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Imperfect Capital Markets, Income Distribution and the 'Credit Channel': A General Equilibrium Approach

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Abstract

We develop and analyse a simple general equilibrium model with capital market imperfections We find that the impact of monetary policy on real economic activity depends on the initial distribution of wealth in the economy. Changes in the opportunity cost of funds affect not only the choice of financial source but also the decisions of agents to become entrepreneurs. We also identify a number of new issues that can potentially be addressed by following our general equilibrium approach.

Key Words: Income Distribution, Imperfect Capital Markets, Credit Channel

JEL Classification Codes: G20, E44

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1 Introduction

The strong development of direct finance in recent years has provided an alternative source of funds for a large number of borrowers, especially large firms, which previously relied on bank loans for their financial needs. In practice, bank loans are more expensive than direct finance and as a result only those borrowers without access to capital markets apply for bank loans. The co-existence of alternative sources of finance has recently been the subject of a number of papers.

The choice most frequently examined is that between bank loans and direct debt. In Besanko and Kanatas (1993), Boot and Thakor (1997), Diamond (1991), Holmstrom and Tirole (1997), Hoshi, Kashyap and Scharfstein (1993) and Repullo and Suarez (2000) banks provide costly monitoring services to alleviate a moral hazard problem due to the non-observable choice of technology by firms. Berlin and Mester (1992), Chemmanur and Fulghieri (1997) and Hart and Moore (1995) emphasize the cost advantage that banks have in contract re-negotiation. Finally, Diamond (1977) suggests that when there is limited market participation banks provide liquidity to the markets because the liquidity needs of their large number of depositors are predictable.

Bank loans also might be preferred to equity finance by firms which do not want to reveal information about their innovations. The problem of proprietary information has been studied by Bhattacharya and Chiesa (1995) and Yosha (1995).

The co-existence of bank loans, equity finance and public debt is addressed by Bolton and Freixas (2000), where firms face a high intermediation cost with bank loans, an inefficient liquidation cost with bond finance and an information dilution cost with equity finance.

The above literature has followed a partial equilibrium approach by focusing on the demand side of the funds market. In these models, the economy comprises of a fixed number of firms that each needs funds to finance a project. Firms are distinguished by their level of net worth that determines, if any, their source of finance. Funds are supplied either by financial intermediaries or the capital market (bonds or equity). These models make predictions about the effects of a change in monetary policy (captured by a change in the opportunity cost of funds) on both aggregate investment and the taxonomy of firms according to their source of finance.

These contributions notwithstanding, there are many important unanswered questions.

•Given that agents in the economy can always choose to participate in either side of the market, how do they make this choice? Put differently, what determines the birth and death rates of firms?

•What is the impact of monetary policy on economic activity not only through its effects on the investment decisions of existing firms but also taking into account that it might also affect the total number of firms in the economy?

•How does the distribution of wealth in the economy affect (a) the size of the banking sector relative to the size of the capital market, and (b) the level of economic activity?

Answers to there questions can only be provided from the study of a general equilibrium framework. In this paper, we show that the development of such a framework is not only feasible but also that it can be accomplished at a low cost of excess complexity so that it remains flexible enough in order to allow us to address the above questions.

In the following section, we specify the economic environment. The only source of heterogeneity among economic agents is the level of their initial endowments. In section 3, we find the equilibrium for the benchmark case where there are not any frictions in financial markets. In section 4, we introduce *ex post* informational asymmetries with respect to projects' returns and derive the equilibrium without banking. In section 5, we also endow agents with a costly monitoring technology. To keep things simple at this stage we ignore any economies of scale in banking. As a result, the size of the banking sector is determined by the mass of projects financed by agents who monitor the projects of other agents. We derive a taxonomy of agents according to their decision to become lenders or borrowers and, furthermore, in the latter case, according to their source of finance. In section 6, we analyze the impact of changes in monetary policy on the market equilibrium and we demonstrate that it crucially depends on the initial distribution of endowments. In the final section, we offer suggestions for further research.

2 The Model

There are two periods ($t = 0, 1$).

Agents: There is a continuum of risk-neutral agents of measure 1, indexed by i, who derive utility only from consumption at $t = 1$.

Goods: There is a single good in the economy that can be consumed or used for production or invested in a risk-free asset that yields $Z(> 1)$ units of the good at $t = 1$ for each unit invested at $t = 0$.

Endowments: Agent i is endowed with W_i units of the good at time 0, where $W_i \in [\underline{W}, \bar{W}]$. Let $F(W)$ denote the distribution of endowments across agents and $f(W)$ the corresponding density function. Let $\widehat{W} = \int_{\underline{W}}^{\bar{W}} W_i f(W) dW_i$.

Technologies: Each agent is endowed with a stochastic technology that requires a fixed investment of F units of the good at time 0. The return $\widetilde{X}_i$ at time 1 has the following distribution:

$$\widetilde{X}_i = \begin{array}{c} H \\ L \end{array} \quad with \quad prob \quad \begin{array}{c} p \\ 1-p \end{array}$$

Assumption 1: $pH + (1-p)L \equiv \widehat{X} > F > L$.

Notice that because each project requires a fixed size investment the number of firms (entrepreneurs) in the economy will be perfectly correlated with aggregate investment. Nevertheless, in the final section we show how this model can be extended so that we can examine separately those issues related to the birth of new firms and the death of old firms from the choice of investment level by existing firms.

Information: Endowments and distributions of projects' returns are public information. Realized project returns are either public (perfect capital markets) or private (imperfect capital markets) information.

3 Perfect Capital Markets

In this section, we assume that realized project returns are public information. The expected gross return of the technology $R^*$is equal to $\widehat{X}/F$.

Assumption 2: $R^* > Z$.

Agents with $W_i > F$ can self-finance their technologies and invest the rest of their endowment in the capital market. Let R^E denote the equilibrium interest rate. The following proposition describes the capital market equilibrium:

Proposition 1 *Capital Market Equilibrium:*

a) If $\widehat{W} > F$ *then* $R^E = Z$ *and all technologies are funded,*

b) if $\widehat{W} < F$ *then* $R^E = R^*$ *and the proportion of technologies funded is equal to* $\widehat{W}/F$.

Proof. a) In this case there is an excess supply of credit. All projects will be funded. Competition in the capital market implies that the interest rate will be set equal to the return of the risk-free asset.

b) If $R^E > R^*$ then all agents with $W_i < F$ prefer to invest their endowment in the capital market and, therefore, there is an excess supply of credit. If $R^E < R^*$ then all agents with $W_i < F$ prefer to borrow $F - W_i$ from the capital market and invest in their technologies and, therefore, there is an excess demand for credit. Then, at the market clearing interest rate R^* the proportion of technologies funded is equal to $\widehat{W}/F$. ■

The first case, from an economics point of view is not interesting and, therefore, we are going to restrict attention to case (b).

Assumption 3: $\widehat{W} < F$.

The Modigliani-Miller theorem asserts that in perfect capital markets firms are indifferent about the form of financial contract which is also valid in our model because the derivation of the equilibrium does not depend on the type of financial contract used. In addition, in our model, while the equilibrium proportion of technologies funded is determined, the decision to borrow or lend is not because it does not depend on the level of endowments, W_i. Both decisions yield the same gross return, R^*.

Proposition 2 *In perfect capital markets agents are indifferent: a) about the form of financial contract, and b) between being borrowers or lenders.*

4 Imperfect Capital Markets without Banking

From now on we assume that realized project returns are private information. Let X_i be the realization of $\widetilde{X}_i$.

Assumption 4: X_i is private information.

The informational asymmetry implies that the maximum amount that lenders are willing to lend to any borrower is equal to L/R^E; because borrowers have always the incentive to report that $X_i = L$. Then, all loans are risk-free because the repayment does not depend on the realization of $\widetilde{X}_i$. Therefore, all agents with $W_i < F - (L/R^E)$ will either invest their endowment in the capital market or invest it in the risk-free asset. Depending on the parameters of the model there are three possible equilibria:

Proposition 3 *Imperfect Capital Market Equilibrium:*

a) If $\int_{F-(L/Z)}^{\bar{W}} f(W)dW_i < \widehat{W}/F$ *then* $R^E = Z$ *and there is an excess supply of credit that is invested in the risk-free asset.*

b) if $\int_{F-(L/R^*)}^{\bar{W}} f(W)dW_i > \widehat{W}/F$ *then* $R^E = R^*$ *and the proportion of technologies funded is equal to* $\widehat{W}/F$*.*

c) if $\int_{F-(L/Z)}^{\bar{W}} f(W)dW_i \geqslant \widehat{W}/F \geqslant \int_{F-(L/R^*)}^{\bar{W}} f(W)dW_i$ *then* $Z \leqslant R^E \leqslant R^*$ *and the proportion of technologies funded is equal to* $\widehat{W}/F$*.*

Proof. The equilibrium interest rate defines a cut-off endowment level, $W^c(R^E)$, such that all agents with $W_i < W^c(R^E)$ can not finance their technologies. This cut-off value is increasing in the equilibrium interest rate.

a) The lowest value that the equilibrium interest rate can attain is equal to Z because at lower interest rates agents prefer to invest in the risk-free asset to investment in the capital market. The left-hand side of the inequality is equal to the proportion of agents with $W_i \geqslant W^c(Z)$. When the inequality holds there is an excess supply of credit because the proportion of technologies that lenders are willing to fund is less than the proportion of technologies that could be funded given the aggregate endowment.

b) The highest value that the equilibrium interest rate can attain is equal to R^* because at higher interest rates agents prefer investment in the capital market to investment in their technologies. The left-hand side of the inequality is equal to the proportion of agents with $W_i \geqslant W^c(R^*)$. When the inequality holds the proportion of technologies that, in principle, lenders would be willing to fund is higher than the proportion of technologies that can be funded given the aggregate endowment. In this case, the informational asymmetry does not affect the equilibrium outcome.

c) In this case, there is an excess demand for credit when the interest rate is equal to Z and an excess supply of credit when the interest rate is equal to R^*. Then, the equilibrium interest rate is determined by the following equality: $\int_{F-(L/R^E)}^{\bar{W}} f(W)dW_i = \widehat{W}/F$. ■

5 Imperfect Capital Markets with Banking

Suppose that agents are also endowed with the following monitoring technology:

Monitoring Technology: They can observe the realized returns of other agents' technologies at a cost $m > 0$ per loan unit.

Let P denote the loan repayment that a contract specifies when the return is equal to H and let B denote the size of the loan. Then if the following condition holds an agent will be indifferent between investing in the capital market and offering a loan to an agent with $W_i < W^c(R^E)$:

$$BR^E = pP + (1-p)L - (1-p)mB \tag{1}$$

The expected loan repayment minus the expected monitoring cost must be equal to the gross capital market return. The above condition implies that:

$$P = \frac{1}{p}\left[B(R^E + (1-p)m) - (1-p)L\right] \tag{2}$$

An agent with wealth $W_i < W^c(R^E)$ will be indifferent between investing in the capital market and borrowing $F - W_i$ iff:

$$W_i R^E = p\{H - \frac{1}{p}\left[(F - W_i)(R^E + (1-p)m) - (1-p)L\right]\}$$

which can be rewritten as:

$$\widehat{X} - FR^E = (F - W_i)(1-p)m \tag{3}$$

This equality implies that the equilibrium interest rate defines a cut-off endowment level, $W^b(R^E)$, such that all agents with endowments below that level invest their endowments in the capital market. Let R_b denote the interest rate charge by lenders who monitor.

Proposition 4 *Imperfect Capital Market and Banking Equilibrium:*

a) If $\int_{F-(L/R^*)}^{\bar{W}} f(w)dW_i \geqslant \widehat{W}/F$ *then* $R^E = R^*$ *and the proportion of technologies funded is equal to* $\widehat{W}/F$*,*

b) if $\int_{F-(L/R^*)}^{\bar{W}} f(w)dW_i < \widehat{W}/F$ *then either*

i) $Z < R^E < R^*$ *,* $R_b = R^E + (1-p)m$*, the proportion of technologies funded is equal to* $\left[\widehat{W} - (1-p)m \int_{W^b(R^E)}^{W^c(R^E)} f(W)dW_i\right] /F$ *and there is no investment in the risk free asset, or*

ii) $R^E = Z$*,* $R_b = Z + (1-p)m$*, the proportion of technologies funded is less or equal to* $\left[\widehat{W} - (1-p)m \int_{W^b(Z)}^{W^c(Z)} f(W)dW_i\right] /F$ *and the total investment in the risk-free asset is equal to* $\widehat{W} - (1-p)m \int_{W^b(Z)}^{W^c(Z)} f(W)dW_i - F \int_{W^b(Z)}^{\bar{W}} f(W)dW_i$*.*

Proof. a) This case corresponds to case (b) of Proposition 3; i.e. informational asymmetries do not affect the equilibrium outcome.

b) The equilibrium interest rate charged by agents who monitor is determined by the following condition:

$$BR_b = pP + (1-p)L$$

Using (2) we find that $R_b = R^E + (1-p)m$.

i) In this sub-case the equilibrium interest rate is higher than Z and, therefore, no agent invests in the risk-free asset. All agents with $W^b(R^E) \leqslant W_i < W^c(R^E)$ borrow $F - W_i$ at the interest rate R_b and their investments are monitored. All agents with $W^c(R^E) < W_i < F$ borrow $F - W_i$ from the capital market at the interest rate R^E. All agents with $F < W_i$ self-finance their technologies and invest $W_i - F$ either in the capital market or in other technologies that they monitor. All agents with $W_i < W^b(R^E)$ invest W_i either in the capital market or in other technologies that they monitor. The equilibrium capital market interest rate is determined by the following market clearing condition:

$$\int_{\underline{W}}^{W^b(R^E)} W_i f(W)dW_i + \int_F^{\bar{W}} (W_i - F)f(W)dW_i =$$

$$\int_{W^b(R^E)}^{W^c(R^E)} (F - W_i) f(W) dW_i + \int_{W^c(R^E)}^{F} (F - W_i) f(W) dW_i +$$

$$(1-p)m \int_{W^b(R^E)}^{W^c(R^E)} f(W) dW_i$$

The left-hand side of the equality corresponds to the total supply of funds. The first two terms on the right-hand side correspond to the demand for funds and the third term to the aggregate spending on monitoring costs.

ii) In this sub-case the market clearing interest rate that satisfies the above condition is less or equal to Z. The equality holds when the solution of the above market clearing condition is equal to Z. When it is less than Z agents prefer to invest in the risk-free asset than either investing in the capital market or in other technologies that they monitor. Agents of type $W^b(Z)$ are indifferent between borrowing from other monitoring agents or lending and monitoring the technologies of other agents or investing in the capital market or investing in the risk-free asset. ■

6 Monetary Policy

In the context of our model, we can analyze the impact of monetary policy by examining the effects of changes in the return of the risk-free asset on the total volume of credit and its allocation between bank and market finance. Proposition 4 suggests that the equilibrium outcome depends on both the stance of monetary policy (i.e. the level of Z) and the initial distribution of endowments. Below we examine how the distribution of wealth affects the impact of a change in monetary policy on the equilibrium outcome for a given initial level of the risk-free rate.

When case (a) describes the equilibrium, monetary policy is ineffective since Z does not appear in the solution. A close look at the inequality reveals that this takes place when the average wealth of the economy is low relative to the proportion of wealthy agents; i.e. those with a wealth level sufficiently high so that, in principle, can finance their projects in the capital market. Therefore, the demand for funds by these agents exceeds the available supply.

The equilibrium interest rate in the capital market is determined by the project return R^*.

In case (bi) the risk-free rate is sufficiently low so that it does not affect the market equilibrium. The mass of agents with low and average levels of endowments is higher than in case (a); assuming the same average endowment level, $\widehat{W}$. Some of those agents with average level of endowments finance their projects by borrowing funds from other agents who monitor their projects. The market clearing interest rate is above the risk-free rate. The proportion of projects funded is lower than in case (a) because of the monitoring cost. Either a decrease or a small increase of the risk-free rate will not affect the equilibrium outcome. However, a severe tightening of monetary policy (a large increase in Z) will further reduce the mass of projects funded. In fact, this would result in moving the economy from a type (bi) equilibrium to a type (bii) equilibrium.

Case (bii) corresponds to distributions of wealth where the mass of agents with low levels of wealth is high. This is the case mostly considered in the literature where the market equilibrium rate is equal to the opportunity cost of funds. The reason is that, in the absence of a risk-free asset, the market clearing rate would be less than Z. As a consequence, some of the endowments are diverted away from investment and the proportion of projects funded is lower than the one corresponding to case (bi). A decrease in the risk-free rate would free funds for investment and stimulate economic activity. On the contrary, a tightening of monetary policy would decrease the proportion of projects funded by agents who monitor (banking activity would decrease).

7 Discussion and Extensions

In recent years economists have identified to main channels through which monetary policy influences the real economic activity. The first, known as the *bank lending channel*, stresses the importance that banks' balance sheet positions and banking regulations have for the transmission of monetary policy. The literature on the bank lending channel is surveyed in Kashyap and Stein (1994). The second, known as the *broad credit channel*, by emphasizing the imperfect substitutability of alternative types of credit, focuses on the impact of monetary policy on the allocation of credit through its effects on firms' balance sheets. The literature on the broad credit channel is surveyed in Gertler (1988), Hubbard (1995) and Kashyap and Stein (1994) and can be classified into three groups. Early work used standard extensions of the IS/LM that allow for imperfect substitutability between bank loans and bonds. Another group, following the financial accelerator literature, has examined the impact of monetary policy on economic activity through its effects on borrowers' financial positions. The third group of models analyses the implications of monetary policy for the investment decisions of firms recognizing that changes in the cost of funds affects the allocation of credit between different forms of external finance.

The general equilibrium model presented in this paper belongs to the last group. Our approach has allowed us to endogenize the decision of agents to participate either on the supply side or the demand side of financial markets and, as a result, we are able to make predictions not only about the investment decisions of existing firms but also about the number of firms in the economy. We mentioned above at this early stage we have fixed the size of projects. This has allowed us to concentrate on the effects of income distribution on the total availability of external finance and its allocation among alternative sources. The next step, would be to substitute a neo-classical technology for the one postulated above. In that case, agents with high levels of initial endowments would still choose the same level of investment, that is the first-best optimal level. However, agents with medium levels of wealth would face liquidity constraints and their investment levels would be sub-optimal. Then, an interesting issue to investigate is how the distribution of initial endowments and the stance of monetary policy affect the level of underinvestment.

We could have introduced economies of scale in monitoring activities and allow for the endogenous formation of financial intermediaries. However, at this stage it is not clear how these complications would offer any insights beyond those already gained through the seminal work of Diamond (1994). However, we could add labor as another input in the production function and then agents would need to decide how to divide their time between working and monitoring. This approach could enhance our understanding of economies in their early stages of development where efficiency gains in the financial sector would translate in gains in production efficiency. Naturally, this extended version would allow us to address a number of other issues such as (a) the impact of monetary policy on employment by taking into account the employment decisions of existing firms and the gains or losses through the creation of new firms or the destruction of old firms, and (b) the role of monetary policy for developing economies.

For along time, the important role that financial markets play for economic development has been the subject of an extensive literature surveyed by King and Levine (1993). Most of the early literature has focused on the emergence of financial intermediaries that alleviate capital market imperfections either by sharing risks more efficiently or by providing monitoring services. More recently, research in this area has evolved along two paths. The first one followed, for example, by Boyd and Smith (1996, 1998) studies the evolution of equity markets along an economy's development path. The second one involves research that provides a link between imperfections in capital markets and income inequality; see Aghion and Bolton (1992, 1997) and Greenwood and Jovanovic (1990). A dynamic version of our model would provide a natural set-up for considering these issues together. Potentially, it could provide answers to the following questions: (a) How does the co-evolution of the real and financial sectors depend on the initial distribution of wealth? (b) How is the evolution of wealth distribution influenced by the state of development of financial markets? And how do capital market imperfections affect income inequality?

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