho\Gamma)\Phi'(0)}}$$

$$J^*_{12} = \frac{-a\alpha\overline{\Pi}h'(0)\Gamma}{(1 + i^*)^2 - h'(0)\left(\alpha(1 + i^*)\Gamma + b(1 - \rho\Gamma)\Phi'(0)\right)}$$

$$J^*_{21} = (1 - \theta)\left(\Gamma I'_{\Pi^e_{t+1}} J^*_{11} - 1\right)$$

$$J^*_{22} = \theta + (1-\theta)\Gamma\left(I'_{\Pi^e_{t+1}} J^*_{12} + I'_{x_t}\right)$$

where,

$$I'_{\Pi^e_{t+1}} = \frac{h'(0)}{(1+i^*)\left(1 + \frac{b\overline{\Pi}h'(0)(1-\rho\Gamma\ )\Phi'(0)}{(1+i^*)^2}\right)}$$

$$I'_{x_t} = \frac{-\,a\overline{\Pi}h'(0)}{(1+i^*)\left(1 + \frac{b\overline{\Pi}h'(0)(1-\rho\Gamma)\Phi'(0)}{(1+i^*)^2}\right)}$$

and where

$$\Gamma = \Pi'_I = \frac{1 - c(1-\rho) + \gamma'_I(.)(Wc\rho + c(1-\rho)\rho\overline{\Pi})}{\left(1 - c(1-\rho)\right)^2}$$

Thus, we have :

$$Det(J^*) = J^*_{11}\left(\theta + (1-\theta)\Gamma I'_{x_t}\right) + (1-\theta)J^*_{12} \qquad (0.17)$$

$$Tr(J^*) = J^*_{11} + \theta + (1-\theta)\Gamma\left(I'_{\Pi^e_{t+1}} J^*_{12} + I'_{x_t}\right) \qquad (0.18)$$

Assuming that $\Gamma > 0$, necessitating that $\gamma'(.) > \frac{c(1-\rho)-1}{c\rho\left(W + (1-\rho)\overline{\Pi}\right)}$, with $a < 0,\ b > 0,\ \Phi'(0) > 0$, one can verify that[17]:

$$0 < \Gamma < Min\left\{\frac{1}{\rho}, \frac{1+i^*}{\alpha h'(0)}\right\} \Leftrightarrow \{\ I'_{\Pi^e_{t+1}} > 0,\ I'_{x_t} > 0,\ J^*_{11} > 0,\ J^*_{12} > 0\ \} \qquad (0.19)$$

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17 Condition $\gamma'(.) > \frac{c(1-\rho)-1}{c\rho\left(W + (1-\rho)\overline{\Pi}\right)}$ is not restrictive since it simply means that the percentage of deficit to GDP is bounded from above. In addition we have, $\frac{1}{\rho} > 1$. Indeed, specifying the investment function as in the numerical example below by: $h(p_k - p_I) = Arc\tan(p_k - p_I) + \frac{\pi}{2}$, we obtain, at the stationary state $h'(0) = 1$. Then with, $0 < \alpha < 1$, we have $\frac{1+i^*}{\alpha h'(0)} > 1$.

Consequently, it is obvious, since $0<\theta<1$ that condition (0.19) implies :

$$Det(J^*) > 0 \text{ and } Tra(J^*) > 0$$

Hence, the stability criterion writes:

$$Det(J^*) < 1 \tag{0.20}$$
$$Tr(J^*) - 1 - Det(J^*) < 0 \tag{0.21}$$

Substituting the values of $J^*_{11}$, $J^*_{12}$, $I'_{\Pi^e_{t+1}}$ and of $I'_{x_t}$ into (0.20) and (0.21), we obtain the respective values of the determinant and of the trace at the stationary state:

$$Det(J^*) = \frac{(1+i^*)^2(1-\alpha)\theta + \overline{\Pi}h'(0)\big(a(\theta-1)\Gamma + b(1-\alpha)\theta(1-\rho\Gamma)\Phi'(0)\big)}{(1+i^*)^2 - h'(0)\big(\alpha(1+i^*)\Gamma - b\overline{\Pi}(1-\rho\Gamma)\Phi'(0)\big)}$$
$$Tr(J^*) = \frac{(1+i^*)^2(\alpha-1-\theta) + h'(0)\big[\Gamma(\alpha\theta(1+i^*) + a(1-\theta)\overline{\Pi}) + b(\alpha-1-\theta)\overline{\Pi}(1-\rho\Gamma)\Phi'(0)\big]}{(1+i^*)^2 - h'(0)\big(\alpha(1+i^*)\Gamma - b\overline{\Pi}(1-\rho\Gamma)\Phi'(0)\big)}$$

and the two stability conditions become:

$$\frac{(1+i^*)^2(1-\alpha)\theta + \overline{\Pi}h'(0)\big(a(\theta-1)\Gamma + b(1-\alpha)\theta(1-\rho\Gamma)\Phi'(0)\big)}{(1+i^*)^2 - h'(0)\big(\alpha(1+i^*)\Gamma - b\overline{\Pi}(1-\rho\Gamma)\Phi'(0)\big)} < 1 \tag{0.22}$$
$$\frac{\alpha(\theta-1)\big[(1+i^*)^2 - h'(0)\big((1+i^*)\Gamma - b\overline{\Pi}(1-\rho\Gamma)\Phi'(0)\big)\big]}{(1+i^*)^2 - h'(0)\big(\alpha(1+i^*)\Gamma - b\overline{\Pi}(1-\rho\Gamma)\Phi'(0)\big)} < 0 \tag{0.23}$$

Recalling we have assumed above that $0<\Gamma<Min\left\{\frac{1}{\rho},\frac{1+i^*}{\alpha h'(0)}\right\}$, the denominator in the two conditions is positive. Thus, (0.22) and (0.23) are equivalent to:

$$(1+i^*)^2((1-\alpha)\theta-1) - h'(0)b\overline{\Pi}\Phi'(0) < -h'(0)\Big[\alpha(1+i^*) + a(\theta-1) + b\overline{\Pi}\rho\Phi'(0)(1-(1-\alpha)\theta)\Big]\Gamma$$

$$\alpha(\theta-1)\big[(1+i^*)^2 + h'(0)b\overline{\Pi}\Phi'(0) - h'(0)\big(1+i^* + b\overline{\Pi}\Phi'(0)\big)\Gamma\big] < 0$$

The first condition can be rewritten:

$$0 < \Gamma < \Gamma_1 \tag{0.24}$$

with $\Gamma_1 = -\dfrac{(1+i^*)^2((1-\alpha)\theta - 1) - h'(0)b\overline{\Pi}\Phi'(0)}{h'(0)\left[\alpha(1+i^*) + a(\theta-1) + b\overline{\Pi}\rho\Phi'(0)(1-(1-\alpha)\theta)\right]}$

The second condition can be rewritten

$$0 < \Gamma < \Gamma_2 \tag{0.25}$$

with $\Gamma_2 = \dfrac{(1+i^*)^2 + h'(0)b\overline{\Pi}\Phi'(0)}{h'(0)\left(1+i^* + b\overline{\Pi}\Phi'(0)\right)}$

Consequently $\Gamma$ meets conditions (0.24) and (0.25) if and only if

$$0 < \Gamma < Min\left\{\Gamma_1, \Gamma_2\right\} \tag{0.26}$$

Therefore, one can deduce that it exists a positive threshold value of $\Gamma$, $\tilde{\Gamma} = Min\left\{\dfrac{1}{\rho}, \dfrac{1+i^*}{\alpha h'(0)}, \Gamma_1, \Gamma_2\right\}$, such that $J^*$ has two stable roots, if and only if:

$$0 < \Gamma < \tilde{\Gamma} \tag{0.27}$$

Accordingly, recalling that $\Gamma = \dfrac{1 - c(1-\rho) + \gamma_I'(.)(Wc\rho + c(1-\rho)\rho\overline{\Pi})}{(1-c(1-\rho))^2}$, condition (0.27) finally becomes:

$$\gamma'(.) < \Xi \tag{0.28}$$

where $\Xi = \dfrac{[1-c(1-\rho)]\left[(1-c(1-\rho))\tilde{\Gamma} - 1\right]}{c\rho\left[W - (1-\rho)\overline{\Pi}\right]}$.

Which completes the proof of ***Proposition 2***

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