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THE MONETARY TRANSMISSION MECHANISM IN ITALY: THE CREDIT CHANNEL AND A MISSING RING

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Research on how money affects economic activity has revived interest in the so-called ''credit view''. In this paper we focus on current developments in the credit view in order to assess the results of the past decade's research and its legacy for macroeconomics and monetary policy. We expound the main models of the ''credit channels'' of monetary transmission, drawing a distinction between models of aggregate demand, which are predominant, and models of aggregate supply, which are less developed despite theory suggests a potential connection between credit conditions and firms' production activity. Each approach is accompanied by a survey of the main empirical results with particular reference to Italy, where bank-firm relations are traditionally regarded as particularly important.

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INTRODUCTION

Research on how money affects economic activity has revived interest in the so-called ''credit view''. The latter, in fact, is a rather heterogenous collection of views on the monetary transmission mechanism, which date far back in history, but share the idea that the key ring that links mone-

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tary policy to economic activity is its power to induce changes in *banks' assets* (i.e. total credit to the economy), rather than in banks' liabilities (i.e. money balances in the economy) as assumed by the traditional ''money view'' that has predominated in macroeconomics during the past half-century. In this paper we focus on current developments in the credit view in order to assess the results of the last decade's research and its legacy for macroeconomics and monetary policy [0]. As far as empirical results are concerned, our focus will be on Italy, a traditional research field for studies in the credit view.

Current elaborations on the credit view pursue essentially the same motivation: to explain the large impact that monetary shocks are observed to exert on economic activity in spite of the many weaknesses of real-balance effects. Thus, in the 1990s inclusion of credit supply in the transmission mechanism significantly contributed to the resurgence of the view that ''money matters'' in the explanation of *real* macroeconomic fluctuations. The typical observed pattern taken as benchmark is one where: *i*) Monetary interventions (mainly activated by changes in administered rates and money-market funds rates) are followed by quick and large response in money agreggates, total credit, and different measures of real economic activity, and by slow and delayed adjustment of price indeces (with the possible exception of spells of high inflation with a wage-price spiral); *ii*) ''money matters'' precisely because different mechanisms co-operate in *amplifying* the impact of monetary policy on *aggregate demand*, though their relative weight may vary according to different institutional environments and financial structures [1].

The distinctive feature of current developments in the credit view is

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[0] The comparison between the credit view and the money view is not our main concern here. The interested reader may examine the contributions in Mishkin (1995), and also Trautwein (2000). It should be stressed that the differences among the two approaches are today regarded as less important than in the past, and that most authors are ready to subscribe to the idea that different transmission mechanisms co-operate in the economy (see also below in this Section).

[1] Good overall presentations of this view can be found in e.g. Mishkin (1995), Christiano et al. (1996), Goodfriend - King (1997), AEA (1997), Blanchard (2000). Given the patent resemblance of this view with the one prevailing in the 1960s, Goodfriend - King (1997) have aptly coined the term "New Neoclassical Synthesis". Innovations that warrant the qualification "new" have been concentrated on two issues for which more rigorous theoretical (microeconomic) and empirical investigation was required: *a*) the functioning of assets and credit markets, especially as regards financing firms' spending capacity, in the monetary transmission mechanism, *b*) incomplete, delayed, or staggered price adjustments (so-called "sticky prices") *vis-à-vis* nominal shocks. Major contributions to these issues are often identified also as ''New Keynesian Economics'' (e.g. Gordon 1990).

that the magnifying effect attributed to the role of credit supply in monetary transmission is grafted onto microeconomic theories of capital market imperfections. The thrust of these theories is the violation of the Modigliani-Miller theorem of perfect substitutability among *firms' liabilities* – a phenomenon known as *financial hierarchy* or "pecking order of funds" – which is regarded as the stone that can kill two birds in the transmission mechanism problem: *i*) the well-established fact that investment expenditure displays much less sensitivity to long-term interest rates than is implied by the money view, and *ii*) the fact that firms' spending capacity is instead much more sensitive to, first, market value fluctuations in their internal funds, and, second, credit supply conditions.

However, several shortcomings still remain to be discussed and resolved. Those addressed here are the following.

First, existing empirical works based on macroeconomic models consistent with the credit view have hitherto failed to deliver robust results, owing to the so-called "causation puzzle": namely, inability to identifiy whether the observed positive correlation between bank loans and output is really due to *credit supply shifts* or whether it is instead due to *credit demand shifts* consistent with the traditional monetary transmission mechanism (see e.g. Kashyap - Stein 1994, and the comment by Eichenbaum 1994), or even to a passive role of endogenous monetary aggregates over the real business cycle (King - Plosser 1984).

Second, on theoretical grounds, the credit view has been historically associated with attempts to show that monetary policy can have *permanent* effects on output and employment (Trautwein 2000). Yet current works, being concentrated on how firms' dependence on credit amplifies monetary shocks to *aggregate demand*, namely investment expenditure, shed little light on the issue of non-neutrality *in long-run equilibrium*, and in particular on whether or not the latter depends exclusively on missing adjustments of wages and prices. The majority of contributors to the modern credit view tend to downgrade this issue with respect to ten or twenty years ago, mainly for the pragmatic reasons supported by empirical works showing that *i*) prices are in fact sticky, and that *ii*) the real effects of monetary shocks are absorbed over time as prices catch up with excess demand. However, it should be noted that this kind of evidence is almost invariably derived from "impulse response analyses" (i.e. simulations) based on estimated "a-theoretical models" using the vector autoregression (VAR) technique (e.g. Bernanke - Gertler 1995; Christiano et al. 1996). Consequently, the alternative hypothesis that monetary shocks may have permanent real effects cannot properly be tested against the other.

More importantly, the alternative hypothesis cannot be lightheartedly

set aside within a consistent framework of the credit view. Treating firms' investment decision as a component of aggregate demand as if it were independent of their production decision, i.e. aggregate supply, is inconsistent from an intertemporal point of view. Investment today is production tomorrow. If capital market imperfections in some way transmit monetary policy impulses to 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. Therefore, monetary policy may exert long-lasting real effects because of its influence on aggregate demand *and aggregate supply*. If aggregate demand and supply shift together in the same direction, the result observed is just the familiar pattern of large adjustments in quantities and small ones in prices, quite independently of reasons of ''price stickiness'' (Stiglitz 1992; Greenwald - Stiglitz 1993b; Hahn - Solow 1995)[2]. We believe that the remarkably limited research on the supply-side effects of monetary policy through capital market imperfections leaves a missing ring in the transmission mechanism, and we shall devote part of the paper to an assessment of progress in this direction.

In Section 1 we introduce the main features of current developments in the credit view after a brief review of its modern foundations in imperfect capital markets. We shall then expound the main models of the ''credit channels'' of monetary transmission, following the distinction suggested above between models of aggregate demand (Section 2) and models of aggregate supply (Section 3). Each approach is accompanied by a survey of the main empirical results with particular reference to Italy. The last Section sets out our conclusions.

1. FOUNDATIONS

The credit view has roots that go far back in history – as far as the ''bullion vs. currency'' controversy of the nineteenth century, one might say[3]. It is perhaps worth remembering that early fundamental contribu-

[2] These studies, too, in particular those by Stiglitz and co-authors, are generally also classified as New Keynesian Economics. However, their authors are keen to stress the difference with respect to the other strand of New Keynesian studies in which some kind of price stickiness is necessary to obtain real effects of monetary shocks (see fn. 2). Hence, from this point of view, the credit view camp can be split between the contributors to the New Neoclassical Synthesis, and the followers of the New Keyensian Economics of imperfect capital markets (see Greenwald - Stiglitz 1993b; Delli Gatti - Tamborini 2000).

[3] See Trautwein (2000) for a thorough survey of predecessors.

tions date back to Wicksell (1898), Hawtrey (1927), Keynes (1930), Schumpeter (1934), to name but a few. The *General Theory* (Keynes 1936), however, despite Keynes' (1937) later recognition of the importance of firms' ''finance motive'' in the demand for money, paved the way for the ascent of the money view in monetary theory and macroeconomics, namely in the fashion of the IS-LM model. The credit view was never fully dismissed, however. In the American tradition it was also known as ''availability doctrine'' (Roosa 1951; Okun et al. 1969), and in the '60s it was revived in Britain by the Radcliffe Report (1959) and later by Kaldor's works on ''endogenous money'' (1982).

Today's revival of the credit view – which will be the main subject of this paper – following the current endeavour to theoretically re-found macroeconomics has a distinct focus on capital market imperfections, especially as a consequence of asymmetric information. Among the wide array of violations of the Modigliani-Miller theorem arising from asymmetric information [4], scholars in the credit view concentrate on *imperfect substitution among firms' liabilities and among banks' assets*. In this section we introduce the building blocks of the modern credit view, and describe its two main specifications: the ''net-worth (or balance-sheet) channel'' and the ''bank lending channel''.

1.1 *Firms' financial structure and bank intermediation*

The sources of funds for firms are not perfect substitutes because they carry differential costs. The cost of internal funds is taken as the benchmark, since it is given by the opportunity cost of employing funds in a given investment plan or at an appropriate market rate. The cost of external funds, however, embodies an increasing ''external premium'' charged by the capital markets on top of the market rate as a consequence of moral-hazard or adverse-selection risks entrenched in the agency relation with the firm's management [5]. Therefore, individual firms are typically depicted as facing a kinked cost schedule of funds, horizontal at the market interest rate up to the amount of internal funds, and then upward sloping. In addition, some firms may find no access to external funds, i.e. they may be equity and/or or credit rationed.

The important consequence of firms' financial structure at the macro-

[4] Discussions of the macroeconomic outlook of this literature can be found in Gertler (1988), Gertler - Hubbard (1988), Hubbard (1998), Delli Gatti - Tamborini (2000).

[5] Note that agency risks are firm-specific and different in nature from traditional market risk. Hence the benchmark market interest rate is to be understood as the rate relevant to the market-risk class of the firm.

economic level is that total investment comes to depend on three factors: *i*) the benchmark market rate, *ii*) the external premia on the various types of funds, *iii*) the extent of financially constrained firms.

It is clear that banks as fund suppliers play a crucial role in the financial structure depicted above. From this viewpoint, banks find economic justification for their existence to the extent that they are able to supply funds with a lower external premium than can private agents in the open market, thereby lowering the average cost of capital and increasing investment opportunities (this is true for all firms, and for equity rationed firms in particular)[6]. The path-breaking works by Townsend (1979), Diamond (1984), Gale - Hellwig (1985) have demonstrated that the combination created by the bank of sight deposits to collect funds *vis-à-vis* "standard debt contracts" to allocate them is indeed the optimal solution to the firm-intermediary agency problem on the one hand, and the intermediary-lender agency problem on the other[7].

The efficiency of bank intermediation arises to the extent that the bank may have a comparative advantage in informational activities. But banks, too, may be unable (or unwilling) to bear the costs of removing asymmetric information. The consequence is one of the best-known phenomena of capital market failure: credit rationing[8]. However, credit rationing is a controversial result that seems quite sensitive to the initial assumptions concerning information and the means, other than the interest rate, that the bank can use to screen the quality of firms. Also, credit rationing has received less empirical support than equity rationing[9].

On the whole, as Mayer (1988, 1990, 1994) and Hellwig (1991) have forcefully stressed, credit rationing is likely to arise in cases of spot and anynomous loan operations, whereas bank credit is a substitute for open-market funds to such a large extent because banks provide a whole set of instruments and activities in a repeated, long-term customer relationship

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6 Again we can only refer the reader to some valuable overviews of the so-called "new theory of banking", such as Battacharya - Thakor (1993), Marotta - Pittaluga (1993), Mayer (1994).

7 The contract is optimal in the sense that it maximizes the borrower's expected profit from being truthful under the constraint of minimizing the informational costs of the lender.

8 For reviews of the debate see also Jaffee - Stiglitz (1990), Ardeni - Messori (1996).

9 Italy, for instance, is a country were equity finance is much less developed than in other industrial economies and credit is a pervasive form of business finance; nonetheless, the evidence in favour of credit rationing is rather weak, perhaps with the exception of less developed, more risky Southern regions (e.g. Pittaluga 1988; Angeloni et al. 1997). King (1986) has found only mixed support for credit rationing in the U.S. data, while Berger - Udell (1992) openly criticize the Stiglitz-Weiss approach in the light of direct analysis of banking practices.

that deal with asymmetric information more efficiently than the market [10]. The essential point in the credit-view perspective is that, for a significant number of firms, bank loans are not easily substitutable, or not substitutable at all, with other financial funds. On the other hand, it also worth stressing that bank relationships in this view are not necessarily the vehicle for magnification of monetary policy shocks to firms' spending capacity. Quite the contrary: to the extent that bank relationships are more efficient than market relationships, both fims' spending capacity and banks' lending capacity would be increasingly sheltered against external monetary disturbances. Hence, in view of the discussion to follow, it should be borne in mind that the issue of the importance of credit relationships in the economy is in principle not synonymous with the issue of the amplification of monetary shocks through credit channels [11]. Credit relationships do amplify monetary shocks only if *banks, too, are unable to manage their assets* in such a way as to protect their lending capacity against monetary shocks.

1.2 *Credit channels*

The new foundations of firms' financial policies have given rise to two variations on the theme of the role of credit supply in the transmission mechanism.

1) *Net-worth channel* (NWC). Monetary policy is identified with open market operations able to alter asset prices, while the main source of investment finance is seen in firms' internal funds [12]. Hence, given the amount of profitable investment opportunities, the actual level of investment in the economy responds weakly to long-term interest rates but strongly to the value of the internal resources available to firms, which in turn mainly depend on: *i*) previous cash flow and retained profits, *ii*) the market value of firms' assets. This channel of investment determination implies that monetary policy affects investment mostly through wealth effects on firms' internal means of investment. A contractionary policy

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10 The issue of long-term "relationship banking" is discussed in a recent survey by Boot (2000).

11 It also worth recalling that, historically, some proponents of the credit view were motivated by fact that monetary aggregates and nominal spending capacity in the economy so often seem *out of control* of the monetary authorities. As is well known, this was the idea behind Wicksell's (1898) credit theory of business cycles; the same idea motivated Kaldor's (1982) revival of the credit view against the monetarist theory. On this interpretation of the credit view see e.g. Moore (1988).

12 Reference models are Greenwald et al. (1984), Gertler - Hubbard (1988), Bernanke - Gertler (1989, 1990), Kyiotaki-Moore (1997).

which drives firms' asset prices downwards, reduces the amount of investment that can be financed at low cost by internal funds. *Cet. par.*, *i*) unconstrained firms should expose themselves towards external high-cost funds to a larger extent, *ii*) constrained firms should cut investment plans one to one. Yet, in the case of unconstrained firms, access to bank credit also deteriorates during a monetary contraction because firms' collateral market value diminishes, and banks raise interest rates. As a result, the NWC amplifies the impact of the monetary contraction even though firms' investment decisions depend little on open-market long-term rates.

2) *Bank-lending channel* (BLC). The BLC focuses on financial structures where some important classes of firms are equity rationed (or simply are not publicly quoted) and can at most substitute between internal funds and bank loans. Usually, these firms are also relatively small, so that internal funds would set a severe constraint on aggregate investments. Therefore, firms' spending capacity beyond internal funds is essentially related to the price and amount of credit available, and, indirectly, to the policy determinants of credit supply [13]. BLC models are generally more specific than NWC ones in that they concentrate on credit supply shifts as the key element in the transmission mechanism. Monetary policy is typically introduced in the form of changes in administered rates and money-market rates, or of changes in banks' reserves. These interventions modify the cost of funds for banks, which are induced to change their interest rates. For banks which adopt credit rationing schemes, changes in these schemes may also occur. For these reasons, studies of the BLC have also developed more detailed analyses of firms' funds management in the presence of credit shifts, and banks' portofolio management in the presence of monetary policy impulses.

Before proceeding it is worth bearing in mind that these different specifications of the credit channels of monetary policy have been developed within the general attitude towards eclectism and pragmatism described in Introduction. As a result, differences may be of theoretical interest but are not considered to be dramatically important by the authors concerned (e.g. Bernanke - Gertler 1995). Some models have room for both channels (e.g. Greenwald - Stiglitz 1993a). In practice, one may note that models of the NWC have more typically, though not necessarily, been employed to examine problems of real growth and/or business cycle as a counterpart to the real business cycle theory (e.g. Bernanke - Gertler

[13] The most representative theoretical works are Blinder - Stiglitz (1983), Blinder (1987); Bernanke - Blinder (1988), Greenwald - Stiglitz (1988, 1990, Sec. 1.3, 1993a), Stiglitz - Weiss (1992).

1989, 1990; Kyiotaki - Moore 1997), which is not our main concern here [14]. Instead, a large part of the macroeconomic empirical literature concerned with monetary policy issues has privileged BLC models, probably because of their more detailed treatment of financial relationships at the various stages of the transmission mechanism as explained above (e.g. Bernanke - Blinder 1992; Bernanke 1993; Kashyap et al. 1993; Kashyap - Stein 1994). This latter feature has probably been an important motivation behind the large-scale use of the BLC approach as regards Italy: where, as a matter of fact, the contribution of internal marketable assets to corporate finance is much less important than elsewhere, while firms' bank-dependence is much more pervasive.

However, in our view, although eclectism or agnosticism may be valuable attitudes in scientific research, they should not be pushed too far. In the subsequent parts of the paper, we shall organize our treatment according to the critical line of interpretation explained in Introduction. That is to say, we shall distinguish the credit-view production between models of investment and aggregate demand (Section 2), where the credit channels amplify the monetary transmission to aggregate demand and the impact on real economic activity is due to price stickiness, and models of aggregate supply (Section 3), which purport to show that the credit channels have direct effects on firms' employment and output decisions and hence on aggregate supply. The former class of models, which includes the largest part of current production, naturally tends to emphasize the complementarity between the credit channels and the traditional monetary channel, moving towards a unified view that supports the current re-foundation of macroeconomics in the fashion of the Neoclassical Synthesis. The latter class of models is instead more sharply alternative to the money view, and contributes to a research programme which seeks to recast Keynesian macroeconomics on the basis of imperfect capital markets independently of auxiliary microeconomic assumptions underlying sticky prices.

2. Models of investment and aggregate demand

One of the most successful macroeconomic models of the credit view is the one proposed by Bernanke - Blinder (1988). First, the model is directly comparable with the foundational counterpart of the money view, i.e. the traditional IS-LM model. Second, in a simple way it allows a rich

[14] See Delli Gatti - Tamborini (2000, Part III).

specification of the financial structure of the economy. The qualifying feature of the credit view is firms' diversification of investment *external* finance. This is introduced by assuming imperfect substitution between open-market funds (bonds) and bank debt. Here we shall present a slightly modified and enlarged version of the Bernanke-Blinder model in order to highlight each of the above features, differences with the money view, and the identification of specific credit effects. We shall then briefly review the main results from empirical research.

2.1 *The benchmark model of the BLC*

The economy consists of three classes of agents, households, firms, and banks, plus the central bank. Goods and labour prices are kept fixed in any given period of time (we omit the time index for simplicity), so that all nominal values coincide with real ones and output Q is fully determined by aggregate demand Y, which consists of real consumption C and investment I. Investments can be financed by issuing open-market bonds B^s or by demanding bank loans L^d, and their amount depends on comparison between the marginal efficiency of capital ρ and the real cost of funds. The two kinds of funds differ in their real cost, r_B and r_L, respectively, and each is assumed to be gross substitute for the other, so that the firms' balance sheet is the following (the signs underlying each variable are the signs of the respective partial derivates):

$$\begin{aligned} I &= B^s + L^d \\ B^s &= \beta f(\underset{+}{\rho}, \underset{-}{r_B}, \underset{+}{r_L}) \\ L^d &= \lambda f(\underset{+}{\rho}, \underset{+}{r_B}, \underset{-}{r_L}) \end{aligned} \tag{2.1}$$

Banks accept deposits D from households and hold a fraction α of deposits as reserves H with the central bank [15], while the remainder is lent to firms by granting loans L^s or by buying bonds B^b. The diversification of the banks' portfolio of loans is again derived from the gross substitution hypothesis. Therefore the banks' balance sheet is:

[15] The addition of free reserves would not essentially change the results of the model.

$$\begin{aligned} &B^d + L^s + H = D \\ &H = \alpha D \\ &B^d = \beta^d(\underset{+}{r_B}, \underset{-}{r_L})D(1-\alpha) \\ &L^s = \lambda^b(\underset{-}{r_B}, \underset{+}{r_L})D(1-\alpha) \end{aligned} \tag{2.2}$$

With respect to the traditional IS-LM model, we now have three markets (money, credit and output) and three endogenous variables (the interest rate on bonds r_B, the interest rate on bank loans r_L, and output Q).

The money market must equate money supply M with money demand, which for simplicity only consists of deposits D and takes the conventional form $D = D(r_B, Y)$. Given the absence of cash, and the reserve coefficient α, money supply is simply a multiple of the monetary base H, $M = H/\alpha$. Since bank reserves are the sole component of the monetary base, money market equilibrium requires:

$$H/\alpha = D(r_B, Y) \tag{2.3}$$

which yields the value of r_B:

$$r_B = r_B(\underset{+}{Y}, \underset{+}{\alpha}, \underset{-}{H}) \tag{2.4}$$

The signs of partial derivatives are the same as in standard Keynesian theory. Equation (2.1)-(2.4) can also be used to trace the usual LM locus in the (Y, r_B) space as in Figure 1.

The credit market must equate supply of bank loans with demand as given by the corresponding component of investment; therefore:

$$\lambda^b(r_B, r_L)D(1-\alpha) = \lambda f(\rho, r_B, r_L) \tag{2.5}$$

Since in money-market equilibrium $D = H/\alpha$, the credit market determines the value of r_L:

$$r_L = r_L(\underset{+}{\rho}, \underset{+}{r_L}, \underset{+}{\alpha}, \underset{-}{H}) \tag{2.6}$$

The relationship between r_L and r_B is one of the key features of the model, and we shall comment on it in due time.

Output market equilibrium obtains when aggregate supply equates aggregate demand. The latter is determined according to

$$Y = Y(\underset{+}{\rho}, \underset{-}{r_B}, \underset{-}{r_L}) \tag{2.7}$$

After substituting (2.6) for r_L, equation (2.7) yields a downward sloping locus of equilibrium pairs (Y, r_B) similar to the IS curve which is reproduced in Figure 1. Yet this equation also embodies the equilibrium value

of r_L established in the credit market, and hence Bernake and Blinder call it the CC (commodity and credit) locus, which plays a crucial role in the whole model, as we shall see. Setting $Q = Y$, and taking the equations for r_B and r_L into account, the reduced form of Q is:

$$Q = Q(\rho, \alpha, H^b) \tag{2.8}$$

This result resembles the usual one in the IS-LM models. There are, however, several important differences that attracted close attention from monetary scholars and which we examine below. To highlight the main points analytically, it is convenient to examine the comparative statics of the three endogenous variables (r_B, r_L, Q) taking the total differential of the equilibrium equations (2.4), (2.6), (2.8) with respect to an infinitesimal change in the policy variable dH, holding α and ρ constant (a partial derivative is denoted by a subscript of the relevant variable with the sign attributed in the text):

$$dr_B = (D_Y/D_{rB})dQ - (1/\alpha D_{rB})dH \tag{2.9}$$

$$dr_L = \frac{\lambda^b_{rB} + \lambda^f_{rB}}{\lambda^b_{rL} + \lambda^f_{rB}} dr_B - \frac{1}{\lambda^b_{rL} + \lambda^f_{rB}} \left(\frac{1-\alpha}{\alpha}\right) dH \tag{2.10}$$

$$dQ = -Q_{rB}dr_B - Q_{rL}dr_L \tag{2.11}$$

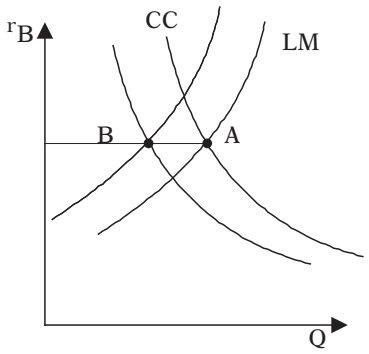
1) *Existence of the BLC*. First of all, one notes immediately that the above system collapses to the IS-LM model if $dr_L = 0$. The credit channel is the set of relations that activate equation (2.10). Monetary policy is identified with changes in banks' reserves H determined by the central bank [16]. These changes affect both households' portfolio equilibrium (and hence the interest rate on bonds as usual) as well as banks' portfolio equilibrium (and hence the interest rate on bank loans). We can easily establish conditions for the existence of the BLC or, conversely, conditions for its disactivation, which are:
– investment demand is insensitive to the bank interest rate, $Q_{rL} = 0$
– firms are indifferent between open-market funds and bank debt, $\lambda^f_{rL} \to \infty$
– banks are indifferent between bonds and loans, $\lambda^b_{rL} \to \infty$

[16] This is of course a simplification because there usually exists a market for reserves with appropriate interest rates. Extensions in this direction have been elaborated by Dale - Haldane (1993), Bagliano - Favero (1995, 1998a). The ensuing problem of identifying monetary policy interventions has prompted intense empirical research: see Gordon - Leeper (1994), Bernanke - Mihov (1995), Bagliano - Favero (1998b).

It is therefore confirmed that imperfect substitutability *both* for firms' liabilities *and* banks' assets is the crucial condition for the BLC [17].

2) *The amplifying effect of the BLC*. The specific amplifying effect on aggregate demand of the BLC can be seen in equation (2.11) in connection with the parameter Q_{rL}. Consider the case in which Q_{rB} is small, as repeatedly found by empirical research in almost all industrialized countries (see also Section 1), or that $\partial rB/\partial H$ is small; monetary policy still impacts on aggregate demand through the BLC. Graphically, amplification (a large change in Q and a small change in r_B) is the result of the co-movement of the LM *and* CC schedules triggered by a monetary contraction as in Figure 1.

FIGURE 1 - *A monetary restriction in the CC-LM model*



3) *Identification of the BLC*. Early works in search of the BLC pointed out that co-movements of output and credit aggregates were stronger, closer and faster than those between output and monetary aggregates (e.g. Friedman - Kuttner, 1992). Current empirical research has clarified that

> to find evidence of the lending channel, [...] you need to make a set of identifying assumptions to argue that the supply, rather than the demand for credit, has moved in response to a monetary policy shock (Eichenbaum 1994, p. 257).

[17] In reality, the issue of portfolio choices of banks should also cover their liability side. In fact, the model presented here overstates the impact of H on banks' loanable funds (see equations 2.2). In the presence of an attempt by the central bank to cut H and hence D, banks may well react by issuing alternative, marketable liabilities like deposit certificates, etc., which are not subject to reserve requirements. If this substitutability is high, the credit channel of monetary policy is weakened or inhibited altogether (the right-hand addendum in equation 2.10 vanishes). This problem has been object of lively debate, especially in the U.S. (e.g. Romer - Romer 1990; Miron et al. 1994).

This point is highlighted by the model. Suppose that $\lambda_{rL}^{b} \to \infty$, and consider a monetary contraction $dH < 0$. The pattern of interest rates predicted by equations (2.9) and (2.10) is

$$d_{rL} = 0, d_{rB} > 0$$

while the patterns of credit and output predicted by equations (2.5) and (2.11) are respectively

$$dL^{d} < 0, dQ < 0$$

That is to say, a positive correlation between bank loans and output arises in spite of the absence of any autonmous contraction of credit supply by banks.

Investigations of the BLC have then followed two identification strategies, one that remains at the level of aggregate models and data, and another that employs disaggregate models and data. The former strategy exploits information contained in equation (2.10), which indicates that after a monetary policy intervention both open-market and bank interest rates should respond together and in the same direction. Moreover, as established by Dale - Haldane (1993), the *spread* between bank rates and other rates should increase. The alternative strategy focuses more closely on the microeconomic prerequisites of the BLC (see Section 1): *i*) the *diversification hypothesis*, by dint of which evidence for substitution across firms' liabilities and banks' assets is sought after a monetary policy shock (e.g. Bernanke - Blinder 1992; Kashyap et al. 1993; Kashyap - Stein 1994b, 1997); *ii*) the *heterogeneity of firms*, owing to which particular classes of firms are expected to display a strong dependence of spending capacity on bank credit (e.g. Gertler - Gilchrist 1993, 1994, who initiated this line of research). Following this approach, the so-called ''cross-sectional'' effects of monetary policy have become an active area of research.

2.2 *An overview of empirical research*

It has long been thought that Italy is a good case-study for scholars interested in the BLC of monetary policy. This is because, among the major industrialized countries, Italy has a less developed capital market and an industrial structure characterized by the presence of a large number of small firms whose most important financial resource is bank credit (Vicarelli 1974; Angeloni et al. 1997). The role of the credit market in the monetary transmission mechanism has always been carefully monitored by the Italian monetary authorities (see e.g. Bertocco 1997), and it is explicitly included in the Bank of Italy's econometric model (1997a). Not surprisingly, there has recently been a proliferation of empirical studies on the BLC in Italy.

These studies may be broadly divided into two groups: one in which empirical tests are based on aggregate time series analysis and use the VAR methodology to estimate impulse response functions; and a second one which comprises more recent analyses based on a disaggregate micro-economic approach. In recent years, attention has also been paid to international comparisons and to the problem of the possible heterogeneity of monetary policy transmission in the EMU. For reasons of space, and in consideration of the fact these studies do not specifically focus on Italy, they are not discussed here [18].

We begin our review by examining the first group of studies. Buttiglione - Ferri (1994), and Bagliano - Favero (1995, 1998b) provided the first rigorous estimations of the BLC in Italy. Both test an adapted version of the Bernanke-Blinder model in which monetary policy shocks affect the economy through exogenous variations of the interest rate in the market for banks reserves, and they reach similar conclusions.

Buttiglione - Ferri (1994) present econometric evidence in favour of the BLC on the basis of an unrestricted VAR model estimated with monthly data running from 1988 to 1993. After discussing two major episodes of monetary tightening in Italy (March 1981 and June-September 1992), Buttiglione and Ferri estimate a VAR that includes six endogenous variables, the overnight rate (used as the monetary policy index), the rate on government paper, the amount of credit granted by banks to customers (a proxy for credit supply) , the amount of credit actually drawn (a proxy for credit demand), the average interest rate on loans, and the index of industrial production. They also add four exogenous variables, the industrial production price index and three dummies intended to capture specific important regulatory interventions by Banca d'Italia in 1988 and

[18] Given the predominant view set out in Section 2 that different transmission mechanisms may account for the different amplitude, and possibly speed, of monetary shocks to aggregate demand, the issue obviously has an important bearing on centralized monetary policy-making. The first extensive study was by Dornbusch et al. (1998), who detected a number of indicators of heterogeneity of transmission mechanisms. Further developments have found mixed evidence. Adopting the disaggregate methodology discussed below, Favero et al. (1999) argue that asymmetries in monetary policy transmission in Europe cannot be ascribed to cross-country differences in the response of bank loans to monetary policy, and that in the case of the 1992 episode there is no evidence of a BLC operating in the four major continental economies. De Arcangelis - Giovannetti (2000) point out that apparent cross-country similarities are in fact restricted to *sectoral* similarities in different countries as regards firm-bank relationships and responsiveness to monetary shocks. Different sectoral weights in different economies may well account for different effects of monetary shocks. Using aggregate macro-data, Fountas - Papagapitos (2001) point out that the BLC is especially significant for Germany and Italy compared to all the other countries in the Union.

1989. The VAR is identified with a Cholesky decomposition in which the variable ordering is as just described. On analysing the impulse response functions from the VAR, Buttiglione and Ferri find that after a one percent positive shock to the overnight rate, the spread between the interest rate on loans and the rate on government paper increases. As explained in the previous section, this is generally considered to be a signal of the BLC. The overnight rate also has a negative impact on credit supply. Finally, shocks to credit supply are positively correlated with the index of industrial production, and they account for about 26% of production index variance. Buttiglione and Ferri's conclusion is that their analysis provides support for the existence of a BLC in Italy.

Bagliano - Favero's (1995) analysis is twofold. On the one hand, it qualitatively analyses four episodes of monetary restriction in the period 1979-1993 [19], showing that strong spread increases are observable in all cases. On the other hand, it tests the implication of the theoretical model with the help of two cointegrated VAR systems fitted to monthly data covering the 1982-1993 period. VAR identification is achieved with the help of standard Cholesky triangular decomposition. The first step consists in testing the response of the spread between the bank loan rate and the Treasury bill rate to innovations in the policy rate (the rate on the Bank of Italy's repurchase agreement operations). Since Bagliano and Favero's results show that the spread may be taken to be an indicator of monetary policy, in a second stage they test the impact of the spread on industrial production and inflation. Their main finding is that impulse response functions show that innovations in the spread have a significant negative impact on industrial production with a lag varying from 6 to 12 months. Bagliano and Favero also conclude that the latter result can be interpreted as evidence that a BLC operates in the Italian economy.

Among more recent developments mention should be made of Chiades - Gambacorta (2000), who extend the Bernanke-Blinder model to the case of an open economy under a quasi fixed exchange rate regime. In their model, Chiades and Gambacorta add an exchange rate channel to the traditional money and credit channels of monetary policy transmission and analytically derive the conditions for their relative importance, which is then empirically tested by means of a structural VAR (SVAR) analysis. One implication of the theoretical model is that it helps solve the so-called ''exchange rate puzzle'', namely the fact that sometimes, after a monetary restriction, the exchange rate depreciates instead of appreciating. In fact,

[19] The timing of the monetary restriction episodes was as follows: from the second half of 1979 up to the beginning of 1981; beginning of 1985; first half of 1986; end of 1992.

if the leftward movement of the CC curve is sufficiently large, the equilibrium of the economy is achieved below the traditional Mundell-Fleming BB curve, so that the exchange rate depreciates.

Turning to the empirical part of the paper, Chiades and Gambacorta estimate a SVAR with six endogenous variables (production index, consumer price index, three month interest rate, Italia lira/DM exchange rate, interest spread, nominal wage index), three exogenous variables (German consumer price index, three month German interest rate, world raw materials price index) and five dummy variables which capture monetary policy interventions by the Bank of Italy during the exchange rate crisis of 1992 and the Mexican crisis of 1995. These dummies are introduced to obtain VAR residuals that are normally distributed. The sample period runs from 1984 to 1998 and the data have a monthly frequency. On the basis of the methodology described in Giannini (1992)[20], Chiades and Gambacorta identify the SVAR by imposing structural links that go from the exchange rate to the interest rate, from prices to wages, and from the interest rate to the spread, and by assuming that reduced-form shocks on the financial part of their model (interest rate, exchange rate and the spread) have no contemporaneous effect on the real part of the system (production and prices). The impulse response functions obtained show that, in the short run, monetary policy shocks are diffused into the economy by both the money and the credit channel, while an ''exchange rate puzzle'' arises, since the exchange rate does not respond to interest rate shocks. As to the long run, Chiades and Gambacorta's results confirm the ''neutrality hypothesis'': monetary policy permanently affects prices but not output. They also find that the BLC exerts greater influence on output than the money channel, while the reverse is true when the effects on prices are considered. Finally, they claim that, consistently with the theoretical model, the importance of the BLC in Italy may provide an alternative explanation for the relative independence of Italy's monetary policy during the EMS period.

Although quite common, the use of aggregate time series in the empirical analysis of the BLC has recently been criticized on the grounds that it prevents researchers from clearly identifying and separating credit demand from credit supply shocks (see Section 2). The suggested solution is to employ disaggregate micro data on both banks and firms in order to detect specific ''microeconomic'' implications of the credit view.

In the first place, the identification scheme of the BLC can be based

[20] Using Giannini's terminology, Chiades and Gambacorta estimate an AB model. For careful examination of the use of SVAR as a method for measuring monetary policy see Bagliano - Favero (1998).

on the prediction that the effects of monetary policy on banks depend on their characteristics and are likely to be differentiated (Kashyap et al. 1993; Kashyap - Stein 1994b, 1997). Angeloni et al. (1995) have made the first attempt to investigate how the heterogeneous nature of the Italian banking system affects the credit channel using a partial disaggregate approach that enables them to examine the different responses of selected groups of banks to monetary shocks. They classify Italian banks into four groups. The first two (A1 and A2 in their paper) include the 15 largest and 25 smallest banks measured by the total size of their loan portfolio, while the other two groups (B1 and B2) include the 15 largest and 25 smallest banks measured by the average size of their loans. Even though there is some degree of overlap among the four groups, Angeloni et al. claim that it is not particularly large, so that tests of hypothesis that distinguish A1-A2 from B1-B2 can be carried out. According to the authors, the portfolio size criterion is best suited to identifying the bank balance sheet characteristics that are likely to make the loan supply responsive to monetary shocks, while the second classification criterion takes into account the size of the borrower under the hypothesis that loan size and borrower size are positively correlated.

The behaviour of the alternative bank groups is then empirically tested by measuring their response to changes in the cost of bank loans. Angeloni et al. estimate a VAR for groups A and B including the following variables: three month interbank rate, the average yield on Government fixed-coupon bonds, the average rate on deposits, and the average rate on loans. As to the long run properties of the VAR, Angeloni et al. identify five cointegrating vectors, while the short run dynamic analysis is performed with the help of a linear transformation of the system in which the variables are the average deposit rate, the deposit rate spread, the average loan rate, the loan rate spread and the loan-government bond yield spread within both groups. Finally, identification of the VAR is achieved and impulse response functions are computed assuming a standard triangular Choleski decomposition. Overall, the results are favourable to the credit view of monetary policy transmission and are consistent with those found by studies based on aggregate time series data. In fact, following a negative monetary shock, the spread between loan rates and bond market rates increases in all the bank groups. As to the rate spread between ''large'' and ''small'' and between ''large-loan'' and ''small-loan'' banks, Angeloni et al. find that this increases, and that ''large'' banks respond more promptly to monetary shocks than do smaller banks. This latter result is at odds with Kashyap - Stein (1994), and it is explained by the

authors by the fact that small banks have closer ties with their customers and usually concentrate most of their borrowing at a single institution.

In a related paper, Conigliani et al. (1997) test the importance of the intensity of the relationship between banks and firms in the transmission of monetary policy, using data on 33,808 non financial firms in the year 1992. In the first part of their analysis, they test the determinants of the level of and the change in the interest rates that banks charge to customers. In the second part they investigate the link between banks-firms relations and the availability of credit after a monetary shock. As explanatory variables they use indexes of concentration and stability. A low concentration index signals the existence of mutiple banking relationships, while a high stability index is a proxy for long lasting customer relationship. The estimate of probit equations shows that firms with both high stability and low concentration indexes have a greater probability of being sheltered from the interest effects of restrictive monetary policy and smaller probability of incurring credit rationing. Since small Italian firms display both characteristics, Conigliani et al. conclude that, in the case of the 1992 monetary restriction, their analysis does not confirm the prediction of the BLC insofar as small firms are concerned.

Although studies like those by Angeloni et al. move a step towards a more disaggregate empirical analysis of the BLC, they rely essentially on the same indirect VAR methodology employed in the previous group of works. A recent study presenting truly micro-based evidence on the different channels of monetary transmission mechanisms in Italy and Europe is the one by Favero et al. (1999), who use balance sheet data from a sample of 651 banks in France, Germany, Italy and Spain to study the response of bank loans to the Europe-wide monetary restriction of 1992. Cross-sectional differences among banks are identified with the help of two variables: the ''strength'' and the ''size'' of banks' balance sheets. The ''strength'' variable is a measure of banks' liquidity and is defined as the sum of cash, securities and reserves as a fraction of total assets[21]. The more ''liquid'' a bank is, the more it can insulate its supply of loans against external monetary policy shocks. The ''size'' variable, as previously pointed out when discussing the Angeloni et al. paper, is useful because it is normally assumed that larger banks are able to escape monetary restrictions by issuing a variety of financial instruments that allow them to raise the funds necessary to back their lending activity[22].

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21 See Kayshap - Stein (1997).

22 Favero et al. observe that banks of comparable size do not necessarily have the same ''strength''.

Favero et al. divide their sample into ten deciles and compare the distribution of banks' total assets in each country with the same parameter in Europe finding no evidence of inter-country asymmetries in the size distribution. On the other hand, banks in Italy and Spain appear to be relatively stronger than those in France and Germany. A distinctive feature of the latter country is that large banks are ''weaker'' than smaller ones. The presence and quantitative importance of the credit channel is then finally tested with an heteroscedastic consistent regression in which the percentage changes in loans from 1991 to 1992 are regressed on the percentage changes in bank reserves, the ''strength'' and ten dummies that discriminate banks by deciles of the distribution on total assets of all four countries in the sample. The regression specification allows for the possibility that loans responses to shifts in monetary policy may be non linear. The estimates results are negative for the BLC, since the tests performed are unable to reject the hypothesis that the response of loans to reserve changes is zero. A country by country analysis of the results, however, shows some interesting features. In Germany, the largest banks use their ''strength'' to counteract the effect of monetary restrictions, while the smallest ones react by expanding their loans – a finding which reverses the credit-view's prediction. Italian and Spanish banks display the same behaviour but size and strength play no role in determining the response of large banks to policy shocks. Finally, in France differences in size have no effects at all and the aggregate result is confirmed for all deciles.

Favero et al. entirely focus on the lender side of the credit market. Microeconomic evidence from the borrower side is instead presented by Dedola - Lippi (2000), who report data on the monetary transmission mechanism based on the reaction to monetary shocks of 21 manufacturing industries in 5 OECD countries (France, Germany, Italy, the UK and the USA). The aim of this paper is to verify the cross-heterogeneity of real effects of unanticipated monetary shocks and to explain such effects in terms of industry characteristics compatible with theories of monetary transmission. Dedola and Lippi start their analysis by identifying and estimating the unanticipated component of monetary policy in the five countries examined, following the method proposed by Christiano et al. (1998). They find that unexpected increases in the short term interest rate have a persistent negative impact on industrial production in all five countries, which peters out after three years. In the European countries, an exchange rate appreciation also emerges. As to country specific behaviour, Germany and Italy display a slower output response, while the effects are more rapid in France, the UK and the USA.

The next step in Dedola and Lippi's analysis is to measure the industry

TABLE 1 - *Summary of empirical studies on the credit channel in Italy*

	METHODOLOGY	ESTIMATION TECHNIQUE	SAMPLE PERIOD	MAIN RESULTS
BUTTIGLIONE - FERRI (1994)	Aggregate time series analysis	Unrestricted VAR	1988-1993 (monthly data)	Overnight rate affects the spread positively and the credit supply negatively; shocks to credit supply account for about 26% of output variance
BAGLIANO - FAVERO (1995, 1998b)	Aggregate time series analysis	Cointegrated VAR	1982-1993 (monthly data)	Spread is an indicator of monetary policy shocks and has a significant negative impact on industrial production
ANGELONI ET AL. (1997)	Disaggregate analysis of behaviour of different bank groups	Cointegrated VAR	1987-1993 (monthly data)	Spread increases in response to monetary policy shocks; "large banks" respond more promptly than "small banks"to policy shocks
CONIGLIANI ET AL. (1997)	Disaggregate cross-section analysis of micro data on non financial firms	Case study; Probit estimation	1992	Contrary to the prediction of the credit view literature, small firms have a higher probability of being sheltered from monetary restrictions.
FAVERO ET AL. (1999)	Disaggregate analysis using microeconomic balance sheet data from individual banks in four European countries	Case study; cross-sectional analysis and OLS with heteroscedasticity consistent standard errors	1992	No evidence of BLC in France, Germany, Italy and Spain
CHIADES - GAMBACORTA (2000)	Aggregate time series analysis; account for the working of an "exchange rate" channel of monetary shocks	Structural VAR	1984-1998 (monthly data)	In the short run, policy shocks affect income and prices via both a money and a credit channel; money is "neutral in the long run; the working of a credit channel helped isolate Italian monetary policy against foreign shocks.
DEDOLA - LIPPI (2000)	Disaggregate analysis using microeconomic data on 21 manufacturing industry in 5 OECD countries	Structural VAR	1975-1997 (monthly data)	Unanticipated monetary policy shocks have long lasting real effects and are transmitted through both the interest rate and the credit channel with broadly the same intensity

effects of monetary policy. After estimating 100 VARs and graphing the associated impulse response functions, they find that industry response is quite different within each country. In general, in food and textile industries the impact of policy shocks is equal to or less than average aggregate industrial production, while in heavy industries such as iron, machinery and motor vehicles the response is much greater than in other industries. This heterogeneity of industrial response is further explored by examining

the interest rate sensitivity of each industry and the indebtedness capacity of firms. The latter characteristic is proxied by firm size and several measures of financial leverage. Since, according to the credit view, credit constrained firms have a lower leverage ratio on average, and are smaller than unconstrained firms, the prediction of an inverse relationship between the effectiveness of monetary policy and the level of these variables is tested with a regression analysis in which the 24-month output elasticity is the dependent variable. Dedola and Lippi find that the impact of monetary policy is stronger in industries that produce durable goods (interest rate sensitive), are more capital intensive, and have smaller borrowing capacity. Their conclusion is that the traditional interest rate channel of monetary transmission is important in the countries in their panel, but also that the credit channel is significant and has the same magnitude as the money channel. The importance of cross-sectoral differences behind aggregate responses to monetary shocks has also been confirmed for EMU contries by De Arcangelis - Giovannetti (2000), along similar lines of analysis.

Given the large number of works and their different econometric methodologies, the main results and characteristics of studies on the BLC in Italy just reviewed are summarized in Table 1 for the reader's convenience.

3. Modelling the missing ring: monetary policy, credit and aggregate supply

In Introduction we put forward reasons why the present tendency to restrict research on credit channels within the boundaries of aggregate demand theory is unsatisfactory. In this section we wish to propose a framework for analysis of the links between monetary policy, credit and aggregate supply. The main goal is to assess *i*) whether a connection may exist between monetary policy and aggregate supply, and *ii*) whether the observed pattern of large quantity adjustments and small price adjustments can be ascribed to supply-side effects with no need for auxiliary assumptions concerning imperfect price determination.

Though models in this vein are usually highly specific in terms of microfoundations and economic structures, we have chosen to adopt a generic representation of agents' behavioural functions which favours the most direct comparison and complementarity with the results presented in the previous sections (conversely, specific models can be obtained from our framework by means of appropriate specifications of functions or market structures). We present a general equilibrium framework with three markets (labour, credit and ouput) and three classes of agents (firms, households and banks, including the central bank), but for the sake of

brevity in the main body of the text we only develop the aggregate supply part of the model, which is the theoretical kernel of the transmission mechanism, whereas the derivation of the other parts of the model can be found in the Appendix.

3.1 *Firms and the levered aggregate supply*

If capital market imperfections are responsible for most of the transmission of monetary policy to investment, then analysis cannot be limited to aggregate demand, because current production decisions too should be consistent with the firm's intertemporal path. Quite naturally, this principle emerges in a group of models of credit economies that address issues in growth and business cycle theory[23]. However, to our knowledge these models have not generated substantial empirical research, and they have had little impact on standard monetary macroeconomics and monetary policy theory, which still concentrates on aggregate demand effects. The reason may reside in the research strategies and idioms used, so that the above-mentioned models are typically ''all real'', have highly specific microfoundations, and leave little room for detailed analysis of monetary and financial transactions among central bank, banks and the economy.

A more promising route is offered by a string of papers by Greenwald - Stiglitz (1988a, 1990, 1993a) the core of which is a ''levered aggregate supply'', that is, an aggregate supply function derived from the assumption that firms should borrow their working capital[24]. In fact – as shown by Dimsdale (1995), Delli Gatti - Gallegati (1997), Tamborini (1999), Tamborini - Fiorentini (2000) – this aggregate supply theory is amenable to macroeconomic and monetary policy analysis and empirical testing in a way fully compatible and comparable with the current standard (namely microfounded AD-AS models, see fn. 2)[25]. Note also that the levered aggregate supply is an intertemporal function which obeys the basic principle mentioned above. In fact working capital is nothing but a particular kind of investment (on this point see also Greenwald - Stiglitz 1993a). Moreover, bank-dependent firms typically rely on credit in order to finance

[23] Farmer (1984), Gertler - Hubbard (1988), Bernanke - Gertler (1989, 1990), Hahn - Solow (1995), Kyiotaki - Moore (1997). See also the overviews by Greenwald - Stiglitz (1993b), Delli Gatti - Tamborini (2000, Part III).

[24] There is apparent connection with Keynes's idea of a ''monetary theory of production'' (1933) and more specifically with his (1937) ''finance motive'' in the theory of the aggregate demand for money.

[25] The connection between credit and aggregate supply has likewise been examined by Blinder (1987) and Stiglitz - Weiss (1992), who, however, focus on the role of credit rationing, which is not our concern here.

not only fixed but also working capital, and businessmen react negatively to increases in bank interest rates first and foremost as increases in general production costs [26].

The key ingredients of the Greenwald - Stiglitz (G-S) theory of aggregate supply are:

i) a sequential economy, with discrete time periods indexed by t, $t+1$, ..., where production takes 1 period of time regardless of the scale of production;

ii) firms have to pay for inputs (labour) in each t before they are able to sell output in $t+1$, and they can start a new production round in $t+1$ only after ''closing accounts'' (i.e. all output has been sold out);

iii) firms face price uncertainty in the form of a probability distribution of each firm's individual sale price around the market price of output [27];

iv) full equity rationing of firms, so that firms' demand for working capital (the wage bill) is met either by internal funds (''equity base'') or by bank credit in a competitive credit market;

v) standard debt contracts between banks and firms [28].

To gain full understanding of the model, the reader should bear in mind the flow chart of the time structure of transactions illustrated in Figure 2.

All firms j produce a homogeneous output by means of a common labour technology with decreasing marginal returns, so that

$$\begin{aligned} &Q(t)_{jt+1} = Q(N_{jt}), \\ &Q_N > 0, Q_{NN} < 0 \end{aligned} \tag{3.1}$$

The sale price of each firm in $t+1$ is the outcome of a random market process around the ''average market price'' of output P_{t+1}, given by the law

$$P_{jt+1} = P_{t+1} u_{jt+1} \tag{3.2}$$

where u_{jt+1} is a i.i.d. random variable with cumulative function F and expected value $E(u_{jt+1}) = 1$.

To pay for labour, firms can spend out of their existing internal funds

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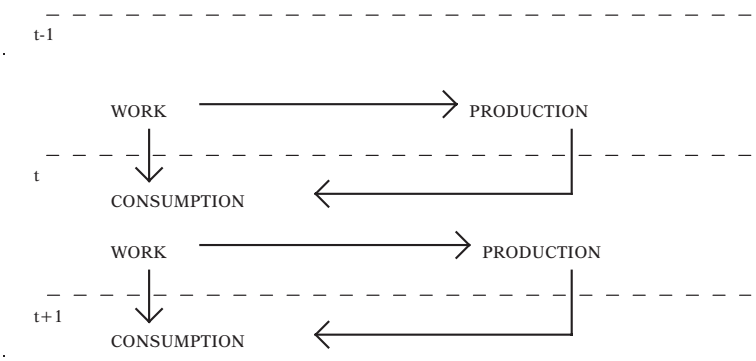
[26] See e.g. Gertler - Gilchrist (1993, 1994), Rondi et al. (1998), Badocchi (1998). It should also be noted that bank-dependence for short term credit is more pervasive than for long term investment plans, as even large firms with access to the open market issue short term commercial paper to a very limited extent.

[27] This form of randomization of individual selling prices is left unexplained by Greenwald - Stiglitz, and we do not explain it either. A cause may be some kind of imperfect arbitrage on the output market, such as badly connected sale points or ''islands''.

[28] Fiorentini - Tamborini (2000) prove that standard debt contracts are indeed optimal under these assumptions.

FIGURE 2 - *Work, production and consumption in the sequence economy*



or can borrow from banks. However, given our purposes here we focus on a pure BLC version of the model, i.e. with no internal funds retained by firms [29]. Given the money wage rate W_t, the amount of borrowing by a firm at time t is therefore

$$L_{jt}^{d} = W_t N_{jt} \tag{3.3}$$

against which, the firm is committed to paying in $t+1$

- $L_{jt}^{d} T_t$ if the solvency state $P_{jt+1} Q(t)_{jt+1} \geq L_{jt}^{d} R_t$ is declared
- $P_{jt+1} Q(t)_{jt+1}$ if the default state $P_{jt+1} Q(t)_{jt+1} < L_{jt}^{d} R_t$ is declared, with deterministic monitoring [30]

The default state also includes bankruptcy, i.e. firm's foreclosure. Given that bankruptcy occurs in all states such that $P_{jt+1} Q(t)_{jt+1} < L_{jt}^{d} R_t$, after little manipulation we see that this condition is equivalent to

$$u_{jt+1} > L_{jt}^{d} R_t / P_{t+1} Q(t)_{jt+1} \equiv u_{jt+1}^{*} \tag{3.4}$$

i.e. whenever the individual price relative to the market u_{jt+1} falls below a critical value u_{jt+1}^{*} equal to the firm's debt/revenue ratio. Knowing the probability distribution $F(u_{jt+1})$, the bankruptcy probability of the firm is:

[29] The NWC implication of the model is particularly important in the orginal G-S papers as a way to generate endogenous dynamics for business cycle analysis (see also Delli Gatti - Tamborini 2000, Part III). However, the absence of internal funds is a more natural basic assumption for small competitive firms.

[30] Deterministic monitoring means that the firm is monitored and its true state is observed with certainty.

$$Prob(u_{jt+1} \leq u^*_{jt+1}) = F(u^*_{jt+1}) \equiv \phi_{jt} \tag{3.5}$$

Bankruptcy may or may not have pecuniary and non-pecuniary extra-costs for firm's managers (like fees, administrative costs, etc.). We exclude these costs here [31], so that the levered firm's expected profit maximization is simply:

$$\max_N Z^e_{jt+1} = P^e_{t+1} Q(t)_{jt+1} - W_t N_{jt} R_t \tag{3.6}$$

Given the assumed time structure of transactions, the firm employs labour and demands credit for the new production period t *after* the previous period's output has been sold out at price P_t (indeed, as we shall see, the price of ouput in each period is fully determined by the previous period's exogenous variables). Hence we can conveniently use P_t as numeraire for all nominal variables, denoting with $w_t \equiv W_t/P_t$ the current real wage rate and with $\pi_{t+1} \equiv P_{t+1}/P_t$ the 1-period price growth factor (inflation for short). Hence, the first order condition for a real profit's maximum is

$$Q_N = \omega_t R_t / \pi^e_{t+1}$$

which states that the firm employs labour up to the point where its marginal product equates the *real expected marginal cost*, which is the compound real cost of labour and credit. Under standard assumptions concerning the production function, the optimal employment level can be written as

$$N^d_{jt} = N^d(\underset{-}{w_t}, \underset{-}{R_t/\pi^e_{t+1}}) \tag{3.7}$$

We have thus obtained the typical labour demand function of the levered firm. In addition to the standard negative dependence on the real wage rate, its main features due to bank debt are: *i*) labour demand is decreasing in the real interest rate, *ii*) it is systematically lower than the standard labour demand for any positive interest rate.

[31] These costs are assumed to be present and play an important role in the original G-S papers because they force managers to take account of the expected bankruptcy cost in their profit maximization, even though they are risk neutral. In this way, bankruptcy probability shows up in the aggregate supply function as a specific consequence of firm's bank-dependence, whereas in a perfect capital market firm's risk would be diverisfied away by equity holders. Instead of adding auxiliary assumptions on bankruptcy costs and their shape, we propose a simpler solution: there are no such costs, but, as we shall see, bankuptcy probability enters the model via bank interest rates in the form of credit risk premium (which is also a specific consequence of bank-dependence).

Output supply is easily derived from labour demand by means of the production function (3.1), i.e.:

$$Q(t)_{jt+1} = Q(N^d(\underset{-}{w_t}, R_t/\underset{-}{\pi^e_{t+1}})) \tag{3.8}$$

Labour demand (3.7) and output supply (3.8) are the core of the supply-side economics of the credit view. They show that firms' employment and production decisions are affected by credit supply conditions to the extent that *i*) these entail changes in the interest rate due to banks, *and ii*) these changes are to some extent transmitted to the real expected marginal cost, i.e. to the extent that wage rate, interest rate and expected price changes do not exactly offset each other. This a crucial aspect of the model which has not received enough attention in the literature. Its importance will become clearer once aggregate supply has been embedded in the rest of the economic system.

3.2 *Macroeconomic equilibrium and monetary policy effects*

At the beginning of each production period t firms plan labour demand, credit demand and output supply as explained in the previous paragraph. In so doing they interact with households in the labour market and with banks in the credit market. In the next period $t+1$ firms will interact again with households in the output market and with banks in order to close their accounts before starting a new production round. Here we only reproduce the relevant functions concerning households' labour supply and output demand, and banks' credit supply, which are fully derived in the Appendix. Given that firms, and all other agents, are ex-ante identical, we can treat individual functions as representative of aggregates, which we shall do by dropping the subscripts.

At the beginning of each t, each household h owns deposits from the previous period D_{t-1}, can sell labour N^s_{ht} at the market wage rate W_t, and earns $W_t N^s_{ht}$. Hence the household can consume $C(t)_{ht}P_t$ out of $t-1$ production by spending D_{t-1}, and save current income in bank deposits D_{ht} for consumption in $t+1$ $C(t)_{ht+1}$, on the expectation of price P^e_{t+1}. The resulting labour supply and output demand functions are, respectively,

$$N^s_t = N^s(\underset{+}{w_t}, \underset{-}{\pi^e_{t+1}}) \tag{3.9}$$

$$C(t)_{t+1} = C(\underset{+}{D_t})/P_{t+1} \tag{3.10}$$

Banks collect deposits from households at zero rate, and offer standard debt contracts at the rate R_t in a competitive market, as explained in

the previous paragraph. Each loan at time t to a firm embodies a default risk ϕ_{jt}. On inspection of the definition of ϕ_{jt}, and of the solution of the production programme of each firm, we find that $\phi_{jt} = \phi_t$ for all j. The bank can insure itself against this risk by borrowing from the central bank at the gross rate K_t, i.e. it can cover all default states $L^s_{bt}\phi_t$ under the obligation to repay the premium $L^s_{bt}\phi_t K_t$ in $t+1$. Since firms are *ex ante* homogenous, competitive pressure will drive the expected return on loans to zero at a single market rate R_t, i.e.:

$$L^s_{bt}R_t(1-\phi_t) - L^s_{bt}\phi_t K_t - L^s_{bt} = 0 \tag{3.11}$$

which implies

$$R_t = (1-\phi_t)^{-1} + \phi_t(1-\phi_t)^{-1}K_t \tag{3.12}$$

The result is that the bank interest rate is determined as a credit risk premium above the central bank rate [32]. At this rate, credit supply is infinitely elastic. Obviously, since in this model the central bank pegs the interest rate, the creation of monetary base is endogenous, being equal to the risk-adjusted fraction of bank loans, $L^s_{bt}\phi_t$

The full model is therefore given by the following equilibrium conditions:

Labour market

$$N^d(\omega_t, R_t/\pi^e_{t+1}) = N^s(\omega_t, \pi^e_{t+1}) \tag{3.13}$$

Credit market

$$L_t = W_t N_t \tag{3.14}$$

$$R_t = (1-\phi_t)^{-1} + \phi_t(1-\phi_t)^{-1}K_t \tag{3.15}$$

Output market

$$Q(N^d(\omega_t, R_t/\pi^e_{t+1})) = C(D_t)/P_{t+1} \tag{3.16}$$

In order to study the comparative statics of this model in the same fashion as in Section 2, let us consider two exogenous impulses from what we may call the "credit variables": dK_t, which represents a monetary policy intervention, and $d\phi_t$, which represents a change in credit risk [33]. In order to focus on key supply-side factors without loss of generality we

[32] Note that for $\phi_t = 0$, $R_t = 1$, and $\partial R_t/\partial\phi_t|_{\phi\in[0,1]} > 0$.

[33] In order to separate off K_t and ϕ_t in the equation of R_t, it is convenient to linearize it by means of the first-order Taylor expansion around $K_0 = 1$.

have set $C(D_t) = D_t$. By virtue of the rational expectations hypothesis, we obtain the following intertemporal equilibrium variations in the real wage ω_t, output $Q(t)_{t+1}$ and inflation π_{t+1}:

$$\begin{bmatrix} dw_t \\ dQ(t)_{t+1} \\ d\pi_{t+1} \end{bmatrix} = \frac{1}{\Delta} \begin{bmatrix} N_w^d(1 + N_\pi^s(1 - Q_N) \\ -N_w^d Q_N(N_\pi^s - N_w^s) \\ N_w^d(1 + N_w^s(1 - Q_N) \end{bmatrix} (dK_t + d\phi_t) \qquad (3.17)$$

$$\Delta = (1 + N_w^d(1 - Q_N))(N_\pi^s - N_w^s)$$

This result can be used to examine and discuss theoretical and empirical issues in the credit view. Here we restrict discussion to two main testable implications of the model. The first concerns the non-neutrality of credit variables, the second concerns the correct identification of the credit channel for empirical analysis.

3.3 *Non-neutrality*

First of all, system (3.17) yields the following non-neutrality proposition:

(P1) *The REE real variables, employment and output, are negatively correlated with the credit variables if* $Q_N < 1$, $N_\pi^s \neq N_\omega^s$.

This is, for obvious reasons, the most controversial issue. Whilst by standard reasoning one may expect credit risk to be a ''real'' phenomenon with ''real'' effects, one may find it less plausible that a ''monetary'' phenomenon such as the nominal discount rate has exactly the same real effects. Our model, where neither price stickiness nor ''money illusion'' are present, sheds light on the conditions under which non-neutrality holds.

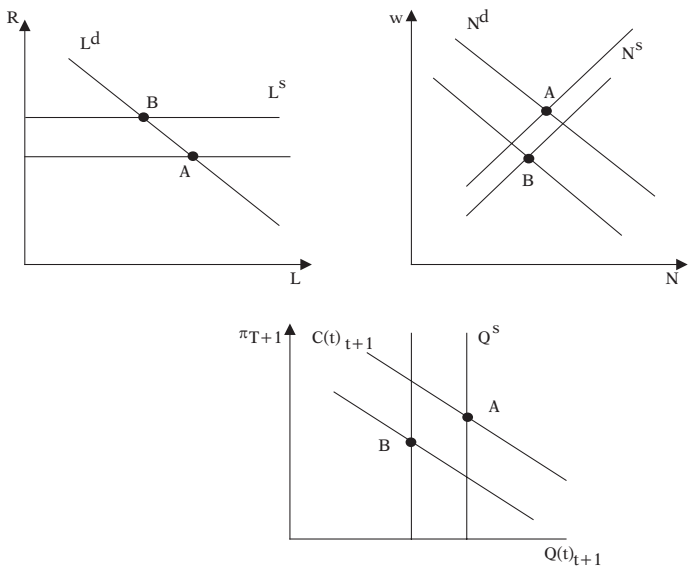
First, the core of the transmission mechanism are the following elements: *i*) shifts in *credit supply* that *ii*) permanently alter the *real expected marginal cost* of firms, as a consequence of the compound change in interest rate, the wage rate and expected inflation, and consequently, *iii*) permanent changes in employment and output. Second, there are three key parameters that rule the effects of this mechanism: Q_N, N_π^s, N_ω^s. In what follows, we shall discuss some issues connected with these two points, and with particular reference to the discount rate.

1) Provided that $N_\pi^s \neq N_\omega^s$, the responsiveness of ouput to changes in the discount rate depends on the output elasticity to labour inputs Q_N. The condition $Q_N < 1$ can be regarded as consistent with non-increasing returns to production in a large class of production functions (the Cobb-Douglas function is the typical example). Hence we can consider this condition as sufficiently general according to current theoretical standards.

2) The condition $N^s_\pi \neq N^s_\omega$ is more complex. N^s_ω measures labour-supply changes in relation to the current real wage. As explained in the Appendix, P_t relative to W_t acts as a wealth effect, determining the amount of consumption available during the working period t and, indirectly, the amount of labour supply. At the same time, N^s_π measures the reaction of labour supply to changes in the intertemporal consumption profile induced by changes in expected inflation. Note that the labour supply function that we have obtained nests two noteworthy special cases. The first is the well-known New Classical function *à la* Sargent-Wallace where labour supply only depends on *the expected real wage*, which obtains if $N^s_\pi = N^s_\omega$. The second is the function adopted by Greenwald - Stiglitz (1993a), Delli Gatti - Gallegati (1997), and others, where labour supply only depends on *the current real wage*, $N^s_\pi = 0$, i.e. workers ignore future consumption. The former specification leaves the system undetermined under rational expectations. The latter ensures that $d\omega_t < d\pi_{t+1}/dK_t < 0$. Yet both special cases seem to impose unwarranted restrictions.

3) In general, the relative magnitude of N^s_π and N^s_ω measures the intensity of intertemporal substitution effects on labour supply. As is well known, this factor has played a major role in the development of the real business cycle theory. Whereas that theory has been weakened by the need for implausibly high intertemporal substitution effects, if $N^s_\pi < N^s_\omega$ (which

FIGURE 3 - *An increase in the discount rate*



implies $\Delta < 0$) the credit transimission mechanism does yield the plausible negative correlations $d\omega_t/dK_t$, $d\pi_{t+1}/dK_t < 0$. The reason can be explained with the help of Figure 3.

Assume the economy is in equilibrium at points A, and consider the case that the central bank raises the discount rate $dK_t > 0$. This displaces the credit supply function (left-hand panel), R_t increases and generates a higher (expected) real interest rate for firms (due to higher R_t *and* lower π^e_{t+1}). Hence labour demand shifts downwards (right-hand panel). As the nominal wage rate W_t falls relative to P_t, workers are induced to supply less labour (along the previous supply schedule), while lower π^e_{t+1} induce them to supply more (shifting the supply schedule downwards), adding further competitive pressure on ω_t. The condition $N^s_\pi < N^s_\omega$ implies that this latter effect is weaker than the former, so that the overall fall of ω_t does not compensate for the rise in the real interest rate, thus leaving firms with higher real marginal costs. The consequence is a net cut in employment and output.

4) The model also provides a straightforward explanation for the observed pattern of large adjustments in quantities and small ones in prices following monetary policy interventions. This is due to fact that, owing to the credit transmission mechanism, both aggregate demand and supply are affected *in the same direction*. As can be seen in the lower panel of Figure 3, after an increase in K_t, the output market in period $t+1$ will receive less supply and less demand, the latter being due to the lesser amount of credit-deposits created in period t. Consequently, the fall of P_{t+1} relative to P_t will be small, or *seemingly* ''sticky'', in relation to the observed change in output (see Stiglitz 1992).

To conclude: the thrust of our analysis is that the credit transmission mechanism can have supply-side effects as it activates compound movements in the bank interest rate, the wage rate and inflation that may not compensate each other. This result is implicit in Greenwald - Stiglitz (1988a, 1993a) and Delli Gatti - Gallegati (1997) The latter paper, which, unlike those by Greenwald and Stiglitz embodies a complete AD-AS model similar to the one presented here, also concludes that in RE-equilibrium aggregate supply depends on the interest rate [34]. In these papers, however, labour market relations are postulated without explicit demand-supply

[34] Delli Gatti and Gallegati also analyze a regime with fully exogenous money supply. They also include the value of internal funds in the aggregate supply function and show that a further NWC of *short-run* neutrality operates as long as firms' expected price differs from the the actual price in $t+1$.

analysis, and they therefore are unable to specify the labour market conditions under which the result holds.

It may be of some interest to note that the transmission mechanism outlined above has connections with the old credit view and with pre-Keynesian monetary theories of business cycles (see e.g. Trautwein 2000; Blanchard 2000). Absent the ''real anchor'' given by the marginal product of capital, there exists a continuum of general equilibria each characterized by an output-inflation couple $(Q(t)_{t+1}, \pi_{t+1})$ for any given couple (K_t, ϕ_t). Once one equilibrium has been chosen, say by a given inflation target, autonomous changes in credit supply – as represented by the impulse variable ϕ_t – generate spells of real expansion-inflation (or real recession-deflation) characterized by downturns (upturns) in the bank interest rate relative to expected inflation. These may be called BLC credit cycles to distinguish them from the NWC credit cycles studied, for example, by Kyiotaki - Moore (1997)[35]. The policy message has instead a Keynesian outlook in that a deflationary monetary policy, which typically makes bank real interest rates increase, has zero real costs only to the extent that real wages fall as much as real interest rates rise. Our model presents an economy where this condition is not fulfilled owing to workers' preferences in an unfettered labour market. Labour market imperfections may throw other spanners into the works[36].

3.4 *Identification of the credit channel and emprical results*

Empirical analyses of the relevance of supply-side effects of the BLC are much less developed than those concerned with traditional demand-side effects. Very indirect indications that supply-side effects may exist can be obtained with the so-called ''cross sectional'' approach examined in Section 2, that is to say, empirical investigations of the impact of changes in credit conditions on firms' asset and liability management (inclusive of inventories) conducted at disaggregate level. Since, as seen in Section 2, these works generally find that bank-dependent firms, especially medium and small ones, normally resort to credit to buy working capital, and that they are unable to fully cushion credit crunches by means of alternative funds, it may be concluded that in these firms supply decisions tend to react to changes in credit conditions, starting from inventories up to production activity.

In Fiorentini - Tamborini (2000), we performed a direct estimation of

35 Of course, our model does not yield an *endogenous* credit cycle as NWC models do.

36 Developments of policy implications can be found in Delli Gatti - Gallegati (1997) and Tamborini (1997).

a general equilibrium model similar to the one presented here with quarterly Italian data from 1987:4 to 1998:14. Starting from a fully specificied general equilibrium model of the economy, and with the goal of testing the permanent BLC effects indicated by the model, we chose to perform a traditional estimation of the system of equations of the model's rational-expectations equilibrium. Assuming a Cobb-Douglas production function for firms, and a conventional semi-linear utility function for workers, we obtained a log-linearized form of the model which implies $Q_N < 1,\ N_\pi < N_\omega$. We chose as dependent variables the wage index deflated by the production price index, the average bank lending rate, the gross domestic product at constant prices (seasonally adjusted), and the rate of change in the production price index; as explanatory variables the overnight rate as an indicator of the monetary policy stance [37], and a proxy for exogenous credit supply shifts [38]. The time lag $t,\ t+1$ was calibrated to 4 quarters.

Let us first address the ''causation puzzle'' in relation to the correct identification of the credit channel of monetary policy discussed in section 3. In alternative to the identification strategy based on disaggregate analysis, we proposed a technique that is suited to aggregate models since it exploits a full general-equilibrium system of demand-supply equations like (3.17). In brief, the null hypothesis was that the credit channel operates *vis-à-vis* the alternative hypothesis that it does not. The identifying signal given by system (3.17) is the sign of the comovements between R_t

[37] We relied on existing evidence and practice in Italian studies pointing to the overnight rate as a good measure of the monetary policy stance in Italy (De Arcangelis - Di Giorgio 1998; Buttiglione - Ferri 1994).

[38] We would point out to readers interested in this approach a particularly delicate aspect that concerns the measurement of autonomous credit supply shifts, i.e. the variable ϕ_t. We think that inclusion of this variable is important in order to obtain a good identification of the BLC. Yet two major difficulties should be overcome. The first is that in theory and practice part of the credit supply policy of banks may be endogenous, i.e. correlated with some of the dependent variables. The problem is analogous to the one addressed in the empirical models of monetary policy discussed in section 3. This possibility is in fact present in the model presented here, where $\phi \equiv F(u_t^*)$. Inspection of equation (3.4) shows that, for all firms, $u_t^* \equiv W_t N_t R_t / P_{t+1} Q(t)_{jt+1}$; given that the profit-maximizing condition is $Q_N = W_t R_t / P_{t+1}$, it results that $u^* = Q_N N_t / Q(t)_{t+1}$, i.e. the value of output elasticity. The Cobb-Douglas production function thus ensures that u^* is exogenous and constant, and that changes in ϕ_t are to be ascribed to exogenous modifications in the generating function F. However, production functions with non-constant output elasticity may imply that credit risk is either pro-cyclical or counter-cyclical. The second difficulty concerns measurement of credit risk, or at least of true innovations in credit supply. Following the methodology adopted by Christiano et al. (1996) to solve the same problem in the case of monetary policy variables, we used as a proxy for ϕ_t the residuals of an independent regression of total credit on the policy variable, a measure of the cycle and time trend, after controlling for exogeneity and orthogonality.

and $Q(t)_{t+1}$ consequent on each of the exogenous shocks. If H0 holds, after a policy shock R_t should *rise* as $Q(t)_{t+1}$ *falls*. If K_t instead affects aggregate demand and hence credit demand but not credit supply – that is, H1 holds – R_t should *not rise* (and might possibly fall) as a consequence of a reduced credit demand and a constant credit supply. An analogous exercise can be performed with the wage equation. Again, under H0, K_t has a negative effect on ω_t. Under H1, K_t can only have real effects as long as ω_t fails to adjust. This identification scheme of the credit channel is summarized in Table 2. As can be seen, the various cases do not overlap, so that identification can be reliable.

TABLE 2 - *Identification scheme*

	dK_t
H_0	
dw_t	−
dR_t	+
$dQ(t)_{t+1}$	−
H_1	
dw_t	0
dR_t	−,0
$dQ(t)_{t+1}$	−,0

After standard tests for unit roots, cointegration and correct identification of exogenous variables, we estimated the model by means of Phillips' Fully Modified Ordinary Least Squares technique. We found evidence in the Italian economy that credit conditions, and monetary policy to the extent that it induces banks to alter credit conditions, affect the supply-side of the economy according to the transmission mechanism described in this section. The estimated steady-state elasticities of output and the bank lending rate relative to the policy instrument are significantly centered on the values 0.4 and −0.27, respectively, at a 5% confidence level. Inflation is weakly, though correctly (i.e. negatively), related to the policy instrument. These estimates are also consistent with the BLC identification scheme in Table 2. Estimation of the wage rate coefficient yields a correctly signed but non-significant value: this may support the stickiness hypothesis, which however may only *amplify* the real effects of the BLC. With respect to the results favourable to the BLC discussed in Section 2, our estimations of output responsiveness to the policy instrument are in line with those of Buttiglione - Ferri (1994) and Bagliano - Favero (1995). However, if the supply-side analysis of the transmission mecha-

nism is correct, the relevant results should be understood as steady-state, permanent relationships rather than transitory dynamics led by aggregate demand and sticky prices.

CONCLUSIONS

Money supply and monetary policy work through the economy in several different ways. The foregoing investigation into the macroeconomics of the credit view has confirmed that the ''special role of credit'' when capital markets are imperfect or less developed like in Italy contributes significantly to the connection between money and economic activity, and indeed deserves closer attention from macroeconomists. On the other hand, the credit channel of monetary transmission is not easily detectable, nor is it easily predictable and controllable for policy purposes, at very aggregate levels of analysis. Specific firm-bank structures and relationships, as well as local institutional features, determine the credit-channel's transmission of monetary impulses – whether these impulses are amplified or dampened – in a way that requires detailed microeconomic analysis.

Further considerations to be drawn from our analysis can be summarized as follows. Firstly, the shift in theoretical focus implied by the credit view is important, yet whether the credit transmission mechanism has stronger effects than the money transmission mechanism remains largely an empirical matter. Secondly, there are both theoretical and empirical clues pointing to credit conditions as an important vehicle for real supply-side effects of monetary policy that has hitherto been disregarded. Pursuing this view opens some interesting lines of research. On theoretical grounds, the time structure of transactions, contractual arrangements in the labour and credit markets, and the formation and effect of price expectations are all critical elements in modelling a credit economy that call for more careful anlysis. With regard to empirical analysis, it is also important to discriminate the source and nature of the shocks driving the adjustment of real and nominal variables in the economy: credit, real or inflationary shocks trigger different patterns of adjustment, though they all involve the credit transmission mechanism. Discriminating among them is necessary in order to correctly identify the existence and extent of the credit channel in the monetary transmission mechanism.

REFERENCES

AEA (1997), «Is There a Core of Practical Macroeconomics That We Should All Believe?», Panel at the American Economic Association, New Orleans, LA, January 4-6, 1997, Papers and Proceedings of the American Economic Association, *American Economic Review*, 87, pp. 230-246.

ANGELONI I. - BUTTIGLIONE L. - FERRI G. - GAIETTI E. (1995), «The Credit Channel of Monetary Policy Across Heterogeneous Banks. The Case of Italy», Banca d'Italia, *Temi di discussione*, n. 256.

—— - CONTI V. - PASSACANTANDO F. (1997), *Le banche e il finanziamento delle imprese*, Bologna, Il Mulino.

ARDENI P. - MESSORI M. (1996), *Il razionamento del credito*, Bari, Laterza.

BADOCCHI M.G. (1998), *Finanziamento delle imprese, domanda di credito e tassi d'interesse*, unpublished dissertation, University of Trento.

BAGLIANO F.C. - FAVERO C.A. (1995), «The Credit Channel of Monetary Transmission. The Case of Italy», paper presented at the conference «I meccanismi di trasmissione della politica monetaria», Catholic University, Milan.

—— - —— (1998a), «Measuring Monetary Policy with VAR Models: An Evaluation», *European Economic Review*, 42, pp. 1069-1112.

—— - —— (1998b), «Canale creditizio della trasmissione della politica monetaria e intermediazione bancaria. Un'analisi dell'evidenza empirica», in G. Vaciago (Ed.), *Moneta e finanza*, Bologna, Il Mulino.

BANCA D'ITALIA (1997a), «I canali di trasmissione della politica monetaria nel modello econometrico trimestrale della Banca d'Italia», *Temi di Discussione*, n. 316.

BATTACHARYA S. - THAKOR A. (1993), «Contemporary Banking Theory», *Journal of Financial Intermediation*, pp. 2-50.

BERGER A.N. - UDELL G.F. (1992), «Some Evidence on the Empirical Significance of Credit Rationing», *Journal of Political Economy*, 100, pp. 1047-1077.

BERNANKE B. (1993), «Credit in the Macroeconomy», *Federal Reserve Bank of New York Quarterly Review*, 18, pp. 50-70.

—— - BLINDER A. 1988, «Credit, Money, and Aggregate Demand», Papers and Proceedings of the American Economic Association, *American Economic Review*, 78, pp. 435-439.

—— - —— (1992), «The Federal Funds Rate and the Channels of Monetary Transmission», *American Economic Review*, 82, pp. 901-21.

—— - GERTLER M. (1989), «Agency Costs, Net Worth and Business Fluctuations», *American Economic Review*, 79, pp. 14-31.

—— - —— (1990), «Financial Fragility and Economic Performance», *Quarterly Journal of Economics*, 105, pp. 87-114.

—— - —— (1995), «Inside the Black Box: the Credit Channel of Monetary Policy Transmission», *Journal of Economic Perspectives*, 9, pp. 27-48.

—— - MIHOV I. (1995), «Measuring Monetary Policy», *Quarterly Journal of Economics*, 113, pp. 869-898.

BERTOCCO G. (1997), «Il governo della moneta e del credito in Italia. Un'analisi del meccanismo di trasmissione della politica monetaria nel periodo 1960-95», *Politica Economica*, n. 4, pp. 375-215.

BLANCHARD J.O. (2000), «What Do We Know About Macroeconomics that Fisher and Wicksell Did Not?», *NBER Working Papers*, Cambridge, Mass., n. 7550.

BLINDER A. (1987), «Credit Rationing and Effective Supply Failures», *Economic Journal*, 97, n. 3, pp. 327-352.

—— - STIGLITZ J.E. (1983), «Money, Credit Constraints and Economic Activity» *American Economic Review*, 73, pp. 297-302.

BOOT A.W. (2000), «Relationship Banking: What Do We Know?», *Journal of Financial Intermediation*, 9, pp. 7-25.

BUTTIGLIONE L. - FERRI G. (1994), «Monetary Policy Transmission via Lending Rates in Italy: Any Lessons from Recent Experience?», *Temi di Discussione*, Bank of Italy, Rome, n. 224.

CHIADES P. - GAMBACORTA L. (2000), «La ''credit view'' in economia aperta: un'applicazione al caso italiano», Banca d'Italia, *Temi di Discussione*, n. 388.

CHRISTIANO L.J. - EICHENBAUM M. - EVANS C.L. (1996), «The Effects of Monetary Policy Shocks: Evidence from the Flow of Funds», *Review of Economics and Statistics*, 78, pp. 16-34.

CONIGLIANI C. - FERRI G. - GENERALE A. (1997), «La relazione banca-impresa e la trasmissione degli impulsi di politica monetaria», *Moneta e Credito*, n. 198, pp. 139-165.

DALE S. - HALDANE S. (1993), «Bank Behaviour and the Monetary Transmission Mechanism», *Bank of England Quarterly Bulletin*, pp. 478-490.

DE ARCANGELIS G. - DI GIORGIO G. (1998), «In Search of Monetary Policy Measures: The Case of Italy in the 1990s», *Giornale degli Economisti e Annali di Economia*, 57, pp. 213-250.

—— - GIOVANNETTI G. (2000), «Once Again on the Monetary Transmission Mechansim», XLI Riunione Scientifica Annuale della Società Italiana degli Economisti, Cagliari, 26-28 ottobre 2000, mimeo (Società Italiana degli Economisti: http://www.sie.unian.it).

DEDOLA L. - LIPPI F. (2000), «The Monetary Transmission Mechanism: Evidence From the Industries of Five OECD Countries», Banca d'Italia, *Temi di Discussione*, n. 389.

DELLI GATTI D. - GALLEGATI M. (1997), «Financial Constraints, Aggregate Supply and the Monetary Transmission Mechanism», *Manchester School*, 65, pp. 101-126.

—— - TAMBORINI R. (2000), «Imperfet Capital Markets: A New Macroeconomic Paradigm?», in R. Backhouse - A. Salanti (Eds.), *Macroeconomics and the Real World*, Oxford, Oxford University Press, vol. II, pp. 169-202.

DIMSDALE N. (1995), «Banks, Capital Markets, and the Money Transmission Mechanism», *Oxford Review of Economic Policy*, 10, pp. 34-47.

DIAMOND D.W. (1984), «Financial Intermediation and Delegated Monitoring», *Review of Economic Studies*, 51, pp. 393-414.

DORNBUSH R. - FAVERO C.A. - GIAVAZZI F. (1999), «Immediate Challenges for the European Central Bank», *Economic Policy*, 26, pp. 15-64.

EICHENBAUM M. (1992), Comment to Sims C., «Interpreting the Macroeconomic Time Series Facts: The Effects of Monetary Policy», *European Economic Review*, 36, pp. 1001-1111.

—— - (1994), Comment to Kashyap A.K., Stein J.C., «Monetary Policy and Bank Lending», in N.G. Manikw (Ed.), *Monetary Policy*, Chicago, Chicago University Press.

FARMER R. (1984), «New Theory of Aggregate Supply», *American Economic Review*, 74, pp. 920-930.

FAVERO C.A. - FLABBI M. - GIAVAZZI F. (1999), «The Transmission Mechanism of Monetary Policy in Europe: Evidence From Bank's Balance Sheets», *CEPR Discussion Papers*, n. 2303.

FIORENTINI R. - TAMBORINI R. (2000), «Monetary Policy, Credit and Aggregate Supply», *mimeo* [Social Science Research Network (SSRN), Financial Economics section: htpp://www.SSRN.com]

FRIEDMAN B.M. - KUTTNER K.N. (1992), «Money, Income, Prices, and Interest Rates», *American Economic Review*, 82, pp. 472-492.

FOUNTAS S. - PAPAGAPITOS A. (2001), «The Monetary Transmission Mechanism: Evidence and Implications for the European Monetary Union», *Economic Letters*, 70.

GALE D. - HELLWIG M. (1985), «Incentive-compatible Debt Contracts: The One Period Problem», *Review of Economic Studies*, 52, pp. 647-663.

GERTLER M. (1988), «Financial Structure and Aggregate Activity: An Overview», *Journal of Money, Credit and Banking*, 20, pp. 559-588.

—— - GILCHRIST S. (1993), «The Role of Credit Market Imperfections in the Monetary Transmission Mechanism: Arguments and Evidence», *Scandinavian Journal of Economics*, 93, pp. 43-64.

—— - —— (1994), «Monetary Policy, Business Cycles and the Behaviour of Small Manufactoring Firms», *Quarterly Journal of Economics*, 109, pp. 309-340.

—— - HUBBARD R.G. (1988), «Financial Factors in Business Fluctuations», in Federal Reserve Bank of Kansas City, *Financial Market Volatility*, Kansas City.

GIANNINI C. (1992), *Topics in Structural VAR Econometrics*, New York, Springler Verlag.

GOODFRIEND M. - KING R.G. (1997), «The New Neoclassical Synthesis and the Role of Monetary Policy», in B.S. Bernanke, J.J. Rotemberg (Eds.), *NBER Macroeconomics Annual*, Cambridge Mass., MIT Press.

GORDON R. (1990), «What is Keynesian Economics?», *Journal of Economic Literature*, 28, pp. 831-878.

—— - LEEPER E.M. (1994), «The Dynamic Impact of Monetary Policy: an Exercise in Tentative Identification», *Journal of Political Economy*, 102, pp. 1228-1247.

GREENWALD B.C. - STIGLITZ J.E. (1987), «Keynesian, New Keynesian and New Classical Economics», *Oxford Economic Papers*, 39, pp. 119-132.

—— - —— (1988a), «Imperfect Information, Finance Constraints and Business Fluctuations», in M. Kohn - S.C. Tsiang (Eds.), *Finance Constraints, Expectations, and Macroeconomics*, Oxford, Claredon Press, pp. 103-140.

—— - —— (1988b), «Money, Imperfect Information and Economic Fluctuations», in M. Kohn - S.C. Tsiang (Eds.), *Finance Constraints, Expectations and Macroeconomics*, Oxford, Clarendon Press.

—— - —— (1990), «Macroeconomic Models with Equity and Credit Rationing», in R.G. Hubbard (Ed.), *Information, Capital Markets and Investment*, Chicago, Chicago University Press, pp. 15-42.

—— - —— (1993a), «Financial Market Imperfections and Business Cycles», *Quarterly Journal of Economics*, 108, pp. 77-113.

—— - —— (1993b), «New and Old Keynesians», *Journal of Economic Perspectives*, 7, pp. 23-44.

HAWTREY R.G. (1927), *Currency and Credit*, London, McMillan, 3rd ed.

HAHN F. - SOLOW R. (1995), *A Critical Essay on Modern Macroeconomic Theory*, Cambridge Mass., The MIT Press.

HELLWIG M. (1991), «Banking, Financial Intermediation and Corporate Finance», in A. Giovannini - C. Mayer (Eds.), *European Financial Integration*, Cambridge, Cambridge University Press.

HUBBARD R.G. (1998), «Capital Market Imperfections and Investment», *Journal of Economic Literature*, 36, pp. 193-225.

JAFFEE D. - STIGLITZ J. (1990), «Credit Rationing», in B.M. Friedman - F.H. Hahn (Eds.), *Handbook of Monetary Economics*, Amsterdam, North Holland.

KALDOR N. (1982), *The Scourge of Monetarism*, Oxford, Blackwell.

KASHYAP A.K. - STEIN J.C. - WILCOX D.W. (1993), «Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance», *American Economic Review*, 83, pp. 78-79.

—— - —— (1994a), «Monetary Policy and Bank Lending», in N.G. Manikw (Ed.), *Monetary Policy*, Chicago, Chicago University Press.

—— - —— (1994b), «The Impact of Monetary Policy on Bank Balance Sheet», *NBER Working Paper*, n. 4821.

—— - —— (1997), «What a Million Banks Have to Say About the Transmission of Monetary Policy?», *Carnegie-Rochester Conference Series on Public Policy*, p. 42.

KEYNES J.M. (1930), *A Treatise on Money*, in *The Collected Writings of John Maynard Keynes*, ed. by E. Moggridge, London, MacMillan, 1973, vol. IX.

—— (1933), «A Monetary Theory of Production», in *The Collected Writings of John Maynard Keynes*, ed. by E. Moggridge, London, MacMillan 1987, vol. XIV.

—— (1936), *The General Theory of Employment, Interest and Money*, in *The Collected Writings of John Maynard Keynes*, ed. by E. Moggridge, London, MacMillan, 1973, vol. VII.

—— (1937), «Alternative Theories of the Rate of Interest», in *The Collected Writings of John Maynard Keynes*, ed. by E. Moggridge, London, MacMillan, 1973, vol. VIII.

KING S.R. (1986), «Monetary Transmission: Through Bank Loans or Through Bank Liabilities?», *Journal of Money Credit and Banking*, 18, pp. 290-303.

KIYOTAKI N. - MOORE J. (1997), «Credit Cycles», *Journal of Political Economy*, 105, pp. 211-248.

MIRON J.A. - ROMER C. - WEIL D.N. (1994), «Historical Perspectives on the Monetary Transmission Mechanism», in G. Mankiw (Ed.), *Monetary Policy*, Chicago, Chicago University Press.

MAROTTA P. - PITTALUGA G.B. (eds.) (1993), *La teoria degli intermediari bancari*, Bologna, Il Mulino.

MAYER C.P. (1988), «New Issues in Corporate Finance», *European Economic Review*, 32, pp. 1167-1188.

—— (1990), «Financial Systems, Corporate Finance and Economic Development», in R.G. Hubbard (Ed.), *Asymmetric Information, Corporate Finance and Investment*, Chicago, Chicago University Press.

—— (1994), «The Assessment. Money and Banking, Theory and Evidence», *Oxford Review of Economic Policy*, 10, pp. 1-13.

MOORE B. (1988), *Horizontalists and Verticalists*, Cambridge, Cambridge University Press.

MORELLI P. - PITTALUGA G.B. (1997), «Le sofferenze bancarie: tendenze e previsione», *mimeo*, Centro di Economia Monetaria e Finanziaria "Paolo Baffi", Milano.

OKUN A. - PECK M. - SMITH W. (1969), *The 1969 Annual Report of the Council of Economic Advisors*, Washington, U.S. Government Printing Office.

PITTALUGA G.B. (1998), *Il razionamento del credito*, Milano, Franco Angeli.

RADCLIFFE COMMITTEE (1959), *Report on the Working of the Monetary System*, London, HMSO.

ROMER C.D. - ROMER D. (1990), «New Evidence on the Monetary Transmission Mechanism», *Brookings Papers on Economic Activity*, n. 1, pp. 149-213.

RONDI L. - SACK B. - SCHIANTARELLI F. - SEMBENELLI A. (1998), «Firms' Financial and Real Responses to Monetary Tightening: Evidence for Small and Large Italian Companies» *Giornale degli Economisti e Annali di Economia*, 57, 35-64.

SARGENT T. (1986), *Macroeconomic Theory,* New York.

SCHUMPETER J.A. (1934), *A Theory of Economic Development*, Cambridge Mass., Harvard University Press.

STIGLITZ J.E. - WEISS A. (1992), «Asymmetric Information in Credit Markets and Its Implications for Macroeconomics», *Oxford Economic Papers*, 44, pp. 694-724.

TAMBORINI R. (1997), «Il costo del denaro è uno strumento anti-inflazionistico?», *Rivista di Politica Economica*, 87, pp. 57-83.

—— (1999), «An investigation into the New Keynesian macroeconomics of imperfect capital markets», in M. Messori (Ed.), *Liquidity Constraints and Market Failures. The Microeconomic Foundations of New Keynesian Economics*, London, Elgar.

TOWNSEND R. (1979), «Optimal Contracts and Competitive Markets with Costly State Verification», *Journal of Economic Theory,* 20, pp. 265-293.

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

VICARELLI F., a cura di (1974), *Capitale industriale e capitale finanziario: Il caso italiano*, Bologna, Il Mulino.

WICKSELL K. (1898), *Interest and Prices*, London, MacMillan, 1936.

APPENDIX

In this Appendix we provide the derivation of households' labour supply and output demand functions and of banks' credit supply function used in the model set out in Section 3.

A.1 HOUSEHOLDS

Households perform three activities: labour supply, output demand and saving. With respect to the financial structure adopted in Section 2, it will be convenient to limit the scope of assets to money, which is held in bank deposits at zero interest rate [39]. According to the time structure of the economy, at the beginning of each production period t each household h owns the previous period's deposits D_{ht-1}, can sell labour N^s_{ht} at the market wage rate W_t, earn $W_t - N^s_{ht}$ and save D_{ht} for consumption in $t+1$ $C(t)_{ht+1}$, on the expectation of price P^e_{t+1}. Consumption for t $C(t)_{ht}$ can be bought out of $t-1$ production $Q(t-1)_t$ by spending D_{t-1} deposits at the price P_t, before the new production round starts, whereas consumption for $t+1$ $C(t)_{ht+1}$ will be satisfied by $Q(t)_{t+1}$, and so on. Therefore, the general representation of the household's problem as of t is a sequence of choices

[39] This is of course a strong limitation, but it does not alter the substance of the results. Moreover, this assumption is the couterpart of firms' equity rationing in the fashion that has been explained in paragraph 3.1.

$\{C_h : C(t)_{ht+1}, C(t+1)_{ht+2}, \ldots\}$, $\{N^s_h : N^s_{ht}, N^s_{ht+1}, \ldots\}$ such that, for each production period t[40],

$$\begin{aligned} &\max_{C,N} U_{ht} = U(\underset{+}{C_h}, \underset{-}{N^s_h}) \\ &\text{s.t.} \\ &P_t C(t)_{ht+1} \leq D_{t-1} \\ &P^e_{t+1} C(t)_{ht+1} \leq D_t \\ &D_t = D_{t-1} - P_t(t)_{ht} + W_t N_{ht} \end{aligned} \tag{A1}$$

Using P_t as numeraire, the generic form of the solution to the foregoing problem includes a labour supply function of the form:

$$N^s_{ht} = N^s(\underset{+}{\omega_t}, \underset{-}{\pi^e_{t+1}}) \tag{A2}$$

This function reflects the household's choice between working time and consumption in t, *and* between consumption in t and $t+1$. In this model, the value of W_t relative to P_t measures the incentive to work in period t in view of consumption in $t+1$, given the amount of consumption obtained for period t. In fact, for any given value of D_{t-1}, P_t acts as wealth effects, determining the amount of consumption goods $C(t)_{ht}$ with which the household enters the production period. *Cet. par.*, high $C(t)_{ht}$, i.e. low P_t relative to W_t, requires a parallel increase in $C(t)_{ht+1}$ to restore the intertemporal marginal rate of substitution along the optimal consumption path, and therefore the household should also increase labour supply. At the same time, the cross-elasticity between *present* working time and *future* consumption is not nil: higher π^e_{t+1}, i.e. higher P^e_{t+1} relative to P_t, shifts resources from future to current consumption of goods (i.e. output and leisure) so that the labour supply is decreasing in π^e_{t+1}[41].

Looking at the constraints of the household's problem we can also deduce a generic function for consumption, which at the end of each period can be equal to or less than the real value of deposits:

$$C(t)_{ht+1} = C(D_t)/P_{t+1} \qquad C(D_t) \leq D_t \tag{A3}$$

The possibility that $C(D_t) < D_t$ arises because at the end of each period households cannot spend more than previous period's deposits, but may choose to spend less and carry more resources to the next period depending on their intertemporal preferences. In any case, the result is a simple demand function determined by money balances.

40 See Sargent (1986) for a dicussion of general solutions.

41 The fact that households, too, decide under price uncertainty (the actual price P_{jt+1} that any household may pay differs from the expected price $P^e(t)_{t+1}$ with positive probability) may result in their decisions depending on the specific form of the utility function, but does not modify the model's main properties substantially.

A.2. Banks and central bank

Banks collect deposits from households at zero rate, and offer standard debt contracts in a competitive market. Since firms are ex-ante homogenous, banks face no screening problems. However they bear monitoring costs whenever a firm defaults on payments. Credit recovery in case of bankruptcy for any firm j is $P_{jt+1}Q(t)_{jt+1}$. Since the incentive to monitor firms exists up to equality between credit recovery and monitoring cost, without loss of generality we can set the net revenue from defaulting firms to zero [42]. As to the cost of funds, in the absence of the interest rate on deposits, we introduce a kind of cost which is important in bank's risk management and gives an explicit role to play to the central bank as lender of last resort.

In consideration of the time structure of the economy, banks' balance sheets evolve intertemporally over production periods. At the beginning of each t, a bank b can grant loans L^s_{bt}. Loans finance the wage bill for period t and are therefore redeposited by households as savings for period $t+1$ (see paragraph A.1).

$$L^s_{bt} = D_t \tag{A4}$$

The bank expects a gross return from loans (capital and interests) Z^e_{bt} and, in view of the fact that households will claim on D_t, it is committed to fufilling the following liquidity constraint in $t+1$

$$Z^e_{bt+1} \geq L^s_{bt}$$

As explained in paragraph 3.1, each loan at time t to a firm embodies a default risk ϕ_{jt}. After inspection of the definition of ϕ_{jt}, and of the solution of the production programme of each firm, it results that $\phi_{jt} = \phi_t$ for all j. Recalling that the bank expects zero net revenue at time $t+1$ from a defaulting firm, the bank anticipates a liquidity risk (the probability of gross returns falling short of deposits) for each loan with probability ϕ_{jt}. The bank can insure itself against this risk by borrowing from the central bank at the gross rate K_t, i.e. it can cover all default states $L^s_{bt}\phi_t$ under the obligation to repay the premium $L^s_{bt}\phi_t K_t$ in $t+1$. Therefore, under the constraint (A5), the bank's objective function is

$$L^s_{bt}R_{bt}(1-\phi_t) - L^s_{bt}K_t\phi_t - L^s_{bt} \geq 0 \tag{A6}$$

Competitive pressure will drive this expression to equality, and the bank interest rate to the unique market value

$$R_t = (1-\phi_t)^{-1} + \phi_t(1-\phi_t)^{-1}K_t \tag{A7}$$

The result is that the bank interest rate is determined as a credit risk premium above the central bank rate. At the rate R_t all credit demand is satisfied, while the amount $BR_t = L^s_{bt}\phi_t$ of borrowed reserves is created. To maintain the connection with the model in Section 2, we may say that borrowed reserves also show up in the central bank's balance sheet as monetary base H_t. As is obvious, since in this model the central bank pegs the interest rate, the creation of monetary base is endogenous, being equal to the risk-adjusted fraction of bank loans.

[42] See Fiorentini - Tamborini (2000) for detailed analysis.