UNIVERSITÀ DEGLI STUDI DI TRENTO

DIPARTIMENTO DI ECONOMIA

The macroeconomics of imperfect capital markets. Whither saving-investment imbalances?

Roberto Tamborini

Discussion Paper No. 15, 2008

The Discussion Paper series provides a means for circulating preliminary research results by staff of or visitors to the Department. Its purpose is to stimulate discussion prior to the publication of papers.

Requests for copies of Discussion Papers and address changes should be sent to:

Dott. Luciano Andreozzi
E.mail luciano.andreozzi@economia.unitn.it
Dipartimento di Economia
Università degli Studi di Trento
Via Inama 5
38100 TRENTO ITALIA

The macroeconomics of imperfect capital markets. Whither saving-investment imbalances?*

Roberto Tamborini
University of Trento, Department of Economics,
Via Inama 5, 38100 Trento, Italy,
roberto.tamborini@economia.unitn.it

Background paper for lectures
IX Trento Summer School
Financial Instability and Crises
Trento, 30 June - 11 July 2008

Abstract

Starting with Wicksell and until the heyday of Keynesian economics, inflation, unemployment and business cycles were thought and taught mainly as problems originating from "saving-investment imbalances" due to some form of malfunctioning of the capital market. Whereas modern studies of imperfect capital markets have greatly improved our understanding of capital market failures, their impact on macroeconomics has remained surprisingly limited. The macroeconomic consequences of saving-investment imbalances are still undeveloped in this literature The most popular macroeconomic model to date – the so-called New Neoclassical Synthesis – dispenses with capital market imperfections altogether. The aim of this paper is fill this gap. Section 2 overviews the historical foundations and the current state of the macroeconomics of imperfect capital markets. Section 3 presents a competitive, flex-price model of saving-investment imbalances where deviations of the market interest rate from the Wicksellian natural rate generate (disequilibrium) business cycles. In section 4, the model is extended in order to make the market interest rate endogenous. This extension also allows preliminary considerations to be made about monetary policy and the control of the interest rate over the business cycle. Section 5 summarizes and concludes.

*The paper was also presented at the Conference, "The Economics of Imperfect Markets: Their Interaction and the Consequences for Economic Theory and Policy", University of Rome 'La Sapienza', May 16-17, 2008. I wish to thank Axel Leijonhufvud, Vela Velupillai, Edoardo Gaffeo, Andrea Fracasso, Ronny Mazzocchi and Hans Michael Trautwein for helpful discussions and comments. Financial support is acknowledged to the Italy-Germany Inter-Univeristy "Vigoni Programme", 2006-07.

THE MACROECONOMICS OF IMPERFECT CAPITAL MARKETS. WHITHER SAVING-INVESTMENT IMBALANCES?

1. Introduction

Starting with Wicksell [...] until Friedman revived the Quantity Theory, the saving-investment approaches dominated the field in this [Twentieth] century. All Keynesians, of whatever description, belong to this branch. The Stockholm School and the Austrians also descend from the Wicksell Connection. (Leijonhufvud (1981, p.132)).

Since the origins of macroeconomics and for a long time, inflation, unemployment and business cycles had been thought and taught mainly as *problems* related to intertemporal disequilibrium originating from "saving-investment imbalances" due to some form of malfunctioning of the capital market. This approach to macroeconomics progressively fell by the wayside with completion of the Neo-Walrasian general-equilibrium paradigm, the rise of Monetarism, and finally the advent of the New Classical School with its method of dynamic stochastic general equilibrium.

At the same time, a robust and rigorous body of literature has grown devoted to explaining why capital markets may indeed fail in their allocation and coordination tasks. This literature is a prominent branch of the "Post-Walrasian" (Colander (1998)) movement that has been profoundly reshaping the discipline since the end of the 1970s. The common root between the modern theory of imperfect capital markets and this more general theoretical movement is the abandonment of certain key elements in the Walrasian paradigm and the progressive definition of a different framework characterized by combinations of a) *market power and price-making* (no auctioneer markets), b) *heterogeneous agents* with *incomplete* knowledge and/or information, c) *incomplete markets* (e.g. Hahn (ed., 1989)).

It is worth noting that some of the outstanding contributors to the modern theory of imperfect capital markets were motivated by the idea of giving firmer foundations to the original views of Wicksell and Keynes.

"For more than a decade now, I and several of my coauthors (...) have been exploring the thesis that it is imperfections in the capital market - imperfections that themselves can be explained by imperfect information - which account for many of the peculiar aspects of the behaviour of the economy which macroeconomics attempts to explain" (Stiglitz, 1992, p.269).

"[This] second strand of New Keynesian literature explores another path suggested by Keynes: that increased flexibility of prices and wages might exacerbate the economy's downturn. This insight implies that wage and price rigidity are not the only problem, and perhaps not even the central problem" (Greenwald-Stiglitz, 1993b, p.25).

However, whereas the study of imperfect capital markets has had far-reaching ramifications at the microeconomic level of analysis of markets, intermediaries and institutions, its impact on macroeconomics has remained surprisingly limited. As will be seen below, almost all the ingredients of a complete macro-theoretic menu are available, and yet the most popular macroeconomic model put forward to date – the so-called "New Neoclassical Synthesis" (NNS) – dispenses with capital market imperfections altogether. The NNS has been delimited within the triangle given by *intertemporal equilibrium*, *monopolistic competition* and *sticky prices* (Blanchard and Galì (2005)). In spite of the Neo-Wicksellian-Keynesian reading of the NNS popularized by Woodford's major book (2003), the first tip of the triangle clearly excludes any connection with the macroeconomic framework of Wicksell and Keynes (Boianovsky and Trautwein (2004), Mazzocchi et al. (2008)). Thus, a clear divide has also emerged between the NNS and the earlier New Keynesian programme put forward by Stiglitz and co-authors.

The problem, however, is not only of interest for the history of thought. If the association of the NNS paradigm with the age of "Great Moderation" – the sustained growth and employment with low and stable inflation that blessed most of the industrialized world in the 1990s – induced the profession to believe that the right theoretical recipe had been found (Blanchard (2000)), its inability to explain, predict and control the seeds of dramatic instability erupted repeatedly in the world's best developed capital market with the new millennium suggests that the demise of capital market imperfections in the building of the dominant paradigm has turned out to be a hasty and unfortunate choice. Creeping "*financial imbalances* that build up disguised by a benign economic environment" (Borio and Lowe (2002, p. 1); italics added) have been detected as a major empirical regularity behind a significant sample of financial crises.

If this is true, however, it is also fair to say that the current state of development of the macroeconomics of imperfect capital markets, too, reveals some deficiencies. On the one hand, its microfoundations provide us with a rigorous taxonomy of the reasons why the market real interest rate may differ from the rate associated with intertemporal general equilibrium (IGE) of the economy (the Wicksellian "natural rate of interest") (e.g. Stiglitz (1982, 1992)). This malfunctioning may result either in a form of *rationing* (the capital market does not clear at the market rate) or in a form of *trading at false price* (the capital market clears but the market rate differs from the natural rate). In either case, saving and investment will generally differ from the amount that would be consistent with (IGE). On the other hand, with few exceptions, the macroeconomic consequences of saving-investment imbalances are still undeveloped in this literature. Ignoring intertemporal disequilibrium constitutes a major theoretical weakness because it is a *logical implication* in *any* theory based on the distinction between the market interest rate and the natural rate (see also Leijonhufvud (1981), van der Ploeg (2005)). Filling this gap is the main purpose of the paper.

Section 2 overviews the current state of the macroeconomics of imperfect capital markets. The section begins with a summary of the modern foundations of imperfect capital markets, and ends with the remark that these do not develop the implications of saving-investment imbalances that are inherent in capital market misallocations. Section 3 outlines an analysis of these implications. First, preliminary tools are introduced. Second, I present a general-equilibrium flex-price model directly comparable with the standard NNS model. Here, however, (exogenous) deviations of the market interest rate from the Wicksellian natural rate generate (disequilibrium) business cycles with Wicksell-Keynesian features. In section 4, the model is extended in order to make the market interest rate endogenous following insights from both Wicksell and Keynes. This extension also allows for preliminary considerations about monetary policy and the control of the interest rate over the business cycle. Section 5 summarizes and concludes.

2. The macroeconomics of imperfect capital markets. An overview

2.1. Brief historical foundations. Wicksell and Keynes

This subsection simply sketches, with no claim to provide a detailed picture, some historical antecedents of the macroeconomics of imperfect capital markets. As the opening quotation indicates, Wicksell is the right and natural starting point.

As is well known, the role of what came to be known as "saving-investment imbalances" in the business cycle was put forward by Wicksell in his interest-rate theory of the general price level (GPL) and of its "cumulative processes" (e.g. (1898a,b)). This was centred on the notion of the "natural rate of interest". It is worth quoting one of the key sentences once again

> At any moment in time in any income situation there is always a certain rate of interest, at which the exchange value of money and the general level of commodity prices have no tendency to change. This can be called *the normal rate of interest*; its level is determined by the current natural rate of interest, the real return on capital in production, and must rise or fall with this. If the rate of interest on money deviates downwards, be it ever so little, from this normal level, prices will, as long as the deviation lasts, rise continuously; if it deviates upwards, they will fall indefinitely in the same way (1898a, p.82).

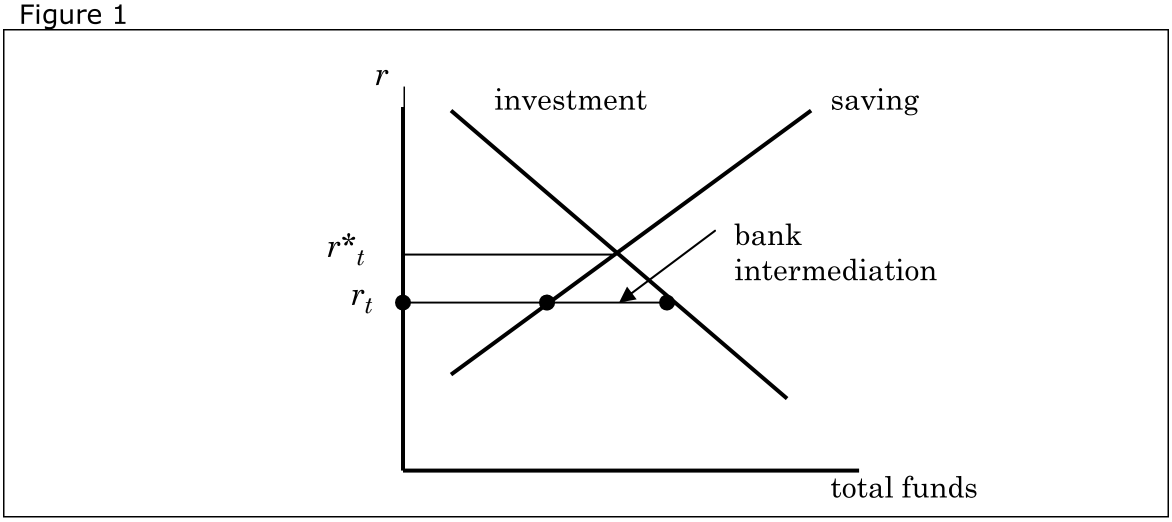
Therefore,

> In Wicksell's theory of the cumulative process, the maladjustment of the interest rate – the discrepancy between the market and the natural rate – is the central idea. It is also the idea that motivates the analysis of changes in the price level (or in nominal income) in terms of saving and investment. [...]. Use of the saving-investment approach to income fluctuations is predicated on the hypothesis that the interest rate mechanism fails to coordinate saving and investment decisions appropriately (Leijonhufvud (1981, p.132)).

The natural question raised by this view is how this maladjustment may happen. Interpretations here are more difficult, but it seems fair to point out two basic ideas. The first is the difference between a monetary economy and a barter or "corn economy". In the former, unlike the latter, capital is not self-lent in kind by households to themselves, but firms need to borrow funds in monetary form from households in order to pay for capital goods (e.g. Wicksell (1898b, p.84)). Second, there are intermediaries between savers and investors. As long as non-bank agents borrow and lend among themselves, the total amount of nominal purchasing power in the economy is redistributed but cannot (need not) increase. The capital market finds its equilibrium at the natural rate of interest as determined by the "forces of productivity and thrift" that equate saving and investment at full-employment of resources. Yet, as soon as the banking system (central bank and private banks) comes into play, the latter proposition no longer necessarily holds. A private bank is in a position to grant additional nominal purchasing power to any of its depositors' accounts with no one else in the economy undergoing an equivalent reduction. Likewise, a private bank can increase its own nominal purchasing (lending) power by borrowing from the central bank. Thus, the point is that the banking system as a whole might both expand the total nominal purchasing power in the economy and allocate it at terms that differ from those dictated by full-employment saving-investment equilibrium (e.g. Wicksell (1898b, p. 74, ff.)).

Note that, from the viewpoint of modern analysis, the kind of market failure that Wicksell introduces is *not* in the form of rationing, but in the form of "trade at false price" (more on this distinction in section 2.3 below). See Figure 1: if the market interest rate r_t differs from the natural rate r^*_t and saving differs from investment, the capital market does clear at all times, with households and firms saving and investing, respectively, what they wish, as the banking sector steps in to fill the gap by hoarding (excess saving) or dishoarding (excess investment) reserves (Leijonhufvud (1981)).

Figure 1



As to the motivation for banks to extend credit beyond (or below) saving-investment equilibrium, a possible explanation may be, in modern terms, *limited information*. In various passages, Wicksell warned that the critical challenge for monetary and banking policy lies in the natural interest rate being subject to unobservable shocks and fluctuations (e.g. 1898a, 82 ff.). If banks do not observe the natural rate directly, and are not immediately constrained in their ability to extend and contract their loans, the market interest may well deviate from the natural rate as long as banks are not induced to revise it in response to some indirect market signal. Such a signal is, in Wicksell's view, precisely the cumulative process of changes in the GPL.

The debate on the business cycle in the first two decades of the Twentieth century was largely dominated by Wicksellian ideas as re-elaborated by the Swedish, Austrian and Cambridge Schools (e.g. Boianovsky and Trautwein (2004, 2006)). At that time it was understood that saving-investment imbalances – or the breakdown of Say's Law as Keynes put it – not only imply that today's supply of goods exceeds demand, but also have an intertemporal nature, in that tomorrow's consumption and production plans will not match. Hence these imbalances are a major force behind the determination of the level of real and nominal variables as well as their (endogenous) fluctuations.

Keynes's first major theoretical work, the *Treatise on Money* (1930), was clearly developed along this line of reasoning, whilst the *General Theory* (1936) can be viewed as an attempt to recast the Wicksellian ideas in terms of real economic activity and employment. Ample textual evidence, in the *General Theory* (e.g. Bk. II) and after (Keynes (1937a, b, c)), testifies that Keynes sought to explain unemployment equilibrium as a result of a mismatch between investment and saving due to a capital market failure. Yet Keynes was even more sceptical than Wicksell about the very existence of the natural rate of interest, and pointed to a different account of the capital market failure. This was related not to intermediaries but to the "monetary nature of the rate of interest". Uncertainty and the demand for money as store of value and as a speculative asset were brought to the forefront as the main causes driving a wedge between the market interest rate and the rate that, in the same given circumstances, would yield the full-employment saving-investment equilibrium. However, like Wicksell, Keynes did not introduce any form of rationing: the capital market eventually clears at a "false" interest rate leading to the unemployment equilibrium.

Throughout the first half of its parable, the "Keynesian revolution" was understood, explained and taught precisely as a departure from the neoclassical macroeconomics of general equilibrium theory on the grounds of capital markets. Keynes's discussion of the role of the labour market in the adjustment process in the event of excess saving, and in particular in light of the possibility that the real wage may not fall *enough* (1936, ch. 19), should be understood as a warning that there is no reason to expect that the misallocational effects of a "wrong" price of capital will necessarily be corrected through changes in the price of labour by market forces. Wage stickiness, though possibly a fact of real life, is a side issue in this theoretical picture. Indeed, the theoretical debate in the aftermath of the *General Theory* concentrated on the theory of the interest rate (see Moggridge, ed. 1987, pp.201-367) with little or no reference to wage stickiness.

2.2. Modern foundations of imperfect capital markets

The modern foundations of imperfect capital markets are rooted in the Post-Walrasian (Colander (1998)) research that, since the late 1970s, has reformulated the first principles of individual behaviour and market organization. As recalled in the Introduction, an initial important impulse came from the scholars who were seeking to give better microeconomic foundations to Keynes's idea that capital market failures are the main source of macroeconomic fluctuations. However, with respect to Keynes's approach centred on outside uncertainty and the demand for money as store of value, which was subsequently embodied in the Neoclassical Synthesis, the modern foundations marked a significant shift towards inside uncertainty, that is asymmetric information (AI) and the related agency problems between lenders and borrowers. From this point of view, the general outlook is more Wicksellian than Keynesian. It is also worth adding that Keynes, and many of his followers, attached great importance to his notion of non-classic-probabilistic uncertainty underlying savers' and investors' behaviour (e.g. (1937c)) as the source of the endemic nature of the capital market failures. The new foundations are instead laid within the boundaries of classical probabilistic uncertainty and rational decision-making. They essentially rest on the following five points (e.g. Stiglitz (1982)).

1) *Agents heterogeneity*: markets exist and trades take place because agents differ. Traditional microeconomics concentrates on differences in preferences and/or endowments as inducements to trade; the economics of imperfect capital markets concentrates on differences in information endowments.

2) *Imperfect information*: agents have free access to a *public information set* on relevant current and future state variables, which may be incomplete for the future variables (probabilistic risk); but they do not have

free access to each other's *private information set* on individual payoff-relevant variables or actions (asymmetric information, AI).

3) *Incomplete markets*: agents are constrained not to trade for goods to which they attach positive value. In particular, economies are studied where future contingent markets for consumption goods are absent. Note that the definition of asymmetric information implies another missing market, the market for private information.

4) *Sequential time and transactions*: markets operate and trades take place in discrete "calendar" time periods. In each period, only spot transactions take place.

5) *The "special nature" of financial "goods"*: capital markets handle "special goods", namely financial contracts. They are special for a number of reasons: a) they are immaterial entitlements to *future* delivery of *money* payments, b) the transaction involved is opened spot (the purchase of the entitlement), but is closed in the future (the delivery of the money payment), c) the open end of the transaction is dependent upon both general market states and specific individual states or actions of the party due to deliver the money payment.

It is the combination of the first four points with the fifth that places capital markets outside the Walrasian paradigm. Given that in the case of financial resources the demander-supplier relationship extends over time, both are in a peculiar position with respect to normal demander-supplier spot relationships in good markets. The demander will seek to optimize the use of the financial resources *under the constraint* of the financial contract with the supplier. The supplier will seek to optimize the allocation of his/her available financial resources among different demanders (financial contracts) *in relation to the characteristics of each*. Therefore, the supplier should engage in three informational activities as the contractual relationship with the demander unfolds over time:

- *screening* (before entering the contractual relationship) to ascertain the distribution of the characteristics of the demanders
- *monitoring* (during a specific contractual relationship) to ascertain that the use of resources made by the demander is consistent with the contractual commitment
- *auditing* (at the end of a specific relationship) to ascertain the final value of the resources employed.

Imperfect information is not removed when any of the above mentioned informational activities is lacking. The following table summarizes the relevant taxonomy.

Table 1

	Type of asymmetry	Consequence
Screening	Ex ante	*Adverse selection*: probability of transacting with low quality subjects
Monitoring Auditing	Ex post	*Moral hazard*: opportunity for non observable actions by the counterparty

In turn each of these activities may have an *opportunity cost* to the supplier, and/or some of the bits of information involved *may not be attainable* at all. In the first case, when paying the cost is sufficient for the supplier to obtain all the relevant information, the market operates with *transaction costs*. In the second case, when some information remains hidden to the supplier, the market operates under *asymmetric information* as defined previously.

Analyses of financial relationships under costly or asymmetric information produce results that as a rule imply some form of capital market failure. These results are often referred to as violations of the Modigliani-Miller theorem (Modigliani and Miller (1958)) that demonstrates the irrelevance of financial factors in firms' real investment choices. Market failures emerge as a consequence of two possible responses of rational agents to imperfect information: one, in a context of pre-defined contracts, ex-ante asymmetry and adverse selection, is the uninformed party's use of the price of the financial transaction as an indicator of the hidden information about the other party (e.g. Stiglitz, 1987), the other, in a context of ex-post asymmetry and moral hazard, is the design of financial contracts able to regulate the conflict of interests between the better informed and the worse informed party once the relationship is established (e.g. Hart, 1995, Part II).

Looking at the macroeconomic level, the foregoing array of imperfect capital-market transactions have mostly been employed to deploy new building blocks regarding

- investment in fixed capital (as a component of aggregate demand: e.g. Fazzari et al. (1988), Bond and Jenkinson (1996))

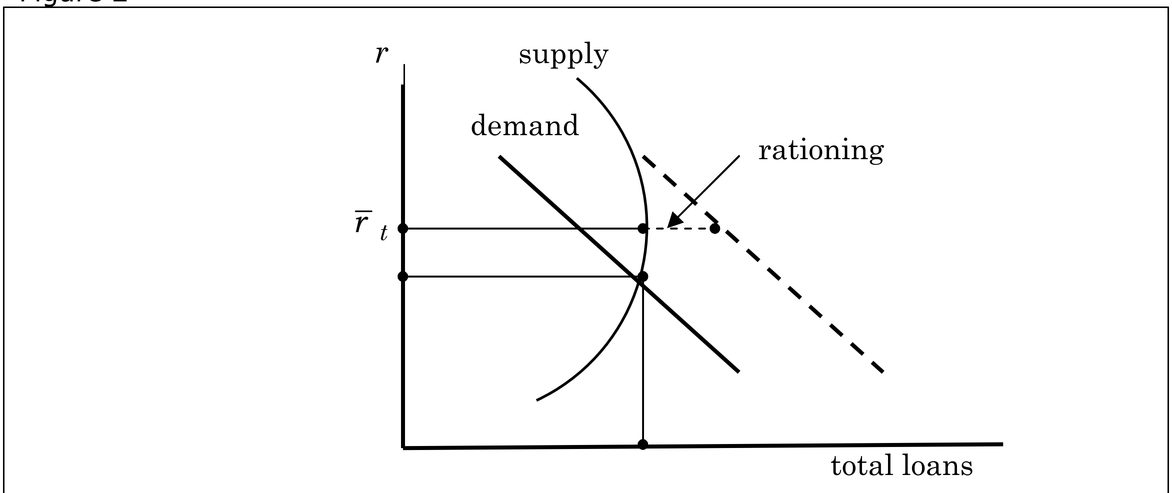
- investment in working capital, in particular the wage bill (as a component of aggregate supply: e.g. Greenwald and Stiglitz (1988, 1993a))
- financial factors in the business cycle (e.g. Bernanke and Gertler (1989), Bernanke et al. (1996), Gertler (1988), Gertler and Hubbard (1988, Kiyotaki and Moore (1997))
- financial factors in growth (e.g. Demirguç-Kunt and Levine (2001), Allen and Gale (2001))
- policy, especially monetary policy, implications (e.g. Bernanke and Blinder (1998), Greenwald and Stiglitz (1991), Gertler and Gilchrist (1993), Bernanke and Gertler (1995))

Hence it seems fair to say that *almost* a complete macroeconomic theory with imperfect capital markets is now available. For reasons of space, here my assessment of the state of the art will be limited to the first and second points, with some indirect considerations of the last[1]. These, in my view, are also the key issues on which the strengths and weaknesses of the theory should be assessed.

2.3. Under-investment and over-investment

Following the taxonomy racalled in paragraph 2.1, let us first consider the class of models with *rationing*. This allocational failure entails that the capital market does not clear, that is, saving is not equal to investment at the market rate. A typical example is given by the Stiglitz-Weiss (1981) model of credit with AI and adverse selection (see Figure 2)

Figure 2



[1]A more comprehensive overview can be found in Delli Gatti and Tamborini (2000)

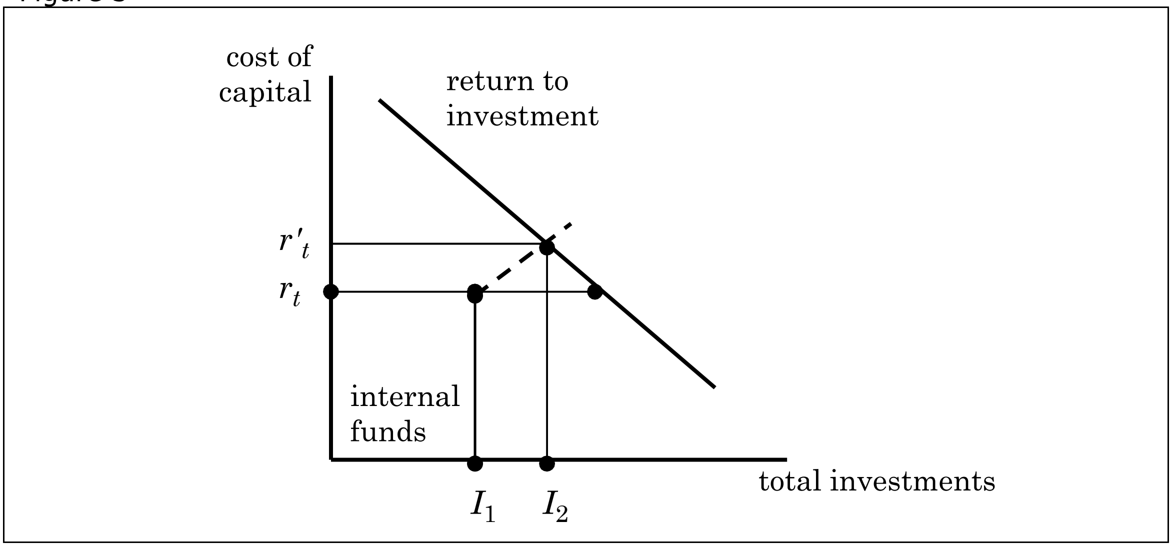
This is a partial equilibrium model of the credit market which, however, includes an endogenous supply of funds *vis-à-vis* a conventional downward-sloping demand curve. The supply of funds comes from households' deposits and can be regarded as representative of savings. In a perfect market, intermediation (if any) would be neutral, and deposits (savings) would equal loans (investments) at the market-clearing interest rate. As a consequence of adverse selection, however, the supply curve of loans is backward-bending. This is because increasing the interest rate raises the unit return to loans on the one hand, but also raises the probability of default by borrowers on the other. Beyond a certain threshold of the interest rate, $\bar{r}_t$ the banks' expected profit bends backward and so does the supply of loans. With this supply curve in place, it may happen that the demand for loans exceeds supply at the maximum interest rate set by banks, and excess demand is rationed. The conclusion is that, at the interest rate set by banks, *notional* investment exceeds saving whereas *actual* investment is constrained to be equal to saving.

Alternatively, we may consider models with *trading at false price*, which is emphatically not to be confused with rationing. In this case the capital market clears, but the market interest rate differs from the natural rate. A useful example is provided by De Meza and Webb (1987). Like Stiglitz and Weiss they consider a credit market characterized by AI and adverse selection. This phenomenon, however, operates in the opposite way from that envisaged by Stiglitz and Weiss. There, increasing the interest rate crowds out low-risk projects, here it crowds in high-return projects. Thus the average quality of borrowers is higher than the quality of the marginal borrower. As a result, the banks' expected profit function, as well as the loan supply curve, are monotonically increasing with the interest rate, and a market-clearing equilibrium can be reached. However, De Meza and Webb demonstrate that the net present value of the project of the marginal borrower is negative. Their conclusion is that adverse selection may well generate excess investment by way of the bank sector. In other words, if the natural interest rate is the rate that drives the net present value of the marginal borrower to zero, we can also say that the equilibrium interest rate charged by banks is below the natural rate[2].

2.4. Macroeconomic implications

The first, in order of time and importance, macroeconomic projection of the study of imperfect capital markets concerns aggregate investment determination, with a particular emphasis on *under-investment*, that is, investment below the perfect-market benchmark (e.g. Fazzari et al. (1988)). Figure 3 depicts the main issues. The vertical axis measures the return to invested capital (however it is measured), and the horizontal axis measures total investment. A standard inverse relationship is considered. The first key point (the first violation of the Modigliani-Miller theorem) is that in AI capital markets *firms face different costs of capital* according to different sources even in the absence of exogenous risk. Typically, the cheapest cost of capital r_t is the risk-free opportunity cost of internal funds (in a risk-free market this would also be the single market rate). External funds, whether they be equity or debt (here we need not distinguish them), entail an extra cost r'_t due to the AI "lemon" premium that the market charges to cope with any of the AI risks recalled above.

Figure 3



[2]Thus this model can be viewed as a modern explanation of the role of banks in Wicksell's theory of saving-investment imbalances

In some circumstances, namely under rationing, the lemon premium becomes "infinite" (the second violation of the Modigliani-Miller theorem), and the corresponding investments cannot be financed at the given market conditions. This phenomenon may occur in the equity market (e.g. Leland-Pyle (1977), Myers-Majluf (1984)) as well as in the credit market (e.g. Jaffee and Stiglitz (1990), Stiglitz and Weiss (1981)).

Consequently, total investment comes to depend on a) the extent to which firms own internal funds, b) the extent to which, and the cost at which, they have access to external funds. Therefore, two main phenomena characterize AI capital markets

- *financial hierarchy* (or *pecking order*): firms finance investment starting from the cheapest source of capital supply, and they resort to other sources only as the scale of, and the return to, investment increase sufficiently
- *financial rationing*: some classes of firms may have no access at all to some forms of capital supply; hence their ability to invest is constrained by their amount of internal resources, say I_1.

It is important to note that the two phenomena give rise to two different allocational situations. The former, generally, entails that total investment may be *less* than it would be in a perfect market, but nonetheless firms are *unconstrained* (i.e. they are *on* their efficient investment curve that they reach by combining different funds). The latter, by contrast, implies both a loss of total investment and that firms are constrained (i.e. they are *off* their efficient investment curve). In other words, in one case we have low but efficient investment at the margin, in the other we have a loss of efficient investments.

It is perhaps a clue to the Keynesian inspiration of this literature that its has largely focused on under-investment, the cases of rationing being the most critical ones. On the other hand, if stagnations and recessions are recurrent evils that may be traced back to under-investment, it is nonetheless striking that the most important episodes of large-scale under-investment, starting from 1929 and ending in 2008, did follow episodes of over-investment, with stock market bubbles and the subsequent crash landing of stock values (Borio and Lowe (2002)). The most important Keynesian author who sought to explore capital market failures leading to over-investment and complete boom-bust cycles was Minsky (1972, 1975). He should be credited with the introduction of the concepts of "financial fragility" and "financial accelerator" that have subsequently been reshaped with the modern tools of the New Keynesians (Bernanke and Gertler (1989, 1990), Bernanke et al. (1996)). De Meza and Webb (1987) have drawn attention to the fact that AI may lead to over-investment, and Tamborini (2001, ch. 8) has exemplified this case in a simple model of equity market *à la* Myers-Majluf. The compelling evidence for the role of over-investment in the generation of recent financial crises has prompted further research extending towards the role of monetary policy (e.g. Cecchetti et al. (2000), Bernanke and Gertler (2001), Bordo and Jeanne (2002)).

2.5. Implications for monetary policy

A few considerations regarding monetary policy are in order since research on capital market failures has produced some tangible effects. The 1990s witnessed the resurgence of the view that "monetary policy matters", in the sense that policy interventions (mainly activated by changes in administered rates and money-market rates) are typically followed by quick and large responses in short-term interest rates, monetary aggregates, total credit, different measures of real economic activity, and by slow and delayed adjustment of different price indexes. More controversial is the search for explanations of the impact of monetary policy on economic activity.

Historically, research has mostly concentrated on aggregate demand as the key connection between monetary policy and economic activity, and consequently on various possible transmission mechanisms from monetary policy instruments to the components of aggregate demand. The first of these, in order of time and importance, is the *open-market channel* whereby open-market operations (exogenous money), embedded in perfect capital markets, affect private expenditure directly (via real balance effect) or indirectly (via interest rates). Consideration of capital market imperfections has reshaped this view, reviving the so-called *credit channel*[3].

This channel helps explain the large impact that monetary interventions are observed to exert on private expenditure by way of capital market imperfections, notably asymmetric information generating agency problems between the firm and its external financial suppliers. According to

[3]In truth, this is a rather heterogeneous collection of views, dating far back in time and sharing the idea that changes in *banks' assets* (i.e. total credit to the economy), rather than in banks' liabilities (i.e. money balances in the economy), are the key mechanisms linking economic activity to monetary policy (Trautwein (2000)).

a large body of evidence, bank credit is the first, or exclusive, choice among external sources, most likely for small firms with poor internal accumulation and with limited access to open markets. The credit channel may be activated by the central bank's control of the monetary base (changes in bank reserves) as well as by interest-rate management (changes in interbank rates). What is relevant to this approach is that monetary policy affects bank lending rates and the supply of credit (endogenous money). When embedded in imperfect financial markets, a monetary restriction that lowers asset prices, diverts bank funds from loans to bonds, and raises bank interest rates, worsens almost all possible sources of investments (reference papers are Blinder (1987), Bernanke-Blinder (1988), Greenwald-Stiglitz (1990, sec.1.3), Stiglitz-Weiss (1992)). In any case, the key theoretical ingredients that may account for the real effects of monetary policy remain located in good and labour market imperfections leading to "nominal rigidities" or "sticky prices" as a *sine qua non* condition for real effects to develop.

Another research path follows the theoretical argument that restricting the link between monetary policy and economic activity to aggregate-demand effects is an over-simplification of microeconomic relationships. There are, in fact, several possible links with *aggregate supply* as well. First, investment decisions determine future production capacity; if imperfect financial markets in some way transmit monetary policy impulses through constrained investment decisions, the effects should also manifest themselves in current production decisions which must be consistent with the overall intertemporal production path of each firm (e.g. Stiglitz (1992)). Second, besides fixed capital, also working capital may need financial resources, as current inputs should be paid before output can be sold, and these resources (liquidity, inventories, credit, etc.) carry a financial cost. Consequently, the interest rate paid on working capital affects production costs – a view largely shared by businessmen (e.g. Goodhart (1986)) – whilst monetary policy, by altering interest rates, can influence aggregate supply through this *cost channel*. Greenwald and Stiglitz (1988, 1993a), Christiano et al. (1997, 2005) paved the way; Barth and Ramey (2001), Ravenna and Walsh (2003, 2006), Chowdhury et al. (2006) testify to the growing interest in this further channel of monetary policy and provide evidence of its importance for monetary transmission.

The supply-side effects of monetary policy have several interesting implications. First, they call into question the general presumption that real effects of monetary shocks can only arise as a consequence of sticky prices. As stressed by Greenwald and Stiglitz (1993b) co-movements of demand and supply after a monetary shock can provide a straightforward explanation for the observed pattern of large adjustments in quantities and small ones in prices even in competitive markets with flexible prices. On the other hand, such co-movements of demand and supply in a general-equilibrium framework offer the appropriate key to establishing whether or not the so-called "price puzzle" (Sims (1992)) – the inflationary effect of a monetary restriction – occurs. According to Christiano et al. (1997), this approach outperforms the traditional sticky price hypothesis on the grounds of the "stylized facts" of the monetary business cycle.

Second, the traditional demand-side effects, which require sticky prices as a *sine qua non* condition for real effects, generally imply that real wages and profits are *anti*-cyclical with output after a monetary shock, whereas it is an empirical regularity that they are *pro*-cyclical. This fact can be explained by bringing supply-side effects into the picture. If, say, a monetary restriction raises firms' variable costs and/or forces them to cut production, then, for a given monetary wage, prices may well increase and real wages fall (Blinder (1987), Barth and Ramey (2001)). Alternatively, firms may respond by cutting back labour demand, thus forcing real wages to fall directly (Greenwald and Stiglitz (1988, 1993a), Christiano et al. (1997)).

Finally, it is typical of the models cited above that, one way or another, the *equilibrium* level of output (employment) comes to depend on the policy interest rate as an element of firms' real unit cost along with the wage rate (and possibly other input prices). Hence, it can no longer be taken for granted that monetary policy interventions are bound to generate mere transitory effects around, with no permanent impact on, potential output, the natural rate of unemployment, etc. (Greenwald and Stiglitz (1993a)).

2.6. Whither saving-investment imbalances?

More than two decades of active research in the field of imperfect capital markets have greatly improved our understanding of the actual working of these markets, and of their role in the life of market economies, either for the better of stability and growth or for the worse of instability and slumps. Nonetheless, the overall picture is still incomplete. The point is that in the presence of market imperfections, it is generally no longer the case that saving equals investment at the Wicksellian natural interest rate, that is, the interest rate which grants IGE (Stiglitz (1992)). Yet we generally do not find explicit treatment of the supply side of the capital market, or of the intertemporal consistency between saving and investment.

Looking back at the evolution of the macroeconomics of imperfect capital markets, from its origins to its modern developments, we may be struck by a sort of paradox. Initially, the key issue was the macroeconomic consequences of saving-investment imbalances, in a theoretical context with relatively poor instruments of microeconomic and intertemporal analysis. Today, we have a rich and powerful theory of capital market failures at the microeconomic level, but their macroeconomic consequences are poorly developed. Exploring this neglected side of the modern macroeconomics of imperfect capital markets is the purpose of the subsequent parts of the paper.

3. Some macroeconomics of saving-investment imbalances. The baseline model

3.1. Preliminary tools and discussion

To begin with, let us consider an economy along its IGE path. The corresponding price vector includes the relative price of factors at each time t (the real wage rate and the real interest rate as dictated by real determinants). The problem is how the economy reacts when the real interest rate is "wrong". As usual, investment in t determines the capital stock for production in t+1. The ensuing allocation scheme is exemplified in Table 2.

Table 2. Allocation scheme when the market real interest rate differs from the natural rate

	t		t+1	
	$R_t < R^*$	$R_t > R^*$	$R_t < R^*$	$R_t > R^*$
Capital market	$S_t < I_t$	$S_t > I_t$	$K_{t+1} > K_t$	$K_{t+1} < K_t$
Goods market	$AD_t > Y_t$	$AD_t < Y_t$	$AD_{t+1} < Y_{t+1}$	$AD_{t+1} > Y_{t+1}$
R = market real interest rate, R^* = natural interest rate, S = saving, I = investment, K = capital stock, AD = aggregate demand, Y = aggregate supply (potential output)				

Consider the case that in t the market real interest rate exceeds the natural one. Excess saving arises, to which there corresponds excess supply in the output market in t, and, by intertemporal Walras Law, excess (planned) demand in t+1. Note that the capital-market disequilibrium in t, if uncorrected, *must* have an intertemporal disequilibrium effect on the output and labour markets in t+1 even though the real wage is perfectly "right" with respect to the natural interest rate. As thoroughly explained by Leijonhufvud (1981), these are the two key logical implications of any saving-investment imbalance theory, namely

- "unemployment will not converge to its natural level *unless* the interest rate goes to its natural level – (...) the latter condition will not always be fulfilled" (p. 135)
- "with the interest rate at the right level, market forces should make unemployment converge to the natural rate – otherwise not" (p.136).

As a corollary, the fact that we may observe disequilibrium in one market, say the labour market, does not imply that the *problem* lies in that market. In a system of interrelated markets, "wrong signals" impinging on one market may well originate from elsewhere.

> The very nature of the problem associated with information asymmetries suggests that it is precisely in those markets which are in charge of coordinating intertemporal decisions that rigidities and inefficiencies are most common [Since] investment decisions are made on the basis of signals sent by these typically inefficient markets, it is only too natural to expect that they lead to distortions. As a result, the burden of adjustment will fall upon other markets (Fitoussi (2001, p.24))

In order to develop these implications analytically, we can take the two alternative analytical routes exemplified in section 2.3, *rationing* or *trading at false price*. The first requires exploring different rationing schemes (e.g. Heijdra and van der Ploeg (2005)) and non-market-clearing processes (e.g. Chiarella et al. (2005)). Rationing schemes typically produce adjustments in quantities at the given rationing prices. A typical example is given by the "short-side-of-the-market" rule. If $R_t > R^*$, the rule states that households are rationed in saving in t and are rationed in consumption in t+1, whereas firms are only rationed in production in t. That is to say, households are forced to save in t, and consume in t +1, as much as it is determined by firms' investment in t, and production capacity in t+1, respectively. Likewise, in t firms can undertake as much investment as they wish, but they are forced to produce less.

With trading at false price, demand equals supply at all times, but the resulting vector of prices and quantities is different than in the IGE vector. Hence, there must be an allocational "error" arising at some point in the system. In general, we may expect a mix of adjustment in prices and quantities. Yet the mix has little to do with the degree of price flexibility. Rather, the eventual result depends first of all on the allocation scheme in the capital market.

Whereas the bulk of the modern literature on capital market failures deals with rationing, here I shall pursue the other route, which was instead common to both Wicksell and Keynes. Here I shall follow Tamborini (2007) based on Wicksell's hypothesis that the banking system sets the market interest rate and then *it fills any possible gap between investment and saving if the market rate differs from the natural rate* by lending or hoarding reserves (see section 2.1 and Figure 1 above)[4]. If firms are on the long side of the market, $R_t < R^*$, they can actually invest more than households wish to save thanks to banks' additional loans. If households are on the long side, they are allowed to save as much as they wish by banks hoarding reserves. For the time being, the interest rate set by the banking system is kept exogenous, whereas it will be endogenized later on. On these assumptions, it can be shown that in a competitive, flex-price economy with optimizing, forward-looking agents, saving-investment imbalances with trades at the "false" interest rate in t imply a single, well-defined vector of output realizations to be accommodated by the goods market in t and t+1. The related market-clearing paths of output and the GPL depend on technology,

[4]Recall the model by De Meza and Webb mentioned in section 2.3.

production capacity and price expectations. Yet the key point is that both deviate from the IGE path that would obtain with trade at the natural interest rate. Under suitable, though standard, conditions on the utility and production functions, *both output and the GPL* deviate upwards if $R_t < R^*$ and deviate downwards if $R_t > R^*$.

3.2. The model

This subsection introduces a log-linear version of the above-mentioned model that focuses on unemployment upon the assumption that a unique, well-defined relationship (e.g. Okun Law) exists between output and unemployment.

Let us consider an economy with IGE characterized by the natural rate of unemployment (NAIRU) u as determined by a given combination of tastes, technology and the relative value of the real wage rate w with respect to the natural interest rate r. All the IGE variables (u, w, r) are assumed to be constant[5]. As discussed above, the actual unemployment rate at any time, u_t, differs from u to the extent that the market real interest rate, $i_t - \pi^e_{t+1}$, differs from r. Also recall that any saving-investment imbalance at time t implies a corresponding labour demand-supply imbalance at time t+1. Hence there should be a *feed-forward effect* of current interest-gaps on *present and future* unemployment gaps. Therefore, looking at the time series of the two variables one may expect to detect 1) dependence of unemployment gaps on past interest-rate gaps, 2) some degree of (spurious) persistence of unemployment gaps due to dependence on the common interest-rate gap[6]. Consequently, the unemployment *out-of-equilibrium* dynamics can also be represented by a first-order linear equation like the following

---

[5]According to standard DSGE methodology these variables may change over time owing to random shocks to the underlying parameters. This feature is inessential for present purposes.

[6]As a matter of fact, recurrent estimates of the output/unemployment and inflation functions invariably find these features. See Orphanides and Williams (2002, 2006) and Caresma et al. (2005) for a survey. These empirical regularities are not easily accommodated within a model whose hallmark is the role of so-called *forward-looking* output and inflation functions, unless the model is filled with additional *ad hoc* "frictions" (Chiarella et al. (2005, chs. 1 and 8) offer a thorough discussion). However, the time structure of our equations (1)-(2) are not due to backward-looking behaviour or other frictions. On the contrary, they result from the correct consideration of the *feed-foward* effects of saving-investment imbalances.

(1) $$u_{t+1} = u + \rho(u_t - u) + \alpha(i_t - \pi^e_{t+1} - r)$$

where $u_{t+1} \neq u$ as long as $(i_t - \pi^e_{t+1}) \neq r$, with some degree of persistence $0 < \rho < 1$. This may be called the "cap-lab" (CL) function since it relates the labour to the capital market.

The inflation rate at any point in time turns out to be governed by an expectations-augmented Phillips curve (PC), i.e.

(2) $$\pi_{t+1} = \pi^e_{t+1} - \beta(u_{t+1} - u)$$

where $\beta > 0$ denotes the responsiveness of nominal prices/wages to goods/labour markets deviations from steady state. It should be noted that this PC is consistent with flexible nominal wages and prices and a finite value of β, in that it describes how unemployment reacts to transitory inflation dynamics as long as $\pi_{t+1} \neq \pi^e_{t+1}$. In other words, this can be regarded as the non-vertical, out-of-equilibrium PC generated by a Lucasian flex-price aggregate supply function with "surprise inflation". Nominal rigidities affecting the value of β may exist as a matter of fact, but they are not necessary theoretically.

Finally, the model is closed by the determination of the expected inflation rate. As is well known, investors' expectation-formation was a matter of endless dispute in the older macroeconomic literature until the advent of the rational expectations hypothesis. In the context of this model, recourse to the rational expectations hypothesis would imply that agents know the steady-state values of the variables, which in turn depend on the inflation expectation itself. This is the notorious self-referentiality inherent in that hypothesis (see e.g. Evans and Honkapohja (2001)). In order to have a flexible framework in which different expectation mechanisms can be assessed, I consider two co-existing hypotheses.

The first is a close antecedent of the modern rational expectations hypothesis, namely the concept of "normal" inflation rate. The concept of normal value of a variable was widely used as point of reference for expectations by Wicksell, Keynes and pre-Lucasian economists in general. Normality was generally referred to the long-run average value observed for a variable, which is also expected to prevail in the future in the states of rest of the system. For simplicity, this information about inflation is taken as a pre-determined (possibly zero) value π. If the belief that π is the normal inflation rate is correct, then π should result as the steady-state solution of inflation. If this happens, π is also the "long-run" rational expectation of the inflation rate. The second expectation mechanism is borrowed from the standard NNS model, namely that agents correctly anticipate next-period's inflation, that is, $E_t(\pi^e_{t+1} - \pi_{t+1}) = 0$, where E_t indicates the statistical expectation operator as of time *t*. These I would call "short-run" rational expectations.

Then, let a share δ of agents form "short-run" rational expectations, while the complementary share believes in the return to normality. As a result, the variable π^e_{t+1} in equations (1) and (2) should be replaced with

(3) $$\delta\pi_{t+1} + (1 - \delta)\pi$$

After substituting for inflation expectations, the CL-PC equations form a system of two first-order difference equations with two endogenous variables $[u_t, \pi_t]$, one time-varying exogenous variable, i_t, and three exogenous constants $[u, \pi, r]$. The system can conveniently be transformed in terms of two endogenous gaps $[\hat{u}_t \equiv u_t - u,\ \hat{\pi}_t \equiv \pi_t - \pi]$, and one exogenous gap $(\hat{i}_t = i_t - i)$, where $i \equiv r + \pi$. The latter is the "non-accelerating-inflation rate of interest" (NAIRI) or the nominal value of the natural rate at the normal inflation rate. This expression is exactly equivalent to the difference between the market real interest and the natural rate, but it is more convenient in the present context. Therefore we have the following non-homogenous system

(4) $$\hat{u}_{t+1} = \rho'\hat{u}_t + \alpha'\hat{i}_t$$

(5) $$\hat{\pi}_{t+1} = -\beta'\hat{u}_{t+1}$$

where

$$\alpha' = \alpha\frac{1-\delta}{1-\delta(1+\alpha\beta)},\ \rho' = \rho\frac{1-\delta}{1-\delta(1+\alpha\beta)},\ \beta' = \frac{\beta}{1-\delta}$$

3.3. Steady state

The first and most important result is that, for any constant initial value $\hat{i}_0 \neq 0$, the system admits of a solution where

(6) $$\hat{u} = \frac{\alpha'}{1-\rho'}\hat{i}_0$$

(7) $$\hat{\pi} = -\frac{\beta'\alpha'}{1-\rho'}\hat{i}_0$$

Then it is easily seen that the system achieves the steady state with zero endogenous gaps $[\hat{u}_t = 0,\ \hat{\pi}_t = 0]$ if and only if $\hat{i}_0 = 0$. The condition $\rho' \in [0, 1]$ also entails that if $\hat{i}_0 \neq 0$, unemployment and inflation converge monotonically to, and remain locked in, the values given by (6) and (7), with *both unemployment and inflation being inefficiently high or low*, and *being* *inconsistent with their IGE values*. This is in fact the analytical solution of the general implication of saving-investment imbalances discussed above (see the quotations from Leijonhufvud (1981) and Fitoussi (2001)). Note, however, that non-zero gaps is a general property of non-homogenous systems, and we have a non-homogenous system because of the assumption that the nominal interest rate is exogenously given. This assumption will be relaxed later on.

The model also captures the essence of Wicksell-Keynes cumultative processes. Suppose, as Wicksell did, that $\hat{i}_0 < 0$, and the initial steady state is one with constant price level. Then, our result means that the price level would indefinitely rise at a constant rate (Wicksell (1898b, pp. 77-78)). Wicksell correctly considered these price changes a major disequilibrium phenomenon which should be carefully understood and curbed, though they may occur in perfectly competitive goods and labour markets (in which case the NAIRU u would simply be zero). Wicksellian cumulative processes are a disequilibrium phenomenon in a precise sense: *expectations of a return to normality are systematically falsified*. While all markets clear at all times, the "error" generated by trading at the "false" interest rate in the capital market shows up as an expectational error about inflation. As was clear to Wicksell himself, and to the Swedish school in general (e.g. Boianovski and Trautwein (2004, 2006)), this fact raises the problem of how expectations are possibly revised, and how the revision mechanism impinges upon the dynamic process. This problem will be reconsidered later on.

What is important to stress at this juncture is that this is a radically different interpretation of the role of changes in the GPL with respect to the NNS. In the NNS model "it is only […] with sticky prices that one is able to introduce the crucial Wicksellian distinction between the actual and the natural rate of interest, as the discrepancy between the two arises only as a consequence of a failure of prices to adjust sufficiently rapidly" (Woodford (2003, p. 238)). By contrast, Wicksell cast his theory in a competitive, flex-price framework, and he argued that interest rates should be brought under policy control not because prices do not move enough, but because unfettered interest rates may force prices to move out-of-equilibrium. On the other hand, changes in the GPL are a means to re-equilibrate the economy only if, and to the extent that, they induce the nominal interest rate to close the gap with the natural rate (Wicksell (1898a, pp. 80 ff.)).

Sticky prices may be introduced into the picture as a matter of realism, yet they are not necessary theoretically.

On the other hand, Wicksell did not pay sufficient attention to the real side of the disequilibrium cumulative process, which was unveiled by Keynes's theory of effective demand[7]. Consider now the case that $\hat{i}_0 > 0$. The system converges to a steady-state unemployment rate above the NAIRU (the unemployment level given by the "right" relative price of labour to capital). This result may be regarded as a characterization of Keynes's concept of "involuntary unemployment" (with a caveat to be discussed below). Given the "false" market real interest rate, not all workers ready to work at the IGE real wage rate will ever be employed. Since no structural parameter has changed that justifies a change in the real wage rate, the unemployment gap is entirely due to the interest-rate gap. Note also, that the much debated β parameter of the PC function is not so much crucial *per se* as it is in connection with the parameter δ regulating expectation formation. Insofar as the interplay between β and δ fulfills the convergence condition $\rho' \in [0, 1]$, the system does not change its qualitative properties. However, for any given δ, the system tends towards instability as β *increases*: that is, the PC function becomes steeper – a well-known argument by Keynes (1936, ch. 19). On the other hand, the unemployment gap is associated with less-than-expected inflation, a well-known argument against the consistency of "involuntary unemployment" as a steady-state.

3.4. System's dynamics and the role of expectations

First of all, the coefficients of the steady-state values of $\hat{u}$ and $\hat{\pi}$ increase with δ in absolute value, that is, short-run forward-looking expectations are *deviation-amplifying* in steady state. Moreover, the system will converge to the steady state only if δ is bounded

$$\delta < \left(\frac{1-\rho}{1-\rho+\alpha\beta}\right) < 1$$

[7]"While Wicksell had refused to use his theory of cumulative processes for the explanation of industrial fluctuations, [it was] Lindahl [who] wanted to extend Wicksell's approach into a general theory of business cycle" (Boianovsky and Trautwein (2006, p. 8). Lindahl (1939) in fact included unemployment in his analysis, foreshadowing the modern distinction between cyclical and structural unemployment (*ibid,* p.11).

As δ exceeds this threshold, unemployment and inflation will take divergent trajectories. This possibility was well understood and feared by both Wicksell, in the event of self-sustained inflation (e.g. Wicksell (1922, XII, n.1)) and Keynes, in the event of bottomless deflation (1936, ch. 19). As long as $\hat{i}_0$ remains positive or negative, investors anticipate the ensuing rise or fall in the inflation rate. As a consequence, the positive or negative gap of the market real interest rate relative to the natural rate is amplified, and so are the unemployment and inflation gaps along the adjustment path.

As $\delta \rightarrow 1$, the system jumps to a steady state where $\hat{u} = 0$, $\hat{\pi} = \hat{i}_0$. On the one hand, there are no real effects, on the other, the sign of the relationship between $\hat{i}_0$ and $\hat{\pi}$ is inverted (low (high) interest rate generates excess deflation (inflation)). This replicates a well-known result in the modern theory of monetary policy established by McCallum (1986). As he stressed, this result is consistent with the Fisher equation. In fact, if one takes the Fisher equation as a basis for inflation expectations, then $\pi^e_{t+1} = i_t - r$. However, *starting* from the Fisher equation is not a correct rendition of models of saving-investment imbalances, in which the Fisher equation should eventually be the *ending* point of the adjustment of a *disequilibrium* process. Indeed, as can be seen from our treatment, McCallum's conclusion is valid only within the limits of uniformly held short-run rational expectations, but there is no trajectory leading the system to the Fisher equation when the starting point is at $\delta < 1$.

4. Endogenizing the nominal interest rate

So far the nominal interest rate has been treated as an exogenous variable. Our next step will be to close the model with an adjustment equation of the nominal interest rate i_t that endogenizes the dynamics of the interest rate gap after an initial shock. The focus will be on *endogenous market mechanisms*, which means that monetary policy is, for the time being, left in the background. This choice can be justified for two reasons. The first is that there are various theories of *market* interest rate determination in the context of saving-investment imbalances that should be considered in order to have a broader view of this phenomenon. The second is that the almost exclusive shift of monetary policy analysis towards interest-rate control that has occurred in the last few years has hidden from view the fundamental fact that there exist other channels of interest rate determination in addition to, or in the place of, direct control of the central bank.

For the sake of comparison, I will consider three different specifications inspired by the alternative theories of the interest rate put forward by the founders of the saving-investment imbalance approach: 1) a Wicksellian bank mechanism, 2) a "dynamic" Keynesian LM equation, 3) a "speculative" LM equation. Let me first point out that, from an analytical point of view, "endogenizing" the nominal interest rate means that, whereas the baseline model with exogenous interest rate was a non-homogeneous system, we may expect that a well-specified interest-rate equation transforms the system into a homogenous one. This class of systems generally admits of zero-gaps steady states, that is, complete stabilization. It should therefore be borne in mind that complete stabilization can be the outcome of *any* interest-rate equation that endogenizes the nominal interest rate properly.

4.1. A Wicksellian bank mechanism.

The well-known Wicksellian idea is that the out-of-equilibrium nominal interest rate is procyclical with the GPL (e.g. (1901, Bk. II), (1898b)). This was a well-established fact even before the inception of inflation-target rules by central banks[8]. In Wicksell's view the reason is that banks raise or lower their nominal lending rate to the extent that the GPL increases above or decreases below what is considered its normal level. This process may be driven by the need of banks to keep their loans balanced with real reserves during the expansion (contraction) of the demand for funds and of the GPL. More simply, banks may have a real interest target and index the nominal rate accordingly. These two explanations have, however, different theoretical implications in the present context. As explained in section 2, the key to interest-rate gaps essentially consists in information about the natural rate. Hence, the former explanation of banks' behaviour hinges on a limited informational requirement, in that banks

[8] At the time when Wicksell was writing, there was already clear evidence that nominal interest rates would tend to move together with the GPL (see e.g. the diagrams in 1898a) – a phenomenon later labelled the "Gibson paradox" by Keynes. Wicksell argued that this phenomenon would not contradict his theory, but that it was instead to be explained as the ongoing adjustment process of nominal interest rates towards a new level consistent with the steady-state level of prices.

need not know what the natural rate is at each point in time, which is consistent with the idea that the *nominal* interest rate may assume wrong values. The latter explanation instead requires an informational hypothesis about the relationship between the target real interest rate of banks and the natural rate, which implies the possibility that the *real* interest rate set by banks may be wrong.

It will be convenient to work with a general formulation nesting more specific ones, like the following

(8) $$i_{t+1} = \phi(i_t + \gamma(\pi_{t+1} - \pi^e_{t+1})) + (1 - \phi)(r^b + \pi_{t+1})$$

This interest-rate equation (IR) states that, starting from a nominal interest rate in t, its law of motion depends on a) the share ϕ of "adaptive" banks that do not have (information on) an explicit real interest target, b) their "indexation" sensitivity γ to excess current inflation with respect to its expected level, c) the share $(1 - \phi)$ of banks which have the real interest target r^b and simply index the nominal rate to it.

As to inflation expectations, let us assume the same structure as the rest of the private sector, namely

$$\pi^e_{t+1} = \delta\pi_{t+1} + (1 - \delta)\pi$$

Now, defining $\hat{r} \equiv r^b - r$ as the possible informational error of banks which have a real interest target, equation (8) can easily be transformed in terms of the baseline model's gaps, i.e.:

(9) $$\hat{i}_{t+1} = \phi\hat{i}_t + (1 - \phi)\hat{r} + \eta\hat{\pi}_{t+1}$$

where $\eta \equiv 1 - \phi + \gamma\phi(1 - \delta)$

This formulation indicates that, as a result of the law of motion of the interest rate (8), interest-rate gaps evolve endogenously according to a) one-period lag in proportion to the share of banks with no real-interest target, $\phi\hat{i}_t$, b) the indexation elasticity to the inflation gap, η. This evolution of interest-rate gaps may however have a drift, $(1 - \phi)\hat{r}$, that is, the incidence of banks' misinformation about the natural rate in proportion to the share of banks with a real-interest target. On adding this equation to the baseline system in gaps (4)-(5) we obtain the CL-PC-IR non-homogeneous system of three first-order difference equations in the three endogenous gaps $[\hat{u}_{t+1}, \hat{\pi}_{t+1}, \hat{i}_{t+1}]$, and one exogenous constant $\hat{r}$:

(10) $$\begin{bmatrix} \hat{u}_{t+1} \\ \hat{\pi}_{t+1} \\ \hat{i}_{t+1} \end{bmatrix} = \begin{bmatrix} \rho' & \alpha' \\ -\rho'\beta' & -\alpha'\beta' \\ -\rho'\beta'\eta & \phi - \alpha'\beta'\eta \end{bmatrix} \begin{bmatrix} \hat{u}_t \\ \hat{i}_t \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 - \phi \end{bmatrix} \hat{r}$$

Let us concentrate on conditions for the system to achieve a zero-gaps steady state.

1) *The system admits of a zero-gaps steady state only if* $(1 - \phi)\ \hat{r} = 0$. Hence, a Wicksellian bank mechanism is potentially able to self-correct the interest-rate gaps that may trigger saving-investment imbalances. However, this potential stabilization role may be jeopardized by the incidence of banks' misinformation about the *real* rate ($\hat{r} \neq 0$). If one looks at the modern economics of imperfect capital markets, a "false" *real* interest rate is the typical result. This suggests that if banks take the market real interest rate as their target, these capital market failures undermine the system's intertemporal stability. For this component to be neutralized, it should happen that, *vis-à-vis* inflation, banks let nominal rates rise but do not engage in real-interest targeting ($\phi = 1$).

2) *In the perfect information case* ($\phi = 0$, $\hat{r} = 0$) *the system's stability requires that the share* δ *of short-run rational forecasters be bounded.* This result is similar to the case of exogenous interest rate as discussed in section 3. As $\delta \to 1$, the steady state is no longer stable. More in detail, we have that unemployment is insensitive to interest-rate gaps ($\rho' = 0$, $\alpha' = 0$) but the latter are nonconvergent ($\phi - \alpha'\beta'\eta = 1$). The reason for this is simple and can be understood from the interest-rate gap equation (9): if all banks just anchor the nominal interest rate to the (true) natural rate ($\phi = 0$), the fact that all them also have short-run rational expectations ($\delta = 1$) implies that they always see the inflation rate at the level they expected to, so that the correction mechanism of the *nominal* interest-rate gaps stops working. Paradoxically, the system falls back in exactly the same situation as the one with exogenous interest-rate gap: if a nominal gap occurs, it becomes permanent, unemployment is unaffected, but inflation deviates from the initial normal rate permanently.

3) *In the limited information, long-run rational-expectations case* ($\phi = 1$, $\delta = 0$), Stability requires that banks' sensitivity γ to inflation gaps is bounded:

$$(11) \qquad \gamma < \frac{(1-\rho^{1/2})^2}{\alpha\beta}$$

Under this condition, the Wicksellian bank mechanism is self-stabilizing: as the nominal interest rate converges to the NAIRI, unemployment converges to the NAIRU and the return-to-normality hypothesis of the inflation rate is fulfilled. Hence the steady state can be characterized as a rational-expectations equilibrium. Notably, the nominal interest rate converges to the NAIRI even though this variable (and hence the natural rate) is not made explicit in the interest-rate equation. Yet this result should be carefully understood: it hinges on the generalized belief in the normal inflation rate π. To be precise, what the model actually says is that *any belief concerning the normal inflation rate consistently held by all agents is self-fulfilling*.

The economic meaning of the boundedness condition on γ can be understood by noting that $\gamma\alpha\beta$ measures how one point of interest-rate gap that triggers α points of unemployment gap is self-corrected through the response γ of the nominal interest rate to the β points of inflation gap generated by the unemployment gap. As is intuitive, a stabilizing adjustment mechanism requires that γ should be smaller, the larger are α and β. As γ increases, the system first takes an oscillatory path and then becomes unstable.

4.2. The dynamic LM

The monetary theory of the interest rate put forward by Keynes's *General Theory*, and transposed into the LM equation, offers a different account of the way in which the nominal interest rate can be endogenized within the saving-investment imbalances framework: an account where money supply and its real value play the key role.

It is clear that the standard specification of the LM equation, which is static in nature, cannot be used to address the problem of saving-investment imbalances, which is intrinsically dynamic (Leijonhufvud (1983)). I have thus devised a "dynamic LM" equation for the nominal interest rate in the following way. Let us start from the textbook LM function which represents the nominal interest rate as a function increasing in current real income and decreasing in real money supply[9]. If μ_y and μ_i are the income and interest-rate elasticities of money demand, then $1/\mu_i \equiv \lambda$ and $\mu_y\lambda$ are the

---

[9] The typical LM function is obtained by starting from a log-linear money demand function,

$$m^d{}_t = \mu_y y_t - \mu_i i_t$$

Equating money demand to real money supply, $m_t - p_t$, the equilibrium interest rate is

$$i_t = (\mu_y/\mu_i)y_t - (1/\mu_i)(m_t - p_t).$$

elasticities of the interest rate relative to real money supply and real income, respectively. This theory implies that the interest rate will be constant over time as long as real income and real money supply are constant. Assuming a log-linear relationship between output (income) and unemployment via production function, and starting from a given interest rate in t, a simple dynamic equation consistent with this theory is the following:

(12) $$i_{t+1} = i_t - \varphi(u_{t+1} - u_t) - \lambda(\hat{m}_{t+1} - \pi_{t+1})$$

where $\hat{m}_{t+1}$ is the growth rate of money supply.

We can now easily re-express this equation in terms of gaps with respect to the NAIRI, the NAIRU and the normal inflation rate, i.e.:

(13) $$\hat{i}_{t+1} = \hat{i}_t - \varphi(\hat{u}_{t+1} - \hat{u}_t) - \lambda((\hat{m}_{t+1} - \pi) - \hat{\pi}_{t+1})$$

Adding equation (13) to the baseline model we obtain the CP-PC-LM system, with three endogenous gaps [$\hat{u}_{t+1}$, $\hat{\pi}_{t+1}$, $\hat{i}_{t+1}$] and one exogenous variable

(14) $$\begin{bmatrix} \hat{u}_{t+1} \\ \hat{\pi}_{t+1} \\ \hat{i}_{t+1} \end{bmatrix} = \begin{bmatrix} \rho' & \alpha' \\ \rho'\beta' & \alpha'\beta' \\ -\lambda\rho'\beta' + \varphi(1-\rho') & 1-\alpha'(\lambda\beta'+\varphi) \end{bmatrix} \begin{bmatrix} \hat{u}_t \\ \hat{i}_t \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ \lambda \end{bmatrix} (\hat{m}_{t+1} - \pi)$$

Hence, the conditions for the system to achieve the zero-gap steady state can now be summarized as follows.

1) *The system admits of a zero-gap steady state only if* ($\hat{m}_{t+1} - \pi$) = 0. Therefore, the message is that a plain dynamic LM function can provide a self-correcting mechanism of interest-rate gaps conditional upon money supply growing at the normal inflation rate. To put it differently, the implied self-correcting mechanism is such that the system can converge to the NAIRU as well as to the inflation rate dictated by the growth rate of money supply.

2) *The share* δ *of short-run rational forecasters should be bounded.* This replicates the results obtained in the other versions of the model

3) *If all agents hold the long-run expectation of the normal inflation rate* ($\delta = 0$)*, the interest-rate elasticities to unemployment and real money supply should satisfy the boundary condition*

(15) $$\lambda\varphi \le \rho/\alpha$$

The only relevant point is that the system's behaviour now crucially hinges on the relationship between the parameters of the LM function. In particular, stability implies an inverse relationship between the two. On the other hand, the smaller is λ, the smoother is the interest rate dynamics and the longer is the whole adjustment process.

4.3. The speculative LM.

The last alternative determination of the nominal interest rate to be examined ensues from one of the many criticisms raised against the textbook LM version of Keynes's theory of the interest rate. The thrust of this criticism is that one major element in that theory, the "speculative motive" of the demand for money, has gone completely astray (Leijonhufvud (1981)). A truly "speculative" component of money demand should be related to *expected movements* of the interest rate relative to its future value, say i^e. Speculators substitute bonds for money whenever they expect capital gains, i.e. a rise in bond prices or else a fall in the market interest rate. Therefore, this component should enter the usual representation of money demand as a negative function of $(i_t - i^e)$ (Leijonhufvud (1981, p.146)). The dynamic LM should therefore be rewritten as follows

(16) $$i_{t+1} = i^e - \varphi(u_{t+1} - u_t) - \lambda(\hat{m}_{t+1} - \pi_{t+1})$$

This specification implies that as long as unemployment and real money supply are constant, speculation keeps the market interest rate aligned with its value expected by speculators i^e.

For brevity I do not report here the analytical results of the new model. Attention should be drawn to the point that equation (16) reintroduces an exogenous constant, i^e, into the model. The consequence is that now the zero-gaps steady state can only be attained if $i^e = i$. That is to say, if the speculators' expected interest rate is the NAIRI, then the market interest rate does convergence to the NAIRI, *otherwise it does not*. In the former case, the convergence and stability conditions are slightly different than in the plain LM case. But this is not the main point, which is instead that now the determination of the nominal interest rate has, again, a crucial informational requirement, that is, i^e.

The scenario under limited information, $i^e \neq i$ resembles the initial one with exogenous nominal interest rate (section 3), and, again, it seems to have genuine Keynesian features, in that if $i^e > i$, "involuntary unemployment" arises because the speculative demand for money prevents the market interest rate from falling enough. The fundamental cause is that speculators do not adjust their expected rate to the lower NAIRI. On the other hand, the market interest rate stabilizes at a value lower than i^e

expected by speculators, who should therefore keep on anticipating capital losses in the bond market which prevent them from buying bonds. It is tempting to see here a possible manifestation of the liquidity trap (clearly any further increase in the money growth rate would be useless). If this is the case, it seems necessary to conclude that the liquidity trap cannot be regarded as an extreme case in the Keynesian pathology but is indeed *the* Keynesian pathology! Are therefore Pigou and Modigliani vindicated? Not exactly. A methodological point made by Leijonhufvud in the "Wicksell Connection" (1981) applies here, namely that the pathological states of the system are not due to structural parameters but to particular combinations of events and the way in which they are processed by markets. In fact, the pathology we have found is not related to anomalous liquidity preference (the relevant parameter is always the same) but to an informational/expectational error. The implications concerning the relevance of the problem are quite different.

On the one hand, this scenario, being fraught with expectational errors, can hardly be considered a genuine steady state. This finding probably frustrates the Old Keynesians' search for "involuntary unemployment equilibria". On the other hand, it is also challenging in that it points out at least one case in which, in a well-specified sense, a purely market-driven interest rate may put the system on the wrong track. Moreover, it is difficult to see where the system can be driven from here, since the corrections of the underlying errors may prove far from smooth and painless.

4.4. A glance at monetary policy

Though monetary policy falls outside the scope of the present paper, it is worth drawing some implications from previous analyses with a view to further research on monetary policy issues.

The results yielded by the different versions of the model of saving-investment imbalances elicit a conception of monetary policy as a visible hand possibly keeping the interest rate on the right track. In the framework of saving-investment imbalances, however, Keynesian, Monetarist as well as New Keynesian monetary policies share the common shortcoming that they do not consider (or explicitly rule out) these phenomena.

From the Wicksellian point of view, we have seen that, although a spontaneous adjustment mechanism may be at work through banks' interest-rate policy, it may well fall short of delivering full stabilization due to a) misinformation about the natural rate of banks which seek to target it, b) excessive weight placed upon short-run anticipation of the inflation rate. A third, more subtle, problem is that, even when the system is self-adjusting, the ending rate of inflation is the rate that agents believe to be the normal rate. Wicksell and his followers were aware of, and worried about, each of these wedges driven into the clockwork by the banking system (see e.g. Boianovsky and Trautwein (2004, 2006)). Thus Wicksell realized that price stability (but one might say economic stability at large, as seen above) would require *two* conditions: connecting the nominal interest rate to changes in the GPL in a stabilizing way, *and* anchoring inflation expectations to a norm against which erratic GPL movements should be gauged. A crucial role for the central bank has emerged as "manager of expectations" (Woodford (2003, pp. 15-17)). Hence Woodford is right when he stresses the remarkable modernity of this Wicksellian view of central banking and its consistency with the modern theory and practice of monetary policy rules. However, the underlying model is substantially different, and so are some key indications for monetary policy.

Keynes, too, brought monetary policy to the forefront, with much more long-lasting success than Wicksell, one should say. However, having embedded saving-investment imbalances and misguided interest rates in a different framework, Keynes set the stage for the resurgence of a view of monetary policy, centered upon the quantity control of liquidity supply, that for about fifty years substantially departed from Wicksell's road. The most important lessons to be learned are two. The first is that a Keynesian LM interest-rate equation does not seem, *per se*, sufficient to explain a steady state with involuntary unemployment. If the real balance effect operates, the economy seems to be endowed with a reliable self-stabilizing mechanism. The second is that the most important role for monetary policy is more Friedmanite than Keynesian. Apart from accelerating and smoothing the adjustment process, little scope is left for money supply. Far more important is the point that the steady-state inflation, the rate in which agents have reason to believe in the long run, is the one dictated by the growth rate of money. Overall, these implications amount to the Monetarist interpretation of the Old Synthesis (see also Leijonhufvud (1981)).

The real threat to this optimistic view "only" comes from the market's misperception of the long-run value of the interest rate. This threat parallels the one we have seen in the case of Wicksellian banks. The result is similar, in that the system is driven out of equilibrium, while monetary policy becomes impotent.

This last conclusion may sound like an additional argument in support of the general endorsement of interest-rate control strategies by all main central banks in the world – in the Neo-Wicksellian spirit highlighted by Woodford. Indeed, it is almost trivial to observe that a Wicksellian interest-rate mechanism like (8) is substantially similar to a rule of inflation targeting with interest-rate smoothing, where π^e_{t+1} is replaced with the central banks' target (Svensson (1997)). Thus, one may interpret (8) as the reduced form of a set of inter-bank relationships whereby the central bank drives the interest rate on loans, with the anchor of expected inflation being explicitly set by the central bank.

As to the Wicksellian pedigree of the Taylor rule, it is indeed easy to see that it consists of the Wicksellian bank mechanism plus the sensitivity of the interest rate to output gaps. However, since the latter are correlated with inflation gaps, an interest-rate equation like (8) can also be interpreted as the reduced form of a Taylor rule. An immediate implication is that the so-called "Taylor principle" – that is, the requirement that the inflation-gap parameter be greater than 1 (Woodford (2001)) – is neither necessary nor sufficient. For particular combinations of very low persistence (ρ) and/or very high elasticity (α) of output gaps with respect to interest-rate gaps, $\gamma > 1$ might even turn out to be destabilizing. On the other hand, once the relevant stability condition has been verified, $\gamma < 1$ may well be sufficient.

Finally, specific consideration should be made of the prescription that the Taylor rule should be pegged to the natural rate of interest (Woodford (2003, ch. 4)). This prescription stands in sharp contrast with our previous findings, which warn that managing the interest rate with a natural-rate target may be dangerous. Wicksell himself was well aware that the crucial challenge for monetary (and banking) policy lies in the natural interest rate being subject to unobservable shocks and fluctuations (1898a, pp. 82 ff.). Keynes (1937a, b) was even more radical, casting doubts on the existence itself of a single, general-equilibrium real interest rate. In a recent study published by the ECB, one reads that

> from the empirical point of view, the "natural" real interest rate is unobservable. The estimation of the natural real interest rate is not straightforward and is

associated with a very high degree of uncertainty (Garnier and Wihelmsen (2005), p.6).

If the central bank has complete and immediate information about the NAIRI, it can and should immediately adjust the nominal interest rate to offset any change in the NAIRI as it arises. If the central bank does not have this information, and if it happens to peg the nominal interest rate to the wrong NAIRI, then the Taylor rule would drive the system out of equilibrium, like the Wicksellian misinformed banks or the Keynesian speculators that the central bank is supposed to keep on the right track. Hence, unless we can be highly confident that central banks are better (perfectly) informed than the market about the natural rate of interest, "adaptive" rules, using step-by-step adjustments of the interest rate *vis-à-vis* observable conditions in the economy are preferable in that they produce adjustment paths which are generally slower, but safer[10].

5. Conclusions

Let me summarize the main findings of this exploration of the old and new macroeconomics of imperfect capital markets. The idea of the founders of this approach to macroeconomics, Wicksell and Keynes above all, was that some form of malfunctioning of the capital market and the consequent saving-investment imbalances were the keys to both the determination of the current level of output and prices and of their fluctuations over time. The modern foundations of imperfect capital markets have greatly improved the microeconomic level of analysis, but saving-investment imbalances still lack appropriate development at the macro-level. The aim of this paper has been to signal the problem and exemplify a model that can deal with saving-investment imbalances.

The model proposed represents a competitive, flex-price economy populated by forward-looking, optimizing households and firms that freely choose their levels of savings and investments in a capital market where the market real interest rate may differ from the natural rate (interest-rate gap). The allocation scheme that has been chosen is that of trading at false

[10]This line of research is actively pursued, for instance, by Orphanides and co-authors (Orphanides and Williams (2002, 2006)).

price, that can be detected in Wicksell's approach as well as in some modern contributions. In this scheme, when saving differs from investment the banking sector fills the gap by hoarding or dishoarding reserves.

The first main conclusion is that as long as the interest-rate gap persists, neither unemployment nor the GPL can remain on their IGE paths. This outcome reflects persistent intertemporal disequilibrium, and it occurs even though no other frictions or rigidities are present in economy. This conclusion stands in sharp contrast with current mainstream macroeconomics, where there are no capital market imperfections, the economy is always on its IGE path, fluctuations are only exogenously driven, and all relevant problems (excess movements in quantities) may only arise due to price stickiness. Nominal wage-price stickiness is not the only problem, wage-price flexibility is not the only solution.

A second set of conclusions can be drawn from analyses of different hypotheses that make the nominal interest rate endogenous. The Wicksellian hypothesis that banks index their nominal rate with excess inflation (with respect to the "normal" rate) has the potential role to stabilize the system, that is, to achieve a zero-gap steady state along the IGE path. A major finding in this respect is that this potential role is under threat if a) banks have limited or wrong information about the natural rate, *and* b) they engage in the natural-rate targeting. Since a typical result of the modern literature on capital market failures is that the *real* interest rate is wrong, the recommendation is that banks let their nominal rates rise with prices but do not aim at the real-rate target.

Analysis of a Keynesian capital market based on the monetary determination of the interest rate by way of a "dynamic" LM function leads to similarly mixed conclusions. A dynamic LM function represents a stabilizing mechanism for the nominal interest rate provided that exogenous money supply grows at the same rate as the "normal" inflation rate, which in fact is realized in the steady state. Under these conditions, the economic system is probably more robust than the Old Keynesians (and Keynes?) believe(d), and the mere existence of the interest elasticity of money demand is not an impediment. On the other hand, if we introduce a wrong "speculative component" – that is, an expected interest rate that is too high with respect to the equilibrium one – the adjustment mechanism breaks down and the economy is trapped in a high unemployment state (in which, however, both the expected interest rate and inflation rate are not realized).

Overall, we have seen that business cycles triggered by saving-investment imbalances *are benign* as long as the system embodies an endogenous mechanism that drives the nominal interest rate to close the gaps with the NAIRI. This is the main message as far as monetary policy is concerned. The current approach based on interest-rate rules is consistent with this perspective. However, the underlying macro-model has to be different from those currently employed in order to capture the features of intertemporal disequilibrium cycles. To mention just one point, the warning against natural-rate targeting, and the plea for simple adaptive rules, extends from private banks to the central bank.

If, against this background, we look at the evidence showing that the natural interest rate is a volatile variable difficult to measure and transmit to capital markets, and that saving-investment imbalances are detectable behind all major boom-bust episodes, we can conclude that reassessment of the macroeconomics of imperfect capital markets may be timely. Further elaborations of saving-investment analysis that can be indicated include the following:

- Keynes (1937), Lindahl (1939), New Keynesians *à la* Greenwald and Stiglitz (1993), and Woodford on passing (2003, ch. 5), would add that the deviations of the market real interest rate from the natural rate do not leave the capital stock unaffected (which is a straightforward implication of the fact that saving-investment imbalances impinge upon aggregate demand, employment and output). If the capital stock changes over the cycle, then the real return to capital also changes. Thus, as Woodford recognizes, we (or the agents in the economy) out of the steady state face *three* interest rates: the market real interest, the actual real return to capital, and the natural interest rate. Yet all this blurs the notion of a given natural rate of interest independent of the cycle to which the economy should return, and we are led back to the question of the normative anchorage of the belief in a particular natural rate.
- A somewhat more radical perspective would add behavioural finance as a repertoire of causes for the mispricing of firms' investments and consequent misbeliefs in the natural interest rate.
- Neo-Hicksians (e.g. Amendola and Gaffard (1998)) stress that "technological shocks" (possibly underlying the volatility of the NAIRI) are as such non existent (e.g. they remain ideas in the mind of entrepreneurs) until they are "validated" by financial means; in this

perspective, *changes* in the NAIRI are not independent of monetary policy and the market interest rate.

References

Allen F., Gale D. (2001), *Comparing Financial Systems*, Cambridge Mass. MIT Press,

Amendola, M., Gaffard J.L. (1998), *Out of Equilibrium*, Oxford, Clarendon Press.

Barth M.J., Ramey V. (2001), “The Cost Channel of Monetary Transmission”, in Bernanke B., Rogoff K. (eds.), *NBER Macroeconomics Annual 2001*, Cambridge Mass., MIT Press.

Bernanke B., Blinder A. (1988), "Credit, Money, and Aggregate Demand", Papers and Proceedings of the American Economic Association, *American Economic Review*, 78, 435-439.

Bernanke B., Gertler M. (1989), "Agency Costs, Net Worth and Business Fluctuations", *American Economic Review*, 79, pp.14-31.

Bernanke B., Gertler M. (1990), "Financial Fragility and Economic Performance", *Quarterly Journal of Economics*, 105, pp.87-114.

Bernanke B., Gertler M. (1995), "Inside the Black Box: the Credit Channel of Monetary Policy Transmission", *Journal of Economic Perspectives*, 9, pp. 27-42.

Bernanke B., Gertler, M. (2001), "Should Central Banks Respond to Movements in Asset Prices?", Papers and Proceedings of the American Economic Association, *American Economic Review*, 91, pp. 253-257.

Bernanke B., Gertler M., Gilchrist S. (1996), "The Financial Accelerator and the Flight to Quality", *Review of Economics and Statistics*, 78, pp. 1-15.

Blanchard O. J. (2000), "What Do We Know about Macroeconomics that Fisher and Wicksell Did Not Know?", *Quarterly Journal of Economics*, 115, pp.1375-1409.

Blanchard O.J., Galì J. (2005), "Real Wage Rigidity and the New Keynesian Model", MIT Department of Economics, Working Paper Series, 05-28.

Blinder, A. (1987), "Credit Rationing and Effective Supply Failures", *Economic Journal*, 97, 327-352.

Boianovsky M., Trautwein M. (2004), "Wicksell after Woodford", paper presented at the History of Economics Society meeting, Toronto, June.

Boianovsky M., Trautwein M. (2006), "Price Expectations, Capital Accumulation and Employment: Lindahl's Macroeconomics From the 1920s to the 1950s", *Cambridge Journal of Economics*, Advance Access.

Bond S., Jenkinson T. (1996), "The Assessment: Investment Performance and Policy", *Oxford Review of Economic Policy*, 12, pp. 1-33.

Bordo M. D., Jeanne O. (2002), "Boom-Busts in Asset Prices, Economic Instability, and Monetary Policy", NBER Working Paper, n.8966.

Borio C., Lowe P. (2002), "Asset prices, Financial and Monetary Stability: Exploring the Nexus", BIS Working Papers, n. 114.

Caresma J.C., Gnan E., Ritzberger-Gruenwald D. (2005), "The Natural Rate of Interest. Concepts and Appraisal for the Euro Area", *Monetary Policy and the Economy*, Austrian National Bank, Q4.

Cecchetti S. G., Genberg H., Lipsky J. Wadwhani S. (2000), *Asset Prices and Central Bank Policy*, London, Internationa Centre for Monetary and Banking Studies.

Chiarella C., Flaschel P., Franke R. (2005), *Foundations for a Disequilibrium Theory of the Business Cycle*, Cambridge UK, Cambridge University Press.

Chowdhury I, Hoffmann M., Schabert A. (2006), "Inflation Dynamics and the Cost Channel of Monetary Transmission", *European Economic Review*, 50, pp. 995-1016.

Christiano L.J, Eichenbaum M., Evans C.L. (1997), “Sticky Price and Limited Participation Models of Money: A Comparison”, *European Economic Review*, 41, 1201-1249.

Christiano L.J., Eichenbaum M., Evans, C.L. (2005), "Nominal Rigidities and the Dynamic Effect of a Shock to Monetary Policy", *Journal of Political Economy*, 113, pp. 1–45.

Colander D. (1998), "Beyond New Keynesian Economics: Towards a Post-Walrasian Economics", in Rotheim R.J. (ed.), *New Keynesian Economics/Post Keynesian Alternatives*, London, Routledge.

De Meza D., Webb D. C. (1987), "Too Much Investment: A Problem of Asyymetric Information", *Quarterly Journal of Economics*, 102, pp. 181-192

Delli Gatti D., Tamborini R. (2000) "Imperfet capital markets: A new macroeconomic paradigm?", in Backhouse R., Salanti A. (eds.), *Macroeconomics and the real world*, Oxford University Press, Oxford, vol.II

Demirguç-Kunt A., Levine R. (eds., 2001), *Financial Structure and Economic Growth*, Cambridge Mass., MIT Press.

Evans G. W., Honkapohja S. (2001), *Learning and Expectations in Macroeconomics*, Princeton, Princeton University Press.

Fazzari S., Hubbard R.G., Petersen B. (1988), "Financing Constraints and Corporate Investment", *Brookings Papers on Economic Activity*, n.1, pp.141-206.

Fitoussi J. P. (2001), "Monetary policy and the macroeconomics of 'soft growth'" in A. Leijonhufvud (ed.), *Monetary Theory and Policy Experience*, London, Palgrave.

Garnier J., Wihelmsen B. (2005), "The Natural Real Interest and the Output Gap in the Euro Area. A Joint Estimation", European Central Bank, Working Paper Series, no.546.

Gertler M. (1988), "Financial Structure and Aggregate Activity: An Overview", *Journal of Money, Credit and Banking*, 20, 559-588.
Gertler M., Gilchrist S. (1993), "The Role of Credit Market Imperfections in the Monetary Transmission Mechanism: Arguments and Evidence", *Scandinavian Journal of Economics*, 93, 43-64
Gertler M., Hubbard R.G. (1988), "Financial Factors in Business Fluctuations", in Federal Reserve Bank of Kansas City, *Financial Market Volatility*, Kansas City.
Goodhart C.A. (1986), "Financial Innovation and Monetary Control", *Oxford Review of Economic Policy*, 2, 75-91.
Greenwald B. C., Stiglitz J. E. (1988), "Imperfect Information, Finance Constraints and Business Fluctuations", in Kohn M., Tsiang S.C. (eds.), *Finance Constraints, Expectations and Macroeconomics*, Oxford. Clarendon Press.
Greenwald B. C., Stiglitz J. E. (1990), "Macroeconomic Models with Equity and Credit Rationing", in Hubbard R. G. (ed.), *Information, Capital Markets and Investment*, Chicago, Chicago University Press.
Greenwald B. C., Stiglitz, J. E. (1991), *Towards a New Paradigm in Monetary Economics*, Cambridge: Cambridge University Press.
Greenwald B.C., Stiglitz J.E. (1993a), "Financial Market Imperfections and Business Cycles", *Quarterly Journal of Economics*, 108, 77-113.
Greenwald B. C., Stiglitz J. E. (1993b), "New and Old Keynesians", *Journal of Economic Perspectives*, 7, pp.23-44.
Hahn F. (ed., 1989), *The Economics of Missing Markets, Information and Games*, Oxford, Oxford University Press.
Hart O. (1995), *Firms, Contracts and Financial Structure*, Oxford, Clarendon Press.
Jaffee D., Stiglitz J. (1990), "Credit Rationing", in Friedman B.M., Hahn F.H. (eds.), *Handbook of Monetary Economics*, Amsterdam, North Holland.
Keynes J. M. (1930), *A Treatise on Money*, London, Macmillan.
Keynes J. M. (1936), *The General Theory of Employment, Interest and Money*, London, Macmillan.
Keynes J.M. (1937a), "Alternative Theories of the Rate of Interest", *Economic Journal*, 47.
Keynes J. M. (1937b), "The Ex-Ante Theory of the Rate of Interest", *Economic Journal*, 47
Keynes J. M. (1937c), "The General Theory of Employment", *Quarterly Journal of Economics*, 14, pp. 109-123.
Kiyotaki N., Moore J. (1997), "Credit Cycles", *Journal of Political Economy*, 105, pp. 211-248.
Leijonhufvud A. (1981), "The Wicksell Connection. Variations on a Theme", *Information and Coordination: Essays in Macroeconomic Theory*, New York, Oxford University Press.
Leijounhufvud A. (1983) "What Was the Matter With IS-LM?", in J. P. Fitoussi (ed.), *Modern Macroeconomic Theory*, Oxford, Blackwell.

Lindahl E. (1939), *Studies in the Theory of Money and Capital*, London, George Allen & Unwin.

Leland H., Pyle D. (1977), "Informational Asymmetries, Financial Structure and Financial Intermediation", *Journal of Finance*, 32, pp.371-387.

Mazzocchi R., Tamborini R, Trutwein M. (2008), "The Two Triangles: What did Wicksell and Keynes know about macroeconomics that modern economists do not (consider)?" Department of Economics, University of Trento, mimeo.

McCallum, B. T. (1986), "Some Issues Concerning Interest Rate Pegging, Price Level Indeterminacy, and the Real Bills Doctrine", *Journal of Monetary Economics*, 17, pp. 135-160.

Minsky H. P. (1972), "An Exposition of a Keynesian Theory of Investment", in *Can It Happen Again? Essays on Instability and Finance*, New York, Sharpe, 1982.

Minsky H. P. (1975), *John Maynard Keynes*, New York, Basic Books.

Modigliani F, Miller M. (1958), "The Cost of Capital, Corporation Finance and the Theory of Investment", *American Economic Review*, 48, pp.261-277.

Moggridge D. (ed., 1987), *The Collected Writings of John Maynard Keynes*, London, Macmillan, vol.XIV, Part II, 2nd ed.

Myers M., Majluf, N. (1984), "Corporate Financial Decisions When Firms Have Information that Investors Do not Have", *Journal of Financial Economics*, 13, 187-220.

Orphanides A., Williams J. C. (2002), "Robust Monetary Policy Rules With Unknown Natural Rates", *Brookings Papers on Economic Activity*, 2, pp. 63-118

Orphanides A., Williams J. C. (2006), "Inflation Targeting Under Imperfect Knowledge", CEPR, Discussion Paper Series, no. 5664.

Ravenna F., Walsh C.E. (2003), “The Cost Channel in a New Keynesian Model: Evidende and Implications”, mimeo.

Ravenna F., Walsh C.E. (2006), "Optimal Monetary Policy With the Cost Channel", *Journal of Monetary Economics*, 53, pp. 199-216.

Sims C. (1992), "Interpreting the Macroeconomic Time Series Facts: The Effects of Monetary Policy", *European Economic Review*, 36, pp. 975-1000.

Stiglitz J. E. (1982), "Information and Capital Markets", in Sharpe W.F., Cootner C. M., *Financial Economics*, Prentice Hall, New Jersey.

Stiglitz J. E. (1987), "The Causes and Consequences of the Dependence of Quality on Price", *Journal of Economic Literature*, 25.

Stiglitz J. E. (1992), "Capital Markets and Economic Fluctuations in Capitalist Economies", Paper and Proceedings of the European Economic Association, *European Economic Review*, 36, pp. 269-306.

Stiglitz J .E., Weiss A. (1981), "Credit Rationing in Markets with Imperfect Information", *American Economic Review*, 71, pp.393-410.

Stiglitz J.E., Weiss A. (1992), "Asymmetric Information in Credit Markets and Its Implications for Macroeconomics", *Oxford Economic Papers*, 44, pp.694-724.

Svensson L. (1997), "Inflation Forecast Targeting. Implementing and Monitoring Inflation Targets", *European Economic Review*, 41, pp. 1111-1147.

Tamborini R. (2001), *Mercati finanziari e attività economica*, Padova: CEDAM.

Tamborini R., (2007) "Back to Wicksell? Some Lessons for Practical Monetary Policy", Money, Macro and Finance Conference, University of Birmingham, September 12-14.

Taylor J. B. (2000), “Teaching Modern Macroeconomics at the Principles Levels”, Papers and Proceedings of the American Economic Associations, *American Economic Review*, 90, pp.90-94.

Trautwein H.M. (2000), "The Credit View, Old and New", *Journal of Economic Surveys*, 14, pp.155-136.

Van der Ploeg F. (2005), "Back to Keynes?", CEPR, Discussion Paper Series, no.4897.

Wicksell K. (1898a), *Interest and Prices*, London, Macmillan, 1936.

Wicksell K. (1898b), "The Influence of the Rate of Interest on Commodity Prices", in Lindahl E. (ed.), *Wicksell: Selected Papers in Economic Theory*, London, Allen & Unwin, 1958.

Wicksell K. (1922), *Vorlesungen ueber Nationaloekonomie, Band 2*, Jena, Gustav Fischer

Woodford M. (2001), "The Taylor Rule and Optimal Monetary Policy", Princeton University, mimeo.

Woodford M. (2003). *Interest and Prices. Foundations of a Theory of Monetary Policy*, Princeton, Princeton University Press.

Elenco dei papers del Dipartimento di Economia

2000.1 *A two-sector model of the effects of wage compression on unemployment and industry distribution of employment*, by Luigi Bonatti

2000.2 *From Kuwait to Kosovo: What have we learned? Reflections on globalization and peace,* by Roberto Tamborini

2000.3 *Metodo e valutazione in economia. Dall'apriorismo a Friedman ,* by Matteo Motterlini

2000.4 *Under tertiarisation and unemployment.* by Maurizio Pugno

2001.1 *Growth and Monetary Rules in a Model with Competitive Labor Markets,* by Luigi Bonatti.

2001.2 *Profit Versus Non-Profit Firms in the Service Sector: an Analysis of the Employment and Welfare Implications,* by Luigi Bonatti, Carlo Borzaga and Luigi Mittone.

2001.3 *Statistical Economic Approach to Mixed Stock-Flows Dynamic Models in Macroeconomics,* by Bernardo Maggi and Giuseppe Espa.

2001.4 *The monetary transmission mechanism in Italy: The credit channel and a missing ring,* by Riccardo Fiorentini and Roberto Tamborini.

2001.5 *Vat evasion: an experimental approach,* by Luigi Mittone

2001.6 *Decomposability and Modularity of Economic Interactions,* by Luigi Marengo, Corrado Pasquali and Marco Valente.

2001.7 *Unbalanced Growth and Women's Homework,* by Maurizio Pugno

2002.1 *The Underground Economy and the Underdevelopment Trap,* by Maria Rosaria Carillo and Maurizio Pugno.

2002.2 *Interregional Income Redistribution and Convergence in a Model with Perfect Capital Mobility and Unionized Labor Markets,* by Luigi Bonatti.

2002.3 *Firms' bankruptcy and turnover in a macroeconomy,* by Marco Bee, Giuseppe Espa and Roberto Tamborini.

2002.4 *One "monetary giant" with many "fiscal dwarfs": the efficiency of macroeconomic stabilization policies in the European Monetary Union,* by Roberto Tamborini.

2002.5 *The Boom that never was? Latin American Loans in London 1822-1825,* by Giorgio Fodor.

2002.6 *L'economia senza banditore di Axel Leijonhufvud: le 'forze oscure del tempo e dell'ignoranza' e la complessità del coordinamento,* by Elisabetta De Antoni.

2002.7 *Why is Trade between the European Union and the Transition Economies Vertical?,* by Hubert Gabrisch and Maria Luigia Segnana.

2003.1 *The service paradox and endogenous economic gorwth,* by Maurizio Pugno.

2003.2 *Mappe di probabilità di sito archeologico: un passo avanti,* di Giuseppe Espa, Roberto Benedetti, Anna De Meo e Salvatore Espa.
(*Probability maps of archaeological site location: one step beyond,* by Giuseppe Espa, Roberto Benedetti, Anna De Meo and Salvatore Espa).

2003.3 *The Long Swings in Economic Understianding,* by Axel Leijonhufvud.

2003.4 *Dinamica strutturale e occupazione nei servizi,* di Giulia Felice.

2003.5 *The Desirable Organizational Structure for Evolutionary Firms in Static Landscapes,* by Nicolás Garrido.

2003.6 *The Financial Markets and Wealth Effects on Consumption* An Experimental Analysis, by Matteo Ploner.

2003.7 *Essays on Computable Economics, Methodology and the Philosophy of Science,* by Kumaraswamy Velupillai.

2003.8 *Economics and the Complexity Vision: Chimerical Partners or Elysian Adventurers?*, by Kumaraswamy Velupillai.

2003.9 *Contratto d'area cooperativo contro il rischio sistemico di produzione in agricoltura,* di Luciano Pilati e Vasco Boatto.

2003.10 *Il contratto della docenza universitaria. Un problema multi-tasking*, di Roberto Tamborini.

2004.1 *Razionalità e motivazioni affettive: nuove idee dalla neurobiologia e psichiatria per la teoria economica?* di Maurizio Pugno.
(*Rationality and affective motivations: new ideas from neurobiology and psychiatry for economic theory?* by Maurizio Pugno.

2004.2 *The economic consequences of Mr. G. W. Bush's foreign policy. Can th US afford it?* by Roberto Tamborini

2004.3 *Fighting Poverty as a Worldwide Goal* by Rubens Ricupero

2004.4 *Commodity Prices and Debt Sustainability* by Christopher L. Gilbert and Alexandra Tabova

2004.5 *A Primer on the Tools and Concepts of Computable Economics* by K. Vela Velupillai

2004.6 *The Unreasonable Ineffectiveness of Mathematics in Economics* by Vela K. Velupillai

2004.7 *Hicksian Visions and Vignettes on (Non-Linear) Trade Cycle Theories* by Vela K. Velupillai

2004.8 *Trade, inequality and pro-poor growth: Two perspectives, one message?* By Gabriella Berloffa and Maria Luigia Segnana

2004.9 *Worker involvement in entrepreneurial nonprofit organizations. Toward a new assessment of workers? Perceived satisfaction and fairness* by Carlo Borzaga and Ermanno Tortia.

2004.10 *A Social Contract Account for CSR as Extended Model of Corporate Governance (Part I): Rational Bargaining and Justification* by Lorenzo Sacconi

2004.11 *A Social Contract Account for CSR as Extended Model of Corporate Governance (Part II): Compliance, Reputation and Reciprocity* by Lorenzo Sacconi

2004.12 *A Fuzzy Logic and Default Reasoning Model of Social Norm and Equilibrium Selection in Games under Unforeseen Contingencies* by Lorenzo Sacconi and Stefano Moretti

2004.13 *The Constitution of the Not-For-Profit Organisation: Reciprocal Conformity to Morality* by Gianluca Grimalda and Lorenzo Sacconi

2005.1 *The happiness paradox: a formal explanation from psycho-economics* by Maurizio Pugno

2005.2 *Euro Bonds: in Search of Financial Spillovers* by Stefano Schiavo

2005.3 *On Maximum Likelihood Estimation of Operational Loss Distributions* by Marco Bee

2005.4 *An enclave-led model growth: the structural problem of informality persistence in Latin America* by Mario Cimoli, Annalisa Primi and Maurizio Pugno

2005.5 *A tree-based approach to forming strata in multipurpose business surveys,* Roberto Benedetti, Giuseppe Espa and Giovanni Lafratta.

2005.6 *Price Discovery in the Aluminium Market* by Isabel Figuerola-Ferretti and Christopher L. Gilbert.

2005.7 *How is Futures Trading Affected by the Move to a Computerized Trading System? Lessons from the LIFFE FTSE 100 Contract* by Christopher L. Gilbert and Herbert A. Rijken.

2005.8 *Can We Link Concessional Debt Service to Commodity Prices?* By Christopher L. Gilbert and Alexandra Tabova

2005.9 *On the feasibility and desirability of GDP-indexed concessional lending* by Alexandra Tabova.

2005.10 *Un modello finanziario di breve periodo per il settore statale italiano: l'analisi relativa al contesto pre-unione monetaria* by Bernardo Maggi e Giuseppe Espa.

2005.11 *Why does money matter? A structural analysis of monetary policy, credit and aggregate supply effects in Italy*, Giuliana Passamani and Roberto Tamborini.

2005.12 *Conformity and Reciprocity in the "Exclusion Game": an Experimental Investigation* by Lorenzo Sacconi and Marco Faillo.

2005.13 *The Foundations of Computable General Equilibrium Theory*, by K. Vela Velupillai.

2005.14 *The Impossibility of an Effective Theory of Policy in a Complex Economy*, by K. Vela Velupillai.

2005.15 *Morishima's Nonlinear Model of the Cycle: Simplifications and Generalizations,* by K. Vela Velupillai.

2005.16 Using and Producing *Ideas* in Computable Endogenous Growth, by K. Vela Velupillai.

2005.17 *From Planning to Mature: on the Determinants of Open Source Take Off* by Stefano Comino, Fabio M. Manenti and Maria Laura Parisi.

2005.18 *Capabilities, the self, and well-being: a research in psycho-economics,* by Maurizio Pugno.

2005.19 Fiscal and monetary policy, unfortunate events, and the SGP arithmetics. Evidence from a *growth-gap* model, by Edoardo Gaffeo, Giuliana Passamani and Roberto Tamborini

2005.20 *Semiparametric Evidence on the Long-Run Effects of Inflation on Growth,* by Andrea Vaona and Stefano Schiavo.

2006.1 *On the role of public policies supporting Free/Open Source Software. An European perspective,* by Stefano Comino, Fabio M. Manenti and Alessandro Rossi.

2006.2 *Back to Wicksell? In search of the foundations of practical monetary policy,* by Roberto Tamborini

2006.3 *The uses of the past,* by Axel Leijonhufvud

2006.4 *Worker Satisfaction and Perceived Fairness: Result of a Survey in Public, and Non-profit Organizations,* by Ermanno Tortia

2006.5 *Value Chain Analysis and Market Power in Commodity Processing with Application to the Cocoa and Coffee Sectors,* by Christopher L. Gilbert

2006.6 *Macroeconomic Fluctuations and the Firms' Rate of Growth Distribution: Evidence from UK and US Quoted Companies,* by Emiliano Santoro

2006.7 *Heterogeneity and Learning in Inflation Expectation Formation: An Empirical Assessment,* by Damjan Pfajfar and Emiliano Santoro

2006.8 Good *Law & Economics* needs suitable microeconomic models: the case against the application of standard agency models: the case against the application of standard agency models to the professions, by Lorenzo Sacconi

2006.9 *Monetary policy through the "credit-cost channel". Italy and Germany,* by Giuliana Passamani and Roberto Tamborini

2007.1 *The Asymptotic Loss Distribution in a Fat-Tailed Factor Model of Portfolio Credit Risk,* by Marco Bee

2007.2 *Sraffa?s Mathematical Economics – A Constructive Interpretation,* by Kumaraswamy Velupillai

2007.3 *Variations on the Theme of Conning in Mathematical Economics,* by Kumaraswamy Velupillai

2007.4 *Norm Compliance: the Contribution of Behavioral Economics Models,* by Marco Faillo and Lorenzo Sacconi

2007.5 *A class of spatial econometric methods in the empirical analysis of clusters of firms in the space,* by Giuseppe Arbia, Giuseppe Espa e Danny Quah.

2007.6 *Rescuing the LM (and the money market) in a modern Macro course,* by Roberto Tamborini.

2007.7 *Family, Partnerships, and Network: Reflections on the Strategies of the Salvadori Firm of Trento,* by Cinzia Lorandini.

2007.8 *I Verleger serici trentino-tirolesi nei rapporti tra Nord e Sud: un approccio prosopografico,* by Cinzia Lorandini.

2007.9 *A Framework for Cut-off Sampling in Business Survey Design,* by Marco Bee, Roberto Benedetti e Giuseppe Espa

2007.10 *Spatial Models for Flood Risk Assessment,* by Marco Bee, Roberto Benedetti e Giuseppe Espa

2007.11 *Inequality across cohorts of households:evidence from Italy,* by Gabriella Berloffa and Paola Villa

2007.12 *Cultural Relativism and Ideological Policy Makers in a Dynamic Model with Endogenous Preferences,* by Luigi Bonatti

2007.13 *Optimal Public Policy and Endogenous Preferences: an Application to an Economy with For-Profit and Non-Profit,* by Luigi Bonatti

2007.14 *Breaking the Stability Pact: Was it Predictable?,* by Luigi Bonatti and Annalisa Cristini.

2007.15 *Home Production, Labor Taxation and Trade Account,* by Luigi Bonatti.

2007.16 *The Interaction Between the Central Bank and a Monopoly Union Revisited: Does Greater Uncertainty about Monetary Policy Reduce Average Inflation?,* by Luigi Bonatti.

2007.17 *Complementary Research Strategies, First-Mover Advantage and the Inefficiency of Patents,* by Luigi Bonatti.

2007.18 *DualLicensing in Open Source Markets,* by Stefano Comino and Fabio M. Manenti.

2007.19 *Evolution of Preferences and Cross-Country Differences in Time Devoted to Market Work,* by Luigi Bonatti.

2007.20 *Aggregation of Regional Economic Time Series with Different Spatial Correlation Structures,* by Giuseppe Arbia, Marco Bee and Giuseppe Espa.

2007.21 *The Sustainable Enterprise. The multi-fiduciary perspective to the EU Sustainability Strategy,* by Giuseppe Danese.

2007.22 *Taming the Incomputable, Reconstructing the Nonconstructive and Deciding the Undecidable in Mathematical Economics,* by K. Vela Velupillai.

2007.23 *A Computable Economist's Perspective on Computational Complexity,* by K. Vela Velupillai.

2007.24 *Models for Non-Exclusive Multinomial Choice, with Application to Indonesian Rural Households,* by Christopher L. Gilbert and Francesca Modena.

2007.25 *Have we been Mugged? Market Power in the World Coffee Industry,* by Christopher L. Gilbert.

2007.26 *A Stochastic Complexity Perspective of Induction in Economics and Inference in Dynamics,* by K. Vela Velupillai.

2007.27 *Local Credit ad Territorial Development: General Aspects and the Italian Experience,* by Silvio Goglio.

2007.28 *Importance Sampling for Sums of Lognormal Distributions, with Applications to Operational Risk,* by Marco Bee.

2007.29 *Re-reading Jevons's Principles of Science. Induction Redux,* by K. Vela Velupillai.

2007.30 *Taking stock: global imbalances. Where do we stand and where are we aiming to?* by Andrea Fracasso.

2007.31 *Rediscovering Fiscal Policy Through Minskyan Eyes,* by Philip Arestis and Elisabetta De Antoni.

2008.1 *A Monte Carlo EM Algorithm for the Estimation of a Logistic Auto-logistic Model with Missing Data,* by Marco Bee and Giuseppe Espa.

2008.2 *Adaptive microfoundations for emergent macroeconomics*, Edoardo Gaffeo, Domenico Delli Gatti, Saul Desiderio, Mauro Gallegati.

2008.3 *A look at the relationship between industrial dynamics and aggregate fluctuations*, Domenico Delli Gatti, Edoardo Gaffeo, Mauro Gallegati.

2008.4 *Demand Distribution Dynamics in Creative Industries: the Market for Books in Italy*, Edoardo Gaffeo, Antonello E. Scorcu, Laura Vici.

2008.5 *On the mean/variance relationship of the firm size distribution: evidence and some theory*, Edoardo Gaffeo, Corrado di Guilmi, Mauro Gallegati, Alberto Russo.

2008.6 *Uncomputability and Undecidability in Economic Theory*, K. Vela Velupillai.

2008.7 *The Mathematization of Macroeconomics*: *A Recursive Revolution*, K. Vela Velupillai.

2008.8 *Natural disturbances and natural hazards in mountain forests: a framework for the economic valuation*, Sandra Notaro, Alessandro Paletto

2008.9 *Does forest damage have an economic impact? A case study from the Italian Alps,* Sandra Notaro, Alessandro Paletto, Roberta Raffaelli.

2008.10 *Compliance by believing: an experimental exploration on social norms and impartial agreements,* Marco Faillo, Stefania Ottone, Lorenzo Sacconi.

2008.11 *You Won the Battle. What about the War? A Model of Competition between Proprietary and Open Source Software*, Riccardo Leoncini, Francesco Rentocchini, Giuseppe Vittucci Marzetti.

2008.12 *Minsky's Upward Instability: the Not-Too-Keynesian Optimism of a Financial Cassandra,* Elisabetta De Antoni.

2008.13 *A theoretical analysis of the relationship between social capital and corporate social responsibility: concepts and definitions,* Lorenzo Sacconi, Giacomo Degli Antoni.

2008.14 *Conformity, Reciprocity and the Sense of Justice. How Social Contract-based Preferences and Beliefs Explain Norm Compliance: the Experimental Evidence,* Lorenzo Sacconi, Marco Faillo.

2008.15 *The macroeconomics of imperfect capital markets. Whither saving-investment imbalances?* Roberto Tamborini

PUBBLICAZIONE REGISTRATA PRESSO IL TRIBUNALE DI TRENTO