

Agency Costs, Net Worth and Endogenous Business Fluctuations

Giovanni Favara*

February, 2006

Abstract

The role of credit market imperfections as source of amplification and persistence of temporary exogenous shocks to the economy is widely accepted in the literature. Little attention has been paid to the possibility that credit frictions also generate instability. This paper proposes a theory of business fluctuations where the source of the oscillatory dynamics is an agency problem between investors and entrepreneurs. A central tenet of the theory is that investment decisions depend upon entrepreneurs' incentive to exert effort *ex-ante* and investors' incentive to control entrepreneurs *ex-post*. This double-sided incentive is used to show how recessions prevent entrepreneurs from engaging in unproductive activity and booms facilitate the adoption of unproductive arrangements, so that recessions sow the seeds for a subsequent boom while economic expansions create the conditions for their own demise.

JEL:E 32, E 24

Keywords: Credit market imperfections; Double moral hazard; Business cycles; Endogenous fluctuations.

1 Introduction

Starting with the seminal contributions of Bernanke and Gertler (1989) and Kiyotaki and Moore (1997), a large theoretical literature in macroeconomics has studied the implications of credit market imperfections for investment and output dynamics. At the heart of this literature is the inverse relationship

*IIES-Stockholm University. E-mail: giovanni.favara@iies.su.se. I wish to thank Torsten Persson and Fabrizio Zilibotti for support and advice at different stages of this project. I am also indebted to Nicola Gennaioli for constructive discussions and insightful comments and to Martin Bech Holte and Bard Harstad for special comments. I have also benefited from comments by John Hassler, Dirk Niepelt, Michael Song, David Stromberg, Mirco Tonin and seminar participants at IIES (Stockholm) and Sverige Riksbank. Editorial assistance by Annika Andreasson and financial support by the Jan Wallander och Tom Hedelius Research Foundation is gratefully acknowledged.

between firms' financial assets, or equivalently internal funds, and the agency costs of investment. When asymmetric information or moral hazard problems entail agency costs in lending relationships, firms' debt capacity is constrained by the level of assets that can be pledged to outside lenders. An adverse shock that worsen financial conditions may therefore generate a negative spiral, where low profits reduce debt capacity and hence investment, which further reduces profit, amplifying the initial negative shock, and so forth. This amplification mechanism, known as the credit multiplier or the financial accelerator, has been extremely influential in explaining how relatively small and temporary exogenous shocks to the economy may be amplified and become persistent.¹

A salient feature of models featuring a credit multiplier is that agency costs are more severe in recessions than in booms, precisely because agency costs are inversely related to firms' net worth, which is procyclical. While in recessions a firm's ability to finance productive investment is constrained by its balance sheet conditions, financial frictions are mitigated in booms as higher net worth relaxes incentive constraints, thus reducing the conflict of interest with outside investors. The dynamics of cyclical fluctuations that arise from this class of models are thus intrinsically nonlinear. The credit multiplier mechanism is more forceful the deeper the recession, but tends to disappear in a boom as improved financial conditions mitigate the agency cost of investment finance. In absence of exogenous shocks that impair balance sheets, these models are therefore unable to explain why periods of expansion may sow the seeds for future recessions.

This paper presents a model where credit market imperfections are source of endogenous business fluctuations, rather than being a mere source of propagation of exogenous shocks. The key assumption of the analysis is that the profitability of investment projects depends upon the joint effort of investors and entrepreneurs. That is, cash flows are generated under two conditions. First, entrepreneurs need to exert effort in acquiring information about project characteristics. Second, investors need to control the selection of projects, ruling out those that, for example, confer private benefit to the entrepreneur at the expense of cash flows. Underlying this assumption is the idea that bank-like financial intermediaries play a dual role in lending relationships, by limiting entrepreneurs' moral hazard through adequate control and valuations of alternative investment projects, and by assisting entrepreneurs to set up their business by means of specialized expertise.²

¹For a survey of this literature see Bernanke, Gertler and Gilchrist (1999).

²See Diamond (1991), Besanko and Kanatas (1993) and Holmstrom and Tirole (1997), among others, for papers that emphasize the role of banks in limiting entrepreneurial moral hazard, and Manove, Pagano and Padilla (2001) and Inderst and Mueller (2004) for the idea that because of their expertise banks often play an essential role in assisting entrepreneurs. Empirical support to the fact that banks provide special service to the entrepreneur, not available to other lenders, can be found in James (1987), Billet Flanery and Garfinkel (1995), Thakor (1996). The importance of specialized screening and monitoring abilities as well as superior knowledge in some sectors of the economy is also stressed, with reference to venture

More specifically, this paper proposes the following mechanism. An entrepreneur needs to borrow funds from a competitive investor to start one of different potential investment projects. Projects differ in terms of verifiable cash flows and non-verifiable private benefits. The entrepreneur may receive non-transferable private benefits from operating or managing a project, but these private benefits are inefficient, in the sense that they reduce the project's profitability. This generates a basic conflict of interest with the investor since the entrepreneur would like to undertake projects with some private benefits, even if this comes at the cost of lower cash flows. In contrast, the investor can only put her hands on the verifiable cash-flows and thus prefers to finance projects that maximize the size of cash flows or minimize the extent of private benefits.

Before proposing an investment project to the investor, the entrepreneur engages in a costly process of project evaluation. This enables him to understand the project's characteristics and to pick the most preferred one. After the entrepreneur's proposal is made, the investor has the option to exercise some control that gives her the right to affect the course of actions before a project gets started. Interference in the implementation of the project is value enhancing because it forces the entrepreneur to give more weight to cash flows and less weight to private benefits. Too much interference, however, comes at the cost of destroying private benefits, which in turn dilutes the entrepreneur's ex-ante incentive to evaluate projects. Thus, although excess control guarantees that only high cash flow projects get their way, it also stifles the entrepreneur's initiative to propose any projects. This interplay between investor control and entrepreneur effort is the key determinant of endogenous fluctuations in this economy.

In particular, the driving force of the analysis is that neither entrepreneurial effort nor investor control are contractible. This implies that both parties' acquisition of information is endogenous and affected by the relative costs and incentives. Under the assumption of perfect competition in the credit market, the investor's incentives to interfere in the entrepreneur's selection of projects depend uniquely on her concern to break-even. Monitoring incentives are high if financial exposure towards the entrepreneur is large and low when exposure is small. Therefore, when the entrepreneur has low wealth and has to rely extensively on outside funds, the investor controls scrupulously the entrepreneur's selection of projects and endorses only projects that maximize cash flows. Vice-versa, when the entrepreneur's net worth increases and thus needs to borrow less, the investor's incentives to engage in monitoring activity are blunted, since she needs to be compensated less for her investment. A wealthier entrepreneur, therefore, acquires independence from the investor and eventually undertakes projects with lower profitability but higher private benefits — as long as the value of these private benefits is higher than the residual share of cash flows that he can pocket after having repaid the investor.

capitalists, by Gompers and Lerner (1999), Casamatta (2003) and Kaplan and Stromberg (2004), to cite a few.

If such a mechanism is embedded in a simple dynamic model with overlapping generations, interesting endogenous investment dynamics arise. In particular, endogenous reversal of booms may take place even though no external shocks hit the economy, and even though entrepreneurs and investors are perfectly rational. The logic is straightforward. During boom times, when entrepreneurs can supply a large fraction of the initial investment, the incentives of investors to control project characteristics are weak. Since investor control is valuable, the undesired effect is that the average project productivity in the economy deteriorates. Moreover, reduced investor control has the additional effect of inducing entrepreneurs to propose those (low-productivity-high-private-benefit) projects that would hardly pass investors evaluation test during periods of “normal” control activity. Thus, at the peak of an economic boom less and less productive projects get their way, which paves the way for a subsequent downturn. The opposite effect occurs in “bad time”: ruthless cash-flow maximization by investors improves the average productivity of projects, promoting a new period of expansion. Tight investor control, however, comes at the cost of reducing entrepreneurs incentives to evaluate projects. Thus in downturns only a few projects are proposed, but those undertaken are very profitable.

In the mechanics of the model, the condition under which fluctuations arise take the very simple form that the cost of control for the investor (or the degree of the agency problem) is neither too high nor too low. Under this condition the economy either converge to its steady state in an oscillatory manner, or never reach the steady state and keep on cycling between periods of boom and recession. Conversely, if the cost of control is too high, (or the agency problem big) the economy does not experience instability but converges monotonically to a stable steady state, featuring low investment.

Overall, the agency problem emphasized in this paper, and its variation over the cycle, has two main implications. First, it suggests that increased firm internal finance may lower rather than increase economic efficiency. This implication is in line with Jensen’s theory of “free cash flows”, but stands in sharp contrast with a standard model with credit frictions in which more borrower net worth reduces agency costs and therefore restores efficiency. In the story of this paper, better balance sheets are not necessarily associated with more efficient modes of production or allocation of resources, because lower investor control impairs project profitability. Second, exogenous shocks to the economy may be dampened rather than amplified. This is another point of divergence with respect to the standard models based on the credit multiplier. The reason credit markets act as dampeners of shocks in this economy is easy to grasp. A positive shock to firm net worth, relaxes investor incentives to control activity and less and less profitable investments are financed, shortening the boom period and initiating a new recession. A similar, but inverted mechanism occurs after a negative shock to firm net worth. Whether the financial sector acts in dampening or amplifying exogenous shocks still remains an open question in the literature.

This model is not only able to generate endogenous fluctuations in business investments. It also captures salient features of investment dynamics and lending patterns. For example, the model is consistent with the finding that firms' investment is highly dependent on internal funds (see Hubbard for an extensive survey, 1998). In the model, this dependence arises since low net worth triggers investor control and depresses entrepreneurial effort, limiting the total amount of investment undertaken. Another implication of the model is that only productive projects are financed in bad times. This prediction is in line with findings documenting a clear tendency of banks to extend credit only to "good" borrowers during periods of slumps. Such "flight to quality" (see Bernanke, Gertler and Gilchrist, 1996) is commonly taken as evidence that firms with weak financial conditions are more likely to be credit rationed in recession than in boom. Finally, the model captures the importance of lending practices for investment dynamics. For the US, for example, Asea and Blomberg (1998) find that bank lending standards are countercyclical, and lending to risky and less productive borrowers increases when times are good and decreases in bad times.

The rest of the paper proceeds as follows. Section 2 provides a review of the related literature. Section 3 sets up the basic model, studies in a static set-up the main trade-off that arises in the investor-entrepreneur relationship and fleshes out the main macroeconomic implications. Section 4, embeds the analysis into a general equilibrium OLG framework in order to study some dynamics, and to show under which conditions endogenous fluctuations may emerge. Section 5 discusses some of the key assumptions of the model. Section 6 concludes.

2 Related Literature

This paper is related to different strands of literature. First of all, it builds on the insights of Bernanke and Gertler (1989) and Kiyotaki and Moore (1997) that credit market frictions affect investment and output dynamics. It goes beyond those papers, however, in examining how agency costs in credit markets may be a potential source of endogenous macroeconomic fluctuations, and not only a source of amplification of exogenous shocks.

In this respect, the paper is close to the recent contributions of Aghion, Banerjee and Piketty (1999) and Matsuyama (2004). Both papers emphasize the role of a pecuniary externality that arises in an economy in which credit markets are not perfect and borrowers net worth mitigate credit frictions.³ In Aghion *et al.*, the pecuniary externality comes from the general equilibrium effects of the interest rate.⁴ In Matsuyama, it comes from the optimal selection

³Suarez and Sussman (1997) and Azariadis and Smith (1997) have also examined the importance of credit market frictions for endogenous fluctuations. In their set-up, however, borrower net worth has no role to play.

⁴A similar mechanism, operating through the endogenous movements in the price of productive inputs, is explored in Aghion, Bacchetta and Banerjee (2003).

of investment projects that generate different demand spillover in the economy. My contributions is related to both papers for two reasons. As in Aghion *et al.*, there is a separation between lenders and borrowers, in the sense that not everyone in the economy is in the position to run investment projects, and, as in Matsuyama, entrepreneurs have access to projects with different productivity. It differs, however, from both contributions since it stresses the role played by the financial intermediaries in permitting less productive investments to get their way during periods of boom. More importantly, it differs from both papers because the credit market friction is not exogenously imposed, by assuming that only a fraction of the project return is pledgeable to outside investors. In my setting, the credit market imperfection arises explicitly because of the double-incentive problem at the entrepreneur and investor level.

One prediction emanating from my model is that recessions may be beneficial because low borrower net worth induce investors to evaluate projects scrupulously, forcing entrepreneurs to shift to more efficient modes of production. The idea that recessions are beneficial is related to the view advanced by Caballero and Hammour (1994, 1996), among others, that recessions drive out or “cleanse” the least efficient production arrangements, through a process of optimal job reallocation across sectors. In my paper, the beneficial effects of recession arise because of the strengthened investor incentives to finance only productive projects, if entrepreneurs have limited resources to pledge.⁵

Within the large literature on macroeconomic fluctuations, this paper is also related the theory of endogenous business cycles (see Boldrin and Woodford (1990) for a comprehensive survey). It differs, however, from most of the papers in this literature because cycles do not originate from special assumptions on preferences and technology, but only from the existence of imperfections in the credit market, which endogenously affect the overall level of productivity in the economy.

Moreover, this paper is connected to several contributions in the banking literature. The role played by the investor in my model, is similar, for example, to the one emphasized by Holmstrom and Tirole (1997). In their model, investor interference is meant to eliminate non-verifiable entrepreneurial benefits. In my paper, investor control is intended to limit the entrepreneurial waste *and* to increase project profitability. Related are also the papers of Rajan and Winton (1995) and Manove Padilla and Pagano (2001) that explore bank incentives to monitor entrepreneurs ex-post or screen them ex-ante, when debt is collateralized. In Rajan and Winton (1995), more collateral increases the incentive of banks to monitor entrepreneurs, whenever collateral value is sensitive to

⁵In this respect, the idea of this paper is more in line with the view advanced in Hall (2000) and Aghion and Saint Paul (1998) who argue that recessions encourage agents to engage in activities that contribute to future productivity instead of engaging in production, because the return to the latter declines in recessions.

borrower behavior. In Manove *et al.*, (2001), collateral and screening are substitutes because more collateral protects the lenders against the potential risk of default. As in Manove *et al.*, I exploit the fact that collateral and control are substitutes but, in contrast to their paper, I also examine the implications of investor interference on entrepreneur initiative. Related are also the contributions of Thakor (1996) and Ruckes (2004) that point to the screening and monitoring activity of banks as independent sources of credit and investment cycles through the endogenous effect they have on the pool of borrowers.

In closing this review it is worth mentioning that the idea that too much investor control is detrimental for entrepreneurial initiative is inspired by the formal versus real authority analysis of Aghion and Tirole (1997).⁶ Also, the emphasis on the varying degree of investor control on entrepreneurial activity, depending on the state of the firms' balance sheet, is reminiscent of the analysis of Aghion and Bolton (1992) in which the optimal balance of control between investors and entrepreneurs is state contingent: the entrepreneur should have control rights in good states when his actions do not compromise the return to the investor; the investor should have control rights in bad states since private benefits are less important relative to cash flows.

3 The Basic Model

This section considers the basic agency problem between an individual firm and a single investor, in a partial equilibrium setting. It is meant to illustrate the main tensions that arise between the parties and to indicate its implications for business cycles.

3.1 Technology, Information Structure and Payoffs

The economy has two types of agents, an entrepreneur (E) and a deep pocket investor (I), and lasts for two periods, $t = 1, 2$. In the first period investment decisions are made and financial contracts are signed. In the second period, investment returns are realized and claims settled. Both agents have linear utility in period 2 consumption and are protected by limited liability. A single good is used for both consumption and investment. The entrepreneur has an endowment w of this good that can be either stored or invested. Storage has a gross return of r units of output per unit of input. The investment technology, instead, is subject to an agency cost and yields a random payoff that depends on actions taken by the entrepreneur and the investor.

⁶See Burkart *et al.* (1997) for an application of the control-initiative trade-off to corporate finance.

3.1.1 Project Types

The entrepreneur has access to $J = \{B, G, U\}$ *a-priori* identical projects.⁷ Each project J involves a set up cost of $1 > w$ unit of goods, and is characterized by a *verifiable* cash flow Π_J and a non-*verifiable* private benefit b_J for the entrepreneur. While profits and private benefits differ among projects, projects all look *ex-ante* identical and therefore cannot be distinguished from each other without proper investigation. In what follows it is assumed that the entrepreneur has access to a costly evaluation technology that allows him to discern the project characteristics. Of the J projects only G and B are “relevant”, meaning that they yield non-negative cash flows and private benefits. The remaining project, U , entails a big negative payoff for the entrepreneur and (possibly) for the investor. This assumption implies that it is never optimal for the entrepreneur to select a project at random.

More specifically, the J projects have the following payoffs:

	G	B	U
Private Benefits	0	b	$-\infty$
Cash Flows	Π	0	Π

Project G generates more cash flows than the project B but confers no private benefits to the entrepreneur. The congruence of the objectives between the entrepreneur and the investor depends on how much cash flow needs to be shared among the two parties. Private benefits, in fact, are not transferable and pertain to the entrepreneur only. If b is higher than the fraction of Π that the entrepreneur can pocket, after repaying the investor, then the entrepreneur would prefer implementing project B rather than G . Vice versa, because the investor can appropriate cash flows only, she would prefer to see the project G implemented. In the current set-up project choice is not verifiable so that no contract can specify either compensation schemes for the entrepreneur based on project selection or investor control.⁸ I assume that the payoffs associated with the different projects satisfy the following assumption:

Assumption 1: $\Pi > b \geq r$

⁷Adopting the entertaining terminology of Matsuyama (2004), G , B , and U , stands for Good, Bad and Ugly.

⁸At the cost of more involved algebra, one could alternatively assume that project G produces no private benefits and a stochastic cash flow with probability p , while project B produces private benefits b with certainty and cash flows Π with probability $q < p$. If these probabilities of success or failure are independent of entrepreneurial effort and the entrepreneur’s evaluation effort continues to be non contractible, the analysis conducted below would not be affected at all, with the only difference that the investor would now monitor in proportion to the riskiness of his financial claim, equal to the difference of payoffs between the two projects. In the current set-up the payoff for the investor relative to the B project is zero, therefore her degree of control would always be higher than in the modified set-up. If anything, then, the modified set-up would strengthen the results given below.

3.1.2 Information and Control

The information structure is as follows. Since projects payoffs are *ex-ante* unknown, the entrepreneur has to acquire information about the three projects, before suggesting one to the investor. Accumulation of information for the entrepreneur is binary. At private convex cost, $c_e(e)$, he learns the payoffs of all possible projects with probability e . With probability $1 - e$, however, he learns nothing and still views the projects as identical. In this last instance, the entrepreneur does not approach the investor and simply put his wealth in the storage technology that guarantee the safe gross return, r . Selecting a project at random would not be optimal given the large negative payoff associated with the U project. With probability, e , the entrepreneur discovers the projects' characteristics, discards the U project and approaches the investor to borrow $1 - w$.

Depending on the amount of credit that need to be extended, and hence on the risk of receiving due repayment, the investor chooses how much control to exercise on the entrepreneur's selection of projects. I assume that the intensity of control is also binary. Specifically, the investor can interfere at a private convex cost $c_m(m)$. By interfering, she limits the entrepreneur misbehavior avoiding that some projects can get their way. With probability m , the investor forces the entrepreneur to pick the project that maximizes cash flows. With probability $1 - m$, instead, the entrepreneur is left with some freedom to consume private benefits. Since interference is costly and since too much interference discourages *ex-ante* entrepreneurial effort, in equilibrium the investor will refrain from exercising full control (see below).

Remark 1. The investor's control on the implementation of the entrepreneur projects can be given a much broader interpretation than the one of mere interference. For example, the investor may have access to a screening technology that allows her to receive a signal over the type of projects proposed by the entrepreneur. If the signal is informative, the investor understands the project's characteristics and dictates the type of project that the entrepreneur must run. If the signal is not informative, she does not understand the project types, and rubber-stamps the project proposal that can be G or B with, say, equal probability. In an alternative interpretation, the control of the investor can be thought of as assistance to the entrepreneur during the phase of planning and implementation of the project. Too little assistance results in poor cash flow performance and high consumption of perks. Both interpretations are congruent with the interference formulation, since interference has the dual effect of limiting inefficiencies associated with the consumption of private benefits and improving project cash flows.

Remark 2. Rather than just effort devoted to project evaluation, entrepreneur's effort may interpreted as effort to set up a particular business plan, or even more generally a non-contractible firm specific investment that raise firm value or contribute to deteriorate it. What is essential is that some of these

actions are socially sub-optimal though individually optimal. Similarly, private benefits do not need to be interpreted as consumption of perks, diversion of resources or personal satisfaction. They can also be interpreted as the negative of the private cost that the entrepreneur has to pay for adopting new technologies (such as effort to get properly trained, to reorganize the firm or for retraining workers). What is crucial is that private benefits are inefficient, in the sense that one dollar of private benefits reduces firm value by more than a dollar.

Remark 3. One could interpret the problem between the investor and the entrepreneur as arising in the course of an ongoing relationship, rather than upon first contact. The latter interpretation is preferred in order to emphasize the consequences of ex-ante selection of projects. Crucial is that the investor has the opportunity to stop some actions through adequate interference.

3.1.3 Contracts and Timing

It is assumed that there is a large supply of outside financiers. The resulting competition gives all the ex-ante bargaining power to the entrepreneur so that the investor optimal decision to exercise control is taken to maximize the entrepreneur's ex-ante expected utility, subject to her break-even constraint.

The entrepreneur has an endowment w of consumption goods. To activate a project he needs to pay a fixed cost $1 > w$ and thus needs to borrow at least $1 - w$ from the investor. By assumption, the investor has to be repaid out of Π , and to attract the investor the entrepreneur offers her a share α of Π .

The relationship between the two parties is described by the following game, summarized in Figure 0. At stage 0, the entrepreneur exerts an evaluation effort. After evaluation takes place, he decides whether to proceed. If he does not proceed he simply stores his endowment. If he chooses to proceed, the entrepreneur contacts the investor and offers a contract. A contract specifies how much each side should invest and how much each party should be repaid, out of the project's outcome. Without loss of generality, I restrict attention to one arrangement in which: (1) the entrepreneur invests all its funds, w , while the investor puts up the balance, $1 - w$; (2) the investor is paid a fraction $0 < \alpha < 1$ of the verifiable cash flow Π , whereas the entrepreneur keeps the difference.⁹ At stage 1, after the contract is signed, and before the project is implemented, the investor chooses his monitoring intensity as a function of its overall exposure towards the entrepreneur. At stage 2 the project's payoff is realized.¹⁰

⁹Because the projects' outcome have a two point distribution – success or failure – this contract can be interpreted as either a debt or an equity contract.

¹⁰The process of information acquisition for I and E could be simultaneous, rather than sequential. This modification would not bring additional substantive issues into the analysis but would lead to no-closed-form solutions. Moreover, nothing would change if the monitoring intensity is chosen before the financing stage. What is important in the current set-up is that the evaluation cost for the entrepreneur occurs ex-ante, and control rights are given to the investor ex-post so that her interference adversely affects the entrepreneur ex-ante incentives of evaluating projects.

$t = 0$	$t = 1/2$	$t = 1$	$t = 2$
E exerts effort	Financing occurs and contract signed	I chooses monitoring intensity	Π and/or b realize.
e	$(1 - w), \alpha$	m	

Figure 0

3.1.4 Payoffs

Under the assumption that the outside investor receive a share α of the verifiable cash flow Π , a conflict of interest arises between the investor and the entrepreneur whenever $(1 - \alpha)\Pi < b$ for some $0 < \alpha < 1$. In this case, the entrepreneur's preferred project is B while the investor prefers project G .

With the proposed timing and the assumption of universal risk neutrality, the entrepreneur and the investor's ex-ante expected utilities can be written:

$$u_E = (1 - e)rw + e[m(1 - \alpha)\Pi + (1 - m) \max\{(1 - \alpha)\Pi, b\}] - c_e e^2/2, \quad (3.1)$$

$$u_I = e \{m\alpha\Pi + (1 - m) \times 0 - c_m m^2/2\}. \quad (3.2)$$

For the entrepreneur, the first term is the return from storing his endowment, if his evaluation of the projects is not successful. The second term is the expected payoff of undertaking the project. When the investor monitors with intensity m , the entrepreneur receives a fraction $m(1 - \alpha)$ of Π , but can still reap a portion $(1 - m)$ of the available private benefits b , insofar as $(1 - \alpha)\Pi < b$ for some α (to be determined). Finally, the third term is the entrepreneur's cost of evaluating the projects. For the investor, the payoff is positive only if she is approached by the entrepreneur with probability e . Conditional on e , her payoff depends uniquely on the amount of cash flows that she is able to receive whenever she decides to interfere with intensity m .

The two payoff functions highlight the different roles that e and m play in this framework. In both (3.1) and (3.2) e is crucial since it affects the overall size of the return to both parties. More generally, e can be interpreted as determining the overall level of investment of this economy. The "quality" of this investment, in turn, depends on m . Projects produce more cash flow for high m values. Vice-versa, for m low, the entrepreneur can reap some non transferable output in the form of private benefits. e and m are therefore complementary: e determines "the size of the pie", m affects "the way the pie is distributed". Without e no output is produced, without m no cash flow is generated. Because of the non contractibility of the two actions, e and m will be chosen by each of the two parties to maximize their own utility, and given the conflict of interest between the two, e and m will, in general, be strategic substitutes. The implication is that investment size and efficiency cannot, in general, be jointly maximized.

3.2 First Best

The natural benchmark is the case in which there is no conflict of interest. This case arises if $(1 - \alpha)\Pi > b$, i.e. the monetary incentives for the entrepreneur are powerful enough that he forgoes private benefits and always prefers to maximize cash flows.¹¹ If the condition $(1 - \alpha)\Pi > b$ holds, the entrepreneur chooses e to maximize the expected second period consumption from implementing project G :

$$\max_e \{u_E = (1 - e)rw + e(1 - \alpha)\Pi - c_e e^2/2\} \quad (3.3)$$

subject to the investor break-even constraint:

$$\alpha\Pi = r(1 - w).$$

It then immediately follows that the first-best is achieved by setting

$$e^{fb} = \min \left\{ \frac{\Pi - r}{c_e}, 1 \right\}, \quad (3.4)$$

which says that the level of effort is constant and independent of the level of entrepreneurial's wealth.¹²

In a second-best world, the level of entrepreneurial effort will be lower, because in absence of monitoring, the entrepreneur will just implement the project with private benefits, forcing the rational investor to monitor. This results in higher debt repayment than in the scenario of no conflict of interest, given that the entrepreneur now needs to compensate the investor for the opportunity costs of funds *and* for the cost of monitoring. Because the repayment is higher, and control reduces the size of private benefits, the entrepreneur does not appropriate the full marginal return of his evaluation effort, and thus supplies less effort than in the first-best. This inefficiency stems from the inability of the entrepreneur to commit not to undertake projects with private benefits.

3.3 The Optimal Contract

I consider the case in which the level of private benefits is high enough that a conflict of interest exists between the parties. To determine the equilibrium level of effort and monitoring, and hence the optimal selection of the investment project, one must solve the following problem:

$$\max_{e, \alpha} e \{m^*(1 - \alpha)\Pi + (1 - m^*)b\} + (1 - e)rw - c_e \frac{e^2}{2} \quad (3.6)$$

¹¹ Obviously, another possible interpretation of the first best is when the project choice is contractible, or the entrepreneur is not wealth-constrained so that he can finance the project himself. In the latter case the entrepreneur does not need to share any part of the project's cash flow with the outside investor. Given the assumption that $b < \Pi$, the entrepreneur always chooses the G project and the conflict of interest does not arise.

¹² The entrepreneur always prefers evaluating the project to storing his wealth straight away, whenever $u_E(e^{fb}) \geq rw$ holds, i.e. $e^{fb} \geq 0$ or $\Pi \geq r$, which is always true by Assumption 1.

In this first best scenario, monitoring is always zero, since the entrepreneur always chooses project G and thus the investor does not need to monitor.

subject to,

$$m^* = \arg \max_m e^* \left\{ m\alpha\Pi + (1-m) \times 0 - c_m \frac{m^2}{2} \right\} \quad (3.7)$$

$$e^* \left\{ m^* \alpha\Pi + (1-m^*) \times 0 - c_m \frac{m^{*2}}{2} \right\} \geq e^* r(1-w) \quad (3.8)$$

$$0 \leq \alpha \leq 1. \quad (3.9)$$

$$e^* \{m^*(1-\alpha)\Pi + (1-m^*)b\} + (1-e^*)rw - c_e \frac{e^{*2}}{2} \geq rw. \quad (3.10)$$

Equation (3.6) is the entrepreneur's expected utility, equal to his gross gain from evaluating the project less his expected obligation to the investor and the evaluation cost. (3.6) is maximized with respect to the level of effort and the fraction of project outcome to be shared with the investor, subject to the investor incentive compatibility constraints (3.7) and her break-even condition (3.8). Equation (3.9) is a feasibility constraint, which requires that the investor cannot appropriate more than the entire cash flow of the project, ensuring limited liability for the entrepreneur. Finally, (3.10) is the participation constraint for the entrepreneur, stating that at the equilibrium level of effort, e^* , and monitoring, m^* , the utility of evaluating and undertaking the project is larger than the utility of storing his wealth straight away.

3.3.1 The Basic Trade-off

The basic trade-off underlying the entrepreneur-investor relationship follows directly from inspection of the two parties reaction curves:

$$e^* = \min \left\{ \frac{b - rw - m^*(b - (1-\alpha)\Pi)}{c_e}, 1 \right\} \quad (3.11)$$

and

$$m^* = \min \left\{ \frac{\alpha\Pi}{c_m}, 1 \right\}. \quad (3.12)$$

Equation (3.11) indicates that the entrepreneur's effort to become informed (i.e. his *initiative*) increases with the size of the private benefits and, decreases with the opportunity cost of investing funds in the project, rw , and with the evaluation cost, c_e . Moreover, e falls with the likelihood of having to loose control over the choice of the project, m^* , and for a given m^* , effort is lower the higher the share of the final output that must be given to the outside investor $\alpha\Pi$. Equation (3.12) suggests, instead, that the investor incentive to monitor (i.e. the degree of *interference* on the entrepreneurial project choice) increases monotonically with her share in the project's revenue and decreases with the cost of monitoring.¹³

¹³Notice that the investor reaction curve is independent of e because she monitors after the entrepreneur has made his proposal.

The incentive compatibility conditions for effort and monitoring identify the crucial tension between the investor and the entrepreneur. Specifically, when the entrepreneur borrows money, he needs to share part of the project's income, $\alpha\Pi$, with the outside investor. When this share is high, there are two forces affecting entrepreneur incentives to exert effort. The first force is a traditional one in a principal-agent relationship: for a given level of monitoring, a lower share of income that accrues to the entrepreneur increases the conflict of interest with the investor – the discrepancy between b and $(1 - \alpha)\Pi$ – and thus reduces the incentives of the entrepreneur to select the G project. This force is mitigated when the entrepreneur's wealth invested in the project increases. With more wealth at stake, he internalizes the consequences of his actions mitigating the agency problem with the investor and *a fortiori* the incentives of the latter to control the entrepreneur's actions. The second force is more specific to the current set-up and operates through the investor's control. When the share of income that must be given to the investor is high, she has a large incentive to monitor entrepreneur's selection of projects. More interference, however, destroys private benefits, depressing even more the entrepreneur incentive to evaluate projects ex-ante. Extensive recourse on external financing has therefore two negative effects on entrepreneur effort, but also a positive effect on project value, occurring through the increased investor control. In the current setting, therefore, and contrary to the traditional literature on investment in the presence of agency costs, projects financed by external capital may be more profitable than projects that rely more on internal finance, exactly because it ensures control by the investor that limits private benefits and increases cash flows.

The fact that, in the presence of a conflict of interest, i.e. $b > (1 - \alpha)\Pi$, the entrepreneur reaction curve is downward sloping with respect to m^* , implies that the investor refrains from exerting maximum investigation as this worsens the entrepreneur's initiative. The crucial feature of this model that effort and monitoring are substitutes, differs substantially from the one arising in a set-up with ex-post entrepreneurial moral hazard (as in Holmstrom and Tirole (1997)) or in a monitoring model with costly state verification (as in Bernanke and Gertler (1989)). In those models the entrepreneur's unobservable actions occurs after financing takes place and limit the size of future cash flows that can be credibly promised to the investor. To limit the moral hazard problem the investor can monitor or audit, and in equilibrium more control implies more entrepreneurial effort or less entrepreneurial incentives to under-report the project's return. In the set-up of this paper, instead, more control reduces entrepreneur incentives to exert ex-ante effort, limiting the overall amount of ex-ante actions. The investor, therefore, prefers to reduce her interference, to the extent possible: accepting to give the entrepreneur freedom to consume some private benefits assures that the entrepreneur evaluates projects and hence lending occurs.

3.3.2 Equilibrium Outcomes

To understand the implications of non contractible effort and control it is useful to start by substituting the optimal level of monitoring, m^* , into the investor's break even condition which, in equilibrium, must be binding. The equilibrium terms at which lending occurs, i.e. the portion of cash flow that the investor requires to be willing to participate in the contract, is therefore given by:

$$\alpha = \frac{\sqrt{2r(1-w)c_m}}{\Pi}. \quad (3.13)$$

Inspection of (3.13) reveals that, *ceteris paribus*, α decreases with borrower wealth. Hence, as the entrepreneur supplies a larger fraction of the initial investment the investor requires a smaller fraction of the project cash flows. Given that the optimal level of monitoring is monotone in α (see (3.12)) it follows that as the level of entrepreneur net worth increases, investor control falls, and given (3.11) the entrepreneur effort increases.

From the entrepreneur reaction function, however, e^* and m^* are inversely related if and only if $b > (1 - \alpha)\Pi$ or $\alpha > \bar{\alpha} \equiv 1 - b/\Pi$. Using (3.13), this condition amounts to saying that effort and monitoring are strategic substitutes whenever the level of net worth is below the threshold \bar{w} :

$$w \leq 1 - \frac{(\Pi - b)^2}{2rc_m} \equiv \bar{w}. \quad (3.14)$$

In the other case, in which the entrepreneur is sufficiently wealthy, i.e. $w > \bar{w}$, or $\alpha < \bar{\alpha} \equiv 1 - b/\Pi$, the share of the project payoff that accrues to the entrepreneur, $1 - \alpha$, is large enough that he values cash flow more than private benefits. Therefore for $w > \bar{w}$ we are back to the first-best case discussed above, in which only high cash flows projects are selected by the entrepreneur and the conflict of interest is blunted.

For a given project profitability, the contract feasibility constraint (3.9) also determines a lower bound on entrepreneur's wealth below which no profitable transactions take place. Specifically, equation (3.13) and (3.9) imply that entrepreneurs must put a minimum level of wealth into the project to credibly offer a repayment α to the investor. This minimum level of wealth is given by:

$$\alpha \leq 1 \iff w \geq 1 - \frac{\Pi^2}{2rc_m} \equiv \underline{w} \quad (3.15)$$

that is larger than or equal to zero for a value of Π such that $\Pi \leq \sqrt{2rc_m}$, which from now on it is assumed to hold:

Assumption 2: $\sqrt{2rc_m} \geq \Pi$

Finally, the participation constraint of the entrepreneur determines the minimum level of wealth \tilde{w} , above which he is willing to undertake the costly process

of evaluating projects.¹⁴ Defining with $\hat{w} = \max\{\underline{w}, \tilde{w}\}$, these results can be summarized in the following

Lemma 1 *For given parameters (Π, b, r, c_m, c_e) satisfying Assumption 1 and 2, there exist two cut-off values \hat{w} and \bar{w} , with $\hat{w} < \bar{w}$ such that:*

1. If $0 \leq w \leq \hat{w}$ the entrepreneur either has not sufficient wealth to undertake the project or does not wish to invest at all. In this case, $e = m = 0$.
2. If $\hat{w} < w < \bar{w}$, the project is funded and the equilibrium levels of effort and monitoring are given by (3.10) and (3.11), respectively.
3. If $w \geq \bar{w}$, the conflict of interest between the parties vanishes. The optimal level of effort is given by (3.4), and both investment and productivity are constant.

Lemma 1, suggests that the strategic interaction between investor and entrepreneur actions is relevant only for levels of entrepreneurial net worth that are neither too low, nor too high. In this range of wealth, the two actions are strategic substitutes, implying that the overall amount of investment and its productivity cannot be maximized jointly. To further explore the implications of Lemma 1 it is instructive to define

$$p = em\Pi \tag{3.16}$$

as the overall level of investment productivity, measured by the amount of output that can be shared between the entrepreneur and the investor, and

$$i = em\Pi + e(1 - m)b \tag{3.17}$$

as the size of the investment that takes place in this economy, comprising both the amount of output that can be shared $em\Pi$ and the one that accrues to the entrepreneurs only, in the form of private benefits, $e(1 - m)b$.

¹⁴The minimum level of wealth, \tilde{w} , above which the entrepreneur's participation constraint holds, is given by

$$e^* \{m^*(1 - \alpha)\Pi + (1 - m^*)b\} + (1 - e^*)r\tilde{w} - c_e \frac{e^{*2}}{2} = r\tilde{w}.$$

After substituting for the equilibrium values of m^*, e^* and α , the expression above holds whenever $e(\tilde{w}) = 0$ or

$$\frac{(b - r) + (\Pi - b)\sqrt{\frac{2r(1 - \tilde{w})}{c_m}} - r(1 - \tilde{w})}{c_e} = 0$$

It is easy to show that $e(\bar{w}) > 0$ for the parameter values satisfying Assumption 1 and 2, whereas at \underline{w} it may be that $e(\underline{w}) < 0$. However, since the l.h.s of the expression above is an increasing and concave function of w , and reaches a maximum at \bar{w} , there exists a $\tilde{w} > \underline{w}$ such that $e(\tilde{w}) = 0$, and the entrepreneur with $w < \tilde{w}$ prefers not to borrow.

With these definitions in mind, the main result of this section can be stated in the following.

Proposition 1. *When $w \in (\hat{w}, \bar{w})$, the entrepreneur's effort and the investor's control are strictly positive. As w increases in this range, investment, i , increases monotonically. Moreover, there is a threshold level of net worth, $\hat{w} < w^* < \bar{w}$, such that investment productivity, p , rises for $w < w^*$ and falls for $w > w^*$.*

Proof. See Appendix. ■

The mechanism behind Proposition 1 is easy to state. When the entrepreneur is eligible for financing, but has little wealth, the investor's financial exposure is high and she must appropriate a high fraction of the project return to ensure non-negative profits. Given the underlying conflict of interest with the entrepreneur, the investor needs to monitor to be sure that only projects that generate high cash flows are undertaken. Therefore, at low level of net worth, high investor control helps improving the project's profitability, for a given level of entrepreneurial effort. Excess monitoring, however, increases interference, reducing entrepreneur's initiative. It follows that at low levels of net worth, the amount of investment undertaken is low but the overall productivity is increasing in monitoring. The beneficial effect of high control on productivity vanishes, however, when net worth increases further in the range $\hat{w} < w < \bar{w}$. The less is the exposure of the investor (i.e. higher w) and thus higher the fraction of the project's return that falls in the entrepreneur's hands, the more likely it is that the investor will go along with the entrepreneur's proposal. As a consequence, investor control falls and in response entrepreneur effort rises. The overall effect is that as w increases, investment goes up and, with it, the amount of entrepreneurial waste, at the expenses of the investment's productivity. Eventually, as the level of wealth surpasses the threshold w^* , investment's productivity starts falling until w approaches \bar{w} . At this point the conflict of interest vanishes and investment and its productivity depends only on entrepreneurial effort, given by (3.4).

3.3.3 A Numerical Example

To gain further insights into the potential dynamic implications of the model, it is useful to present a simple numerical example. I set $\Pi = 1.37$, $b = 0.8$, $r = 1$, $c_e = c_m = 1.1$ and compute the equilibrium value of α that satisfies the investor's break-even constraint, using equation (3.13) and alternative values of w in $[0, 1)$.

Figure 1 depicts the impact of the equilibrium effort and monitoring on the total amount of investment i , given by (3.17), and its productivity p , given by (3.16). Both variables are plotted against the level of net worth. As hinted in the previous section, there is a non-monotonic relationship between these two variables and the level of entrepreneurial wealth, w . For the parameter

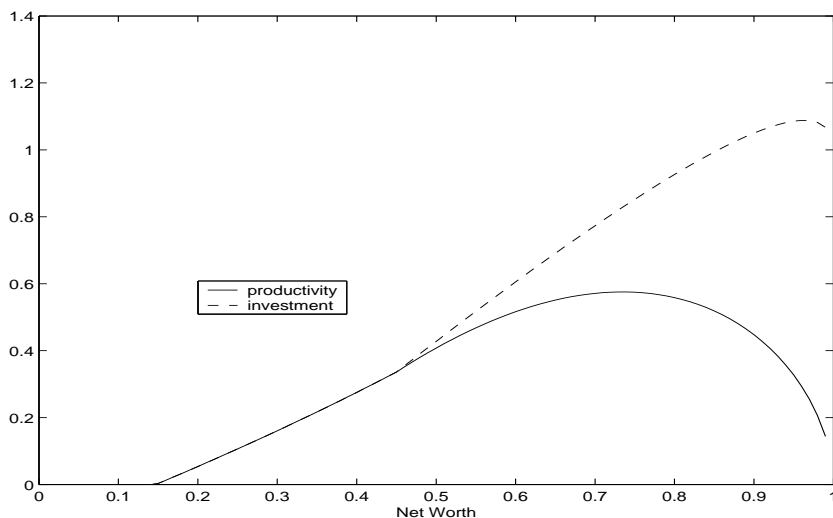


Figure 1: Investment and Productivity

values used in this example, there exists a critical level of net worth, $\underline{w} \approx 0.15$, below which the entrepreneur optimally decides to exert no effort, so that no investment takes place. For an intermediate range of the net worth, $0.15 < w < 0.73$, investment, its productivity and net worth increase monotonically. In this range investor control intensity falls gradually, while the entrepreneurial effort increases steadily. Initially, the increase in e , is enough to compensate for the fall in m , so that i and p , rise in tandem, though at a decreasing rate. As w increases further, i.e. $w > 0.73$, the control exerted by the investor is so low that only non-productive projects are financed. Thus for high values of w , but not too high –that is before the conflict of interest vanishes $\bar{w} \approx 0.85$ – a rising entrepreneurial effort and a falling investor control lead to higher investment and to lower productive investment.

These comparative statics should be contrasted with those arising from a standard investment model with financial frictions (as for example in Bernanke and Gertler, 1989). In that model, an increase in the borrower net worth, reduces the agency costs and thus leads to an increase in the level of investment. This pattern also arises in the current setting, as the total level of investment is increasing in w . In this model, however, there is an additional effect that occurs once entrepreneur net worth becomes sufficiently high: a wealthy entrepreneur gains independence from the investor and less productive projects get their way. In other words, while the current setting has the same implications on the overall level of investment as in a standard model with credit frictions, it also has something to say about the level of productive investment in the economy. Specifically, the productivity of the investment is increasing at low level of

wealths through the value enhancing effect of investor control, and deteriorates when the level of net worth surpasses a certain threshold. Again, this effect primarily arises because the investor reduces interference on the entrepreneur's selection of projects.

4 Dynamics

To endogenize the evolution of borrower net worth and thus the time path of monitoring and effort costs, this section embeds the static analysis presented above into a dynamic model with overlapping generations. The framework is a modified version of the OLG model of Diamond (1965) with agents living for two periods.¹⁵ The dynamic analysis will affect only the entrepreneur net worth but not the financial relationship between borrowers and lenders. The two parties continue to be related by a financial contract that lasts only for one period. Their non-cooperative actions, however, affect the amount of capital that can be brought into a final good sector, and thus the wealth of future generations.

4.1 The Model

4.1.1 Agents, Preferences and Endowments

The economy is populated by an infinite sequence of overlapping generations of agents that live for two periods and each generation consists of a continuum of agents with unit mass. Agents are risk neutral, endowed with a fixed amount of labor, L , and care only about second period consumption, net of effort costs. Within each generation agents are heterogenous. An exogenous fraction, η , are entrepreneurs, with access to an investment technology, to be described below. The remaining fraction, $1 - \eta$, of agents have no ability to carry out investment projects and will be referred to as lenders or investors.

4.1.2 Technology

The production side of the economy consists of a single final good sector and a continuum of intermediate good sectors. The final good sector produces a consumption good by means of a Cobb-Douglas production function,

$$Y_t = A_t K_t^\beta L_t^{1-\beta}$$

where K_t is capital, L_t labor and A_t a scale parameter, which, as in Romer (1986), depends on the aggregate stock of capital in the economy (the effects of which are not internalized by individual firms):

$$A_t = K_t^\gamma \text{ where } \gamma + \beta = 1.$$

¹⁵A similar framework is used in the seminal paper of Bernanke and Gertler (1989), and by Azariadis and Smith (1997) and Matsuyama (2004). As in these papers, the "period" is supposed to represent the length of a typical financial contract, rather than a generation of individuals.

Perfect competition in this sector, implies that the price of capital and the wage rate are respectively,

$$\rho_t = \beta \tag{4.1}$$

and

$$w_t = (1 - \beta)k_t = w(k_t), \tag{4.2}$$

where $k_t = K_t/L_t$ denotes the capital-labor ratio. These two equations imply zero profits for all firms producing $y_t = Y_t/L_t$ and indicate that as the capital stock in the economy, k , expands, the wage income, $w(k_t)$, increases while the price of capital remains constant.¹⁶ For convenience, I normalize the economy-wide labor endowment L to unity so that per capita and aggregate quantities are the same.

In this final good sector, labor is supplied inelastically by the young agents of period t , at no utility cost. Their wage income, w_t , is then used to finance consumption in period $t + 1$, so that the total level of saving in this economy is also equal to w_t .¹⁷ Young entrepreneurs have two saving options: their wage income can be saved in a storage technology, which has a non-stochastic gross return of r units of consumption goods, or it can be used to partially finance an investment project that transforms consumption goods into capital goods. Young lenders, on the other hand, can finance their $t+1$ consumption by lending their wage income to entrepreneurs or by saving through a storage technology.

The capital stock used in the final good sector comes from an intermediate-capital-producing sector operated by young entrepreneurs. The intermediate sector transforms, without using labor, consumption goods of time $t - 1$ into capital goods available for use at time t . More precisely, capital produced by the young entrepreneurs at the end of time $t - 1$ is sold at the beginning of the period t to the final good sector, at the price ρ_t , and for simplicity depreciates fully after use.¹⁸

4.1.3 The Intermediate Sector and the Credit Market

The intermediate sector works in the same way as in the static model discussed in the previous section. Young entrepreneurs have access to the three types of investment technologies, G , B and U , with the qualification that project G now produces capital goods only, while project B generates consumption goods for the entrepreneur. Therefore, the agency problem that arises between entrepreneurs and investors determines the amount of capital that can be brought

¹⁶Aghion *et al.* (1999) use a similar assumption on the production function, with the intent of fixing the wage rate and allowing the interest rate to fluctuate.

¹⁷The fact that agents care only about old-age consumption is an inessential simplification. It allows us to focus on the interaction between investors and entrepreneurs in the intermediate capital producing sector, without having to worry also of the consumption-saving decisions of olds and youngs.

¹⁸The assumption that capital depreciate fully after use permits to ignore the additional complication of formalizing the capital resale market. It also implies that at each point in time investment is equal to the capital stock.

forward to the next period, k_{t+1} , and hence the wage income of future young agents (see equation (4.2)). The feedback from k_{t+1} to w_{t+1} is the crucial link of the dynamics of this economy.

It is convenient to think of the borrowing-lending relationship as occurring through financial intermediaries that accept deposits, extend loans and exercise control on entrepreneurs. This way, lenders and entrepreneurs with a negative evaluation of projects, allocate their wealth between deposit with financial intermediaries and the storage technology. Entrepreneurs that successfully evaluate their projects enter, instead, in a financial arrangement with an intermediary which lasts for one period only.

The final assumption is that the supply of funds available in the economy is larger than the maximum amount of funds demanded by the entrepreneurs¹⁹

$$w_t > \eta e_t.$$

Hence, storage is always used in equilibrium, and its return pins down the interest rate in this economy so that the deposit rate is equal to the return on storage.²⁰ The fact that the supply of loanable funds is perfectly elastic implies that all actions in this economy come from investment demand, whereas the supply side of the credit matters insofar as the lender behavior is examined, and not because the equilibrium interest rate is affected. One may therefore think of this set-up as characterizing an economy in which availability of loanable funds is not a problem. Instead, it is the incentive of the investor to control entrepreneur behavior that shapes investment and project quality.

4.1.4 Payoff Structure

Following the same steps of the previous section, the entrepreneur and lender's expected utility, are given by

$$u_E = (1 - e_t)rw_t + e_t [m_t(1 - \alpha_t)\Pi\beta + (1 - m_t) \max \{(1 - \alpha_t)\Pi\beta, b\}] - c_e \frac{e_t^2}{2}, \quad (4.3)$$

and

$$u_I = e_t \left\{ m_t \alpha_t \Pi \beta + (1 - m_t) \times 0 - c_m \frac{m_t^2}{2} \right\}, \quad (4.4)$$

¹⁹In each period, the amount of loanable funds is equal to the wealth in the hands of lenders, $(1 - \eta)w_t$, plus the wealth of those entrepreneurs that with probability $1 - e_t$ decide not to go ahead with the project, $\eta(1 - e_t)w_t$. The funds demanded are $\eta e_t(1 - w_t)$, corresponding to the fraction of entrepreneurs that decide to go ahead with the project times the amount of consumption goods $(1 - w_t)$ that they need to borrow to start the investment.

²⁰The assumption that the supply of investment funds is perfectly elastic is in line with Bernanke and Gertler (1989), but departs from Aghion et. al. (1999) and Matsuyama (2004), who argue that endogenous movements in the interest rate can give rise to non linear investment dynamics, when credit market are not frictionless. This paper complements the work of these authors by arguing how endogenous cycles can be obtained even if the interest rate is constant.

which are, respectively, the equivalent of (3.1) and (3.2), with the difference that $\Pi\beta$ is now the consumption value of the capital goods produced by the G project. Notice that in this formulation, private benefits and similarly the costs of evaluation and control are expressed in terms of consumption goods.

4.2 First-Best

The benchmark case arises, again, when $b < (1 - \alpha_t)\Pi\beta$. Simple maximization of (4.3), subject to the intermediary break-even constraint

$$\alpha_t\Pi\beta = r(1 - w_t),$$

gives

$$e_t^{fb} = \min \left\{ \frac{\Pi\beta - r}{c_e}, 1 \right\}, \quad (4.5)$$

which parallels equation (3.4).

In this first-best case the dynamic equilibrium of the economy is therefore trivial. At any point in time t , the number of per capita projects undertaken is

$$i_t = e_t^{fb} \times \eta,$$

and assuming an interior solution for e_t^{fb} , the per capita future capital stock is

$$k_{t+1} = i_t \times \Pi = (\Pi\beta - r) \frac{\eta\Pi}{c_e}, \quad (4.6)$$

which is independent of period- t state variables. Hence, in this benchmark economy – free of agency costs – the level of capital formation is constant over time and there will be a unique stable steady state to which the economy converges in one period.²¹

4.3 Equilibrium with Agency Problems

When agency costs are re-introduced in the analysis, the amount of capital produced in the economy depends crucially on the way saving is allocated across the two technologies, G and B . In particular, the equilibrium wage, given the inherited capital stock k_t ,

$$w_t = w(k_t)$$

and the equilibrium level of effort and control, given the current wage w_t ,

$$e_t = e(w_t) \text{ and } m_t = m(w_t)$$

²¹As in Bernanke and Gertler (1989) the fact that the frictionless economy does not have any dynamics is due to the assumption that the supply of investment funds is perfectly elastic with respect to the interest rate. In Bernanke and Gertler the introduction of information asymmetries generates a demand for investment that is persistent and dependent of entrepreneur internal funds. In the current set-up the introduction of agency costs generates not only persistence but also instability in investment dynamics.

determine the production of new capital k_{t+1}

$$k_{t+1} = K(e(w(k_t)), m(w(k_t))) \quad (4.7)$$

where $K_e > 0$ and $K_m > 0$. Therefore, even though the supply of credit is perfectly elastic, the amount of capital that can be brought forward to the next period is now indirectly dependent on the total amount of savings $w(k_t)$, through its impact on $e(w(k_t))$ and $m(w(k_t))$.

In (4.7) k_{t+1} is increasing with respect to both e_t and m_t , but, as shown in the previous section, while e_t is an increasing function of $w(k_t)$, m_t is decreasing in $w(k_t)$. As a consequence, the accumulation path of capital:

$$\frac{dk_{t+1}}{dk_t} = \left(\begin{array}{cc} \frac{\partial K}{\partial e} \frac{\partial e}{\partial w} & + \frac{\partial K}{\partial m} \frac{\partial m}{\partial w} \\ + & - \end{array} \right) \frac{\partial w}{\partial k_t} \quad (4.8)$$

may be non-monotonic in $w(k_t)$.

4.3.1 Investment Dynamics

To gain further insights into the dynamics implied by the difference equation (4.7), I repeat the same steps of Section 3.7, under the technical

Assumption 3. $\sqrt{2rc_m} \geq 2(\Pi\beta - b)$

and the convenient normalization that

Assumption 4. $b = r$.

The following Lemma, which parallels Lemma 1 of Section 3, characterizes investment dynamics for different levels of entrepreneurial wealth

Lemma 2 *For parameters values (Π, β, b, r, c_m) , satisfying Assumption 3 and 4, there exist two cut-off values $\tilde{w} \equiv 1 - \frac{2(\Pi\beta - b)^2}{rc_m}$ and $\bar{w} \equiv 1 - \frac{(\Pi\beta - b)^2}{2rc_m}$, with $\tilde{w} < \bar{w}$ such that:*

1. If $0 \leq w_t \leq \tilde{w}$, the entrepreneur does not wish to invest. In this case $e(w_t) = m(w_t) = 0$.
2. If $\tilde{w} < w_t < \bar{w}$, investment takes place and the equilibrium levels of monitoring and effort are given by:

$$m(w_t) = \sqrt{2r(1 - w_t)/c_m} > 0$$

$$e(w_t) = (m_t(\Pi\beta - b) - r(1 - w_t)) / c_e > 0.$$

3. If $w_t \geq \bar{w}$, the conflict of interest between the parties vanishes and the optimal level of effort, $e(w_t)$, is given by (4.6), while monitoring, $m(w_t) = 0$.

Proof. See Appendix ■

Per-capita investment depends therefore on the interaction of effort and control only for intermediate range of wealth $w_t \in (\tilde{w}, \bar{w})$ and in particular is given by:

$$i = \eta \left[\underbrace{e_t(m_t(w_t), w_t) \times m_t(w_t) \times \Pi}_{k_{t+1}} + \underbrace{(1 - m_t(w_t)) \times e_t(m_t(w_t), w_t) \times b}_{b_{t+1}} \right] \quad (4.9)$$

In (4.9) the first term represents the amount of capital goods available for final good production in $t + 1$, while the second term is the amount of consumption goods available to entrepreneurs for consumption in period $t + 1$, which is larger, the lower the investor control.

For ease of exposition, and given the one-to-one mapping between wage and capital in equation (4.2), it is convenient to formulate the law of motion of capital, k_t , of this economy in terms of the equilibrium wage, w_t :

$$w_{t+1} = \Phi(w_t) = \begin{cases} 0 & \text{if } w_t < \tilde{w}_t \\ \phi(w_t) & \text{if } \tilde{w}_t \leq w_t \leq \bar{w}_t \\ w^{fb} & \text{if } w_t > \bar{w}_t \end{cases} \quad (4.10)$$

where w^{fb} is the first-best equilibrium obtained by replacing (4.2) into (4.6),

$$w^{fb} = \lambda \delta, \quad (4.11)$$

while,

$$\phi(w_t) = (1 - w_t) \left[\sigma \lambda - r \sqrt{\sigma(1 - w_t)} \right] \delta, \quad (4.12)$$

derives by substituting the equilibrium level of control and effort (given in Lemma 2) into the first term of (4.9).

In the expressions above

$$\lambda = \Pi \beta - b \quad (4.13)$$

is the surplus of producing capital relative to the consumption of private benefits, and is therefore a measure of the severity of the agency problem²², $\sigma = \frac{2r}{c_m}$ is a synthetic parameter, while

$$\delta = \frac{\eta \Pi (1 - \beta)}{c_e}, \quad (4.14)$$

²²By Assumption 3, λ is also equivalent to $(\Pi \rho_{t+1} - r)$, i.e. the surplus of productive capital relative to storage. Both expressions measure the degree of idle saving in the economy, i.e. saving not put into the productive investment activity.

measures the fraction $(1 - \beta)$ of the total amount of new capital $\eta\Pi$ that is distributed in form of wage, weighted by the cost of effort.

To solve for the equilibrium trajectory of the economy, the mapping $w_{t+1} = \Phi(w_t)$ can be applied iteratively, for any initial condition w_0 . However, since $\Phi(w_t)$ crucially depends on the shape of the non linear function $\phi(w_t)$, it is essential to spell out its basic property.

Lemma 3 *The map $\phi(w_t)$ is unimodal with a critical point at $w^* \equiv 1 - \frac{8\lambda^2}{9rc_m} \in (\tilde{w}, \bar{w})$ and maximum value $\phi(w^*) = \frac{16}{27} \frac{\lambda^3}{c_m^2} \delta$. Moreover, if*

$$c_m < r\delta\lambda \tag{C1}$$

holds, the mapping $\phi(w)$ has, at most, one interior steady state.

Proof. See Appendix. ■

Lemma 3 implies that the dynamics of $\Phi(w_t)$ is non monotonic for intermediate levels of w_t . It also implies that the dynamic system (4.10) admits at most two steady states. A trivial one, w^{fb} , when $w_t > \bar{w}$, and a second one if the map $\phi(w)$ crosses the 45° degree line at $\tilde{w} \leq w_t \leq \bar{w}$. Unfortunately, in this intermediate range, the steady state, w^{ss} , of $w_{t+1} = \phi(w_t)$, if it exists, does not have a closed form solution. To characterize its stability and the dynamic behavior of trajectories in its neighborhood, it is therefore necessary to consider different possible cases, depending on parameter values. To ensure that the mapping $\Phi(w_t)$ maps (\tilde{w}, \bar{w}) into itself, I also make the additional

Assumption 5. $\frac{4}{3\sqrt{3}}\lambda \leq c_m$,

which requires that the maximal level of wealth $\phi(w^*)$, attainable in the presence of the agency problem, is less than or equal to the first-best level $w^{fb} = \delta\lambda$. Assumptions 4 and 5 and condition (C1) in Lemma 3, require therefore that the following restrictions hold on the cost of monitoring²³

$$\max \left\{ \frac{2\lambda^2}{r}, \frac{4}{3\sqrt{3}}\lambda \right\} \leq c_m < r\delta\lambda. \tag{4.15}$$

²³If c_m were higher than $r\delta\lambda$, the slope of the map would never be larger than one at \tilde{w} and thus the only (trivial) steady state of the dynamics would be $w^{ss} = \tilde{w}$. If c_m were lower than $4\lambda/(3\sqrt{3})$ then $\phi(w^*)$ would be higher than $\delta\lambda$ and $\Phi(w)$ could not map the interval $[\tilde{w}, \delta\lambda]$ into itself. Finally, if c_m were lower than $2\lambda^2/r$, $\tilde{w} = 1 - \frac{2\lambda^2}{rc_m}$ would be negative.

4.3.2 Dynamic Analysis

Figures 2a-2d depict four different cases consistent with the restrictions required in (4.15). The first case, shown in Figure 2a, arises when the mapping $\phi(w)$ satisfies the condition:

$$w^* > \phi(w^*)$$

which can be rewritten more explicitly as

$$1 - \frac{8\lambda^2}{9rc_m} > \frac{16}{27} \frac{\lambda^3}{c_m^2} \delta \quad (4.16)$$

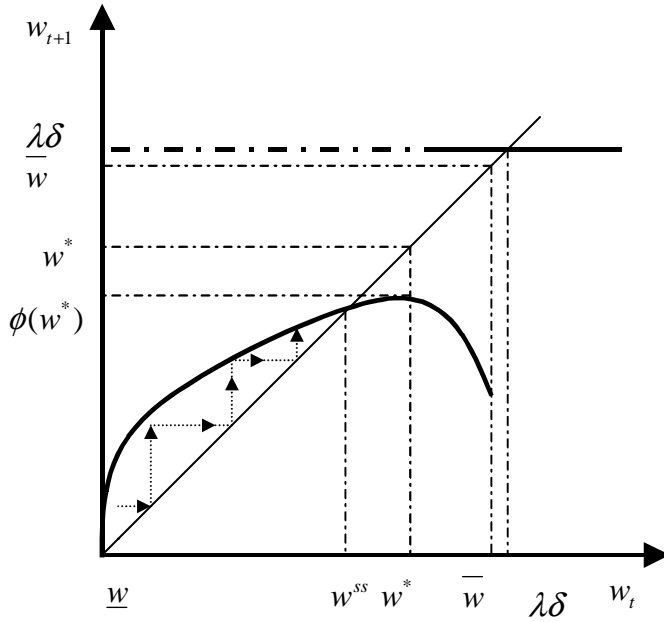


Figure 2a

Under this configuration of parameters, the dynamic is monotonic. Starting from any initial value, w_0 , the economy gradually converges to its (low) steady state $w_1^{ss} = \bar{w}$. For a given level of the agency problem, λ , condition (4.16) is satisfied, if the cost of monitoring, c_m , is sufficiently high. The reason high monitoring cost leads to a well behaved dynamics and to a low steady state is quite intuitive. If the cost of borrowing is high, entrepreneurs incentive to undertake investment projects are lower, since the minimum level of wealth \tilde{w} above which an entrepreneur is willing to exert positive effort becomes larger. As a result, few projects are undertaken and the total wealth that can be accumulated over time is low. Thus when c_m is sufficiently high, the agency problem between intermediaries and entrepreneurs constraints investment dynamics exactly as in a model based on standard credit market imperfections. For given c_m , condition (4.16) is also met when $\lambda = \Pi\beta - b$ (the degree of the agency problem) is

relatively low. Given the normalization made on the level of the private benefits in Assumption 5, a low λ occurs if the productivity of the investment project, Π , is low. In such a case, the wealth that is accumulated over time is limited by the amount of capital goods that can be produced. Entrepreneurs never become rich enough to “escape” from investor control and this process of “controlled” investment leads to a stable, though low, steady state.

Figures 2b-2d show the dynamic of wage accumulation when,

$$w^* < \phi(w^*).$$

Unlike the previous case, the resulting dynamics can be of different types. Figures 2b and 2c display the case where

$$w^* < \phi(w^*) \text{ and } \bar{w} > \phi(\bar{w})$$

or

$$1 - \frac{8\lambda^2}{9rc_m} < \frac{16\lambda^3}{27c_m^2}\delta \text{ and } 1 - \frac{\lambda^2}{2rc_m} > \frac{\lambda^3}{2c_m^2}\delta. \quad (4.17)$$

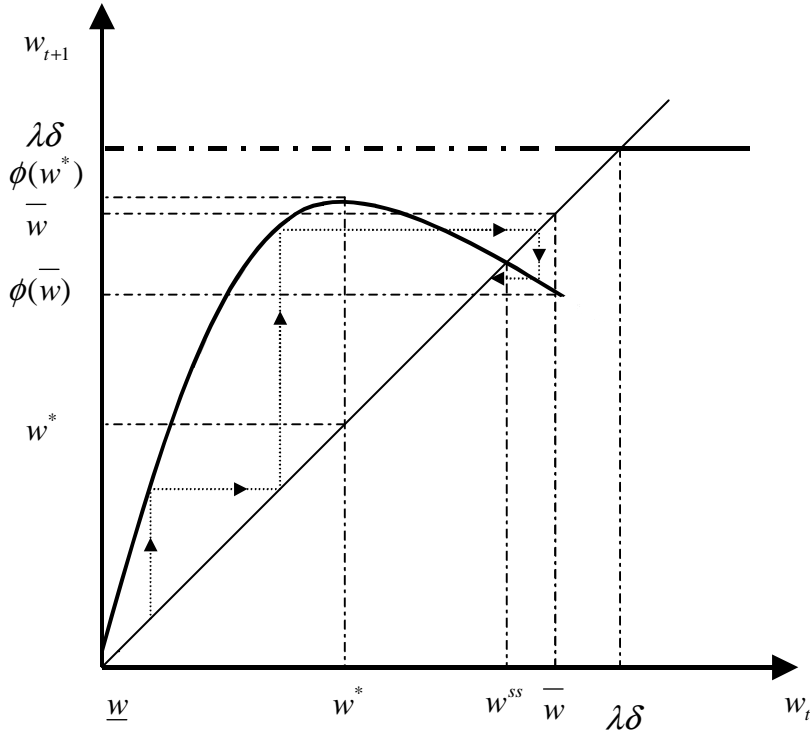


Figure 2b

Under condition (4.17), the map $\phi(w)$ intersects with the 45° line at the downward sloping part, so that the dynamics around the steady state may

be oscillatory but stable, in the sense that the economy eventually converges to the steady state, possibly after several periods of fluctuations. This is the case depicted in Figure 2b. Under the same conditions prevailing in (4.17), however, the dynamic can also be unstable with the economy moving back and forth between booms and recessions, as shown in Figure 2c. In that figure, the interval $[w^*, \bar{w}]$ is a trapping region, i.e. once the economy eventually enters this region it will never leave.²⁴

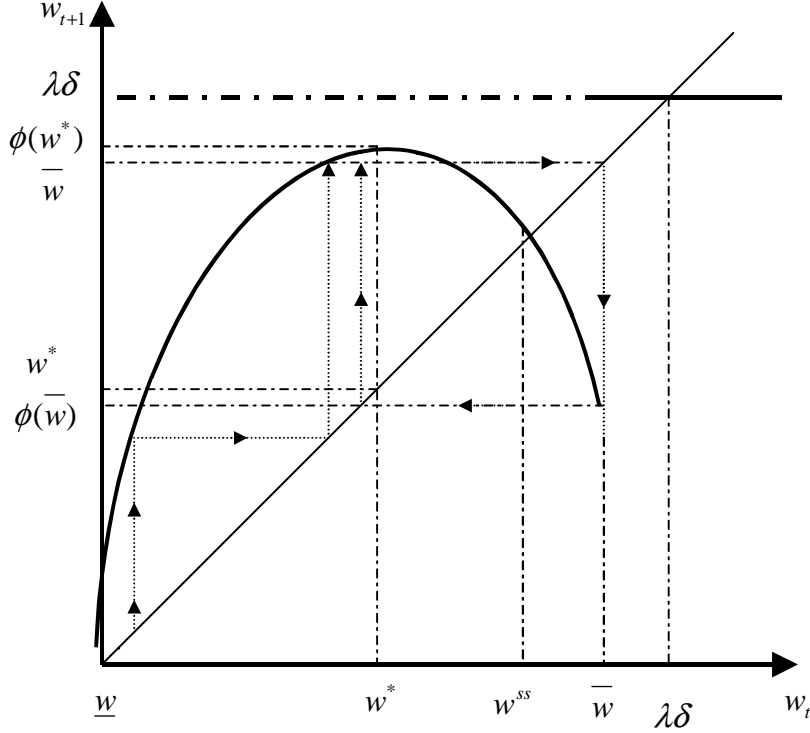


Figure 2c

Conditions (4.17) holds under two conditions: 1) for a given λ , the cost of monitoring is sufficiently low (so that $w^* < \phi(w^*)$) but not too low (so that $\bar{w} > \phi(\bar{w})$), and 2) for a given c_m , λ is sufficiently high but not too high. The reason instability arises in this economy is simple. For a given, λ , if the cost of

²⁴Ideally, to examine for which configuration of parameters this case actually arises, one should check the sufficient condition that the slope of the function $\phi(w)$ at the steady state is such that $|\phi'(w^{ss})| > 1$. Unfortunately, this characterization is not feasible given that the steady state of the mapping, $w_{t+1} = \phi(w_t)$, cannot be derived explicitly. In principle, this case may in fact never arise. A necessary condition for ruling this possibility out is that the slope of the map $\phi(w)$ at the point \bar{w} , is larger than one, in absolute value. Simple algebra shows that

$$|\phi'(\bar{w})| > 1 \text{ iff } c_m < \frac{r\delta\lambda}{2}$$

which is evidently possible, given condition (4.15) and (4.17). Therefore, limit-cycles cannot be excluded for sure, but remain only a possibility.

monitoring is low, investor control is high, forcing the selection of productive projects that contribute to increase the level of wealth in the economy. At the same time, since c_m is not very high, more and more resources remains in the hands of the entrepreneurs, leading to further accumulation of wealth. As next period wealth rises, lenders financial exposure shrinks and monitoring intensity falls. Entrepreneurs eventually gain independence from investors and have the option to finance projects involving private-benefits, which reduces the amount of capital that is available for next period production. Hence capital stock falls, the wealth of future generations deteriorates and the cycle starts all over again.

Similarly, for a given c_m , a high λ , but not too high to blunt the agency problem, leads initially to fast accumulation of capital – given the high degree of investor control at low level of wealth and the fact that high λ reflects a high project return, Π . As soon as the amount of wealth accumulated increases, a fall in investor control permits that resources are put to less than optimal use, generating less wealth for future generations of entrepreneurs and hence initiating a period of slump.

The final case is depicted in Figure 2d. For this case to arise it must be that

$$w^* < \phi(w^*) \text{ and } \bar{w} < \phi(\bar{w}),$$

or,

$$1 - \frac{8\lambda^2}{9rc_m} < \frac{16}{27} \frac{\lambda^3}{c_m^2} \delta \text{ and } 1 - \frac{\lambda^2}{2rc_m} < \frac{\lambda^3}{2c_m^2} \delta. \quad (4.18)$$

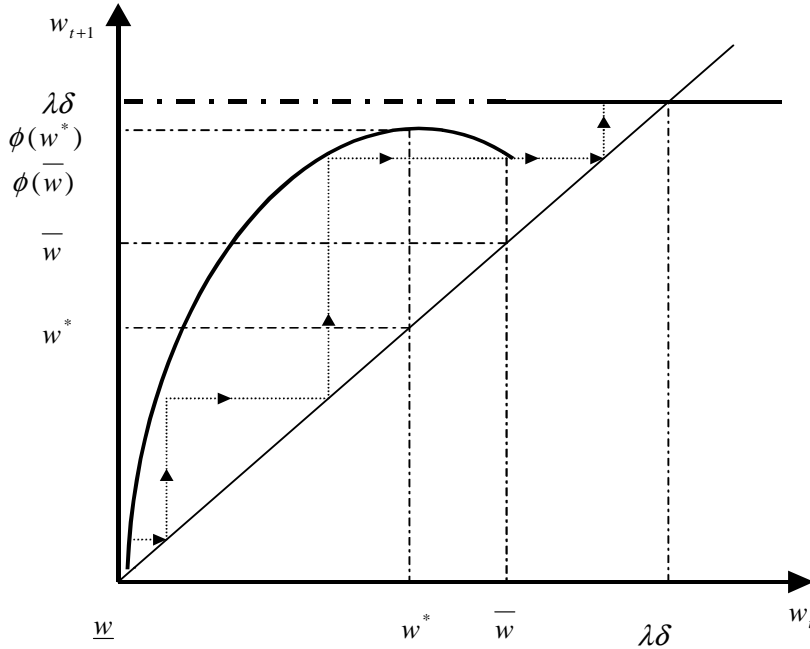


Figure 2d

This restriction is essentially stronger than (4.17), since it requires a lower c_m and/or higher λ . When (4.18) holds, the dynamics always converge to the first best. The reason is very intuitive. If c_m is very low, monitoring is high, and the process of capital accumulation fast. Moreover, a very low c_m reduces \bar{w} and thus the range of wealth below which the conflict of interest between entrepreneurs and investors is active. Hence entrepreneurs internalize more the consequence of choosing projects that generate capital goods and the dynamics eventually converge to that of an economy without agency problems. Similar effects arise when λ is very high, i.e. the agency problem is unimportant or the project return is high. Entrepreneurs have more to gain from undertaking projects that generate capital goods, therefore the drop in wealth in the interval (w^*, \bar{w}) is not so big to generate changes in the dynamics of wealth formation.

To summarize, the central results of this section are synthesized in the following proposition.

Proposition 2. Assume condition (4.15) holds. Then there exist cutoffs $\underline{c}_m < \bar{c}_m$ and $\underline{\lambda} < \bar{\lambda}$ such that:

- a. If $c_m < \underline{c}_m$, or $\lambda > \bar{\lambda}$, the dynamics of w_t converges to the first best equilibrium.
- b. If $\underline{c}_m < c_m < \bar{c}_m$, or $\underline{\lambda} < \lambda < \bar{\lambda}$, the dynamic of w_t has, either locally oscillatory convergence to a unique steady state, or equilibrium trajectories that are trapped in the interval $[w^*, \bar{w}]$.
- c. If $c_m > \bar{c}_m$, or $\lambda < \underline{\lambda}$, the dynamics of w_t , converge monotonically to a low stable steady state.

Proof See Appendix.

4.3.3 Discussion

Proposition 2 suggests that the conditions under which the double incentive problem emphasized in this paper leads to instability and fluctuations depend crucially on the degree of the agency problem, λ , and the costs of monitoring c_m . For given initial conditions small changes in c_m and λ can, therefore, lead to different dynamic patterns. Consider, for example, the case where c_m is related to the characteristics of investment technologies, so that the cost of monitoring is larger for, say, new technologies than for more mature ones. In this case Proposition 2 suggests that it is only after the properties of these technologies become properly understood that instability may arise in the economy. Alternatively, if one is willing to assume that the magnitude of the monitoring costs mirrors the stage of the financial development, then the analysis above suggests that economies with less developed financial markets are not necessarily prone to fluctuations, whereas small improvements in credit markets might lead to

instabilities. In Proposition 2, λ also plays a crucial role. Since Assumption 5 in the model forces λ to commove with Π , small shocks to the productivity of investment projects may initiate different dynamics. If λ is low, negative shocks to Π are amplified and low investment leads to further lower activity. On the other hand, starting from a low λ , small but positive shocks may lead to complicated dynamics and instability. If one thinks of positive shocks to Π as initiated by the adoption of new technologies, then new technologies may lead to periods of fluctuations, unless the jump in their return is big.

4.4 Empirical Predictions

Having discussed the static and dynamic implications of the interplay between entrepreneur effort and investor control, I am now in the position to evaluate some of the predictions of the model. The analysis in Section 3 has two main comparative static results, both stemming from the fact that more investor control reduces entrepreneur incentives. The first prediction is that entrepreneurs with low net worth undertake few investment projects. The second one is that firms with high leverage invest less. Both predictions stand close to the findings that emerge from the large empirical literature on credit frictions and firm investment. That investment is sensitive to cash flow (holding constant investment opportunities) and that large debt burdens prevent firms from raising additional funds are in fact two robust results of this literature (see for example the surveys of Bernanke, Gertler and Gilchrist, 1996 or Stein, 2004).

The static model has the further implication that investors lend more easily if the project is a good one or the entrepreneur can supply a large fraction of the initial investment. This prediction is in agreement with the “received wisdom” in the banking industry and has large empirical support (see for example Gorton and Winton, 2004). Moreover, the emphasis that investor control affects entrepreneurs incentives, has also implications on how this mechanism vary across financial systems and, within country, across industries. It suggests for example that in industries with more pledgeable assets investment profitability should be lower and/or the amount of private benefits enjoyed by entrepreneurs larger than in industries with less tangible capital. Similarly, it suggests that investment’s profitability should vary with respect to the lender’s ability to monitor entrepreneurial activity. Unfortunately I am not aware of any systematic empirical study relating investor control to investment profitability. There is, instead, some evidence that agency costs are lower when financing occurs through banks acting in their role of delegated monitoring on behalf of other shareholders (see Ang, Cole and Lin, 2000).

Several interesting predictions emanate also from the dynamic model of Section 4. First of all, it suggests that investment dynamics is not linear. This is in agreement with the fact that changes in internal finance affect firm’s investment more when the economy is deeper in recession (see Bernanke, Gertler and Gilchrist, 1996). In the model this occurs because at a low level of net worth

a small increase in firm internal funds permits the entrepreneur to gain some independence from the investor and thus to increase investment. This effect is, however, smaller if the degree of external interference is low, since in this situation the entrepreneur effort becomes less and less dependent on internal funds. Second, the varying intensity at which the investor exercises control on the selection of projects, suggests that lending standards shape investment dynamics. This is consistent with the anecdotal evidence reported in Rajan (1995) according to which lending standards (i.e. criteria by which banks determine and rank loan applicants) are relaxed in booms and tightened in recessions. It is also in line with the findings of Asea and Blomberg (1998) and Lown and Morgan (2004) that in the U.S, bank lending standards are important for aggregate economic activity. Moreover, it is related to the phenomenon of “flight to quality” (Bernanke, Gertler and Gilchrist, 1996) i.e. the tendency of lenders to favor, in recession, borrowers that are less likely to default.²⁵

A final prediction worth mentioning is that in the model exogenous shocks to firm net worth may be dampened rather than amplified. This fact stands in sharp contrast with the one arising in a standard model based on the credit multiplier. The reason this occurs rests, once again, on the crucial role that the investor plays in selecting entrepreneur projects. If a recessionary shock arises, for example, stringent control allows only productive projects to get their way and negative shocks are stabilized quickly. Empirical evidence in support of the fact that the credit market acts in dampening of amplifying shocks is unfortunately scant. In the literature, there is only microevidence that firms investment decisions are affected by credit frictions, as discussed above, but not evidence that these frictions actually matter for aggregate dynamics.

5 Robustness

The results of this paper are obtained in an admittedly simplified representation of the economy. It is therefore worth discussing some of its leading assumptions.

1. Perhaps, the assumption doing most of the results is that entrepreneurs are short lived. By adopting investment projects that generate only private benefits entrepreneurs do not internalize the consequences of their choice on the funds available for future investments. If entrepreneurs were long lived, boom periods would last longer and the amplitude of fluctuations reduced, though not completely. In this modified set-up, the concept of borrower net worth would have to be extended to include current and future firm’s expected cash flows. This extension, however, would not invalidate the logic of the model presented above, insofar as lenders expectations on firms future net worth are

²⁵In the literature flight to quality is indeed meant to represent a phenomenon of “flight to safety”, since the focus is on borrowers that can pledge more or less collateral. Though this paper does not distinguish between safe and risky borrowers, its central premise is that less efficient projects are more likely to fail repaying the lenders. In this sense safety and quality go hand in hand.

persistent. If firms profits are high today and expected to remain high also in the future, lenders would reduce monitoring intensity in a manner similar to what discussed above. Moreover, in a repeated interaction, the lender break-even constraint need to be satisfied over a longer horizon rather than period by period, which may further weaken banks incentives to monitor. This effect is obviously counterbalanced by the fact that long-lived entrepreneurs internalize more the consequences of project choice. Allowing for long-lived entrepreneurs, however, is not an easy task, given that the contracting problem between lenders and borrowers would be one with repeated-double-moral-hazard.²⁶

2. The fiction that entrepreneurs enjoy private benefits was used to create a conflict of interest between investors and entrepreneurs. As discussed in the text, several interesting interpretations can be given to private benefits. The most preferred one, however, is that entrepreneurs are “conservative”, in the sense of preferring to delay the adoption of new technologies, because they must otherwise incur a private effort cost. Obviously, there may be different explanations why non-profit maximizing entrepreneurs can survive in a market economy. A first reason may be due to the market structure: in less competitive environment there is bigger scope for entrepreneurial slack. For example, in the OLG model of Section 4, one could for example assume that producers of intermediate goods are protected by monopoly rights on their innovation and thus have the opportunity to “buy time” for the adoption of new technologies, without being threaten by solvency constraints. Alternatively, and this has been the case discussed in the text, there is an agency problems between intermediate producers and outside financier, because for example the adoption of new technologies are non contractible. In both interpretations projects involving private benefits are less productive and as a consequence contribute deteriorating the overall productivity in the economy.

3. Central to the results is the premise that investor control as well as entrepreneur effort are essential to generate cash flows, and that entrepreneurial incentive to exert effort is adversely affected by investor control. These assumptions are responsible for the unimodal shape of the investment dynamics of Section 3 and 4. Alternatively, one may assume that investor enhances profit maximization directly and independently of investor effort by posing, for example, that cash flows are generated with probability $(e + m)$ rather than em , as

²⁶The difficulty associated with having long-lived entrepreneurs is also recognized in Carlstrom and Fuerst (1997) and Bernanke, Gertler and Gilchrist (1999), despite the focus of these authors is on the quantitative implications of a credit multiplier model, within a standard real business cycle framework with infinitely lived agents. In these models entrepreneurs are assumed to have a finite horizon, i.e. a constant probability of surviving till the next period. With this assumption, these papers circumvent the problem arising from the repeated interaction between lenders and borrowers and permit to consider the case of financial contracts that last for one period only. In these papers it is also argued that allowing for multi-period contracts would have no effect as long as borrowers have finite horizon, since in this case the net worth would still affect the lending relationship. In these papers another implications of having entrepreneurs with short life is to preclude that they accumulate enough wealth to be able to self-finance investment, thus eliminating the significance of lending frictions.

assumed in the text. Such formulation would obviously kill the possibility that the investment dynamics is hump shaped and hence that endogenous fluctuations may arise. However, this would capture only one aspect of the problem, namely that the investor assists the entrepreneur in his venture, but not the role of the investor as monitor that destroys private benefits. The multiplicative formulation, instead, ensures that the entrepreneur preferences are congruent with the advising role of the investor if private benefits are small, while they are dissonant with the investor if private benefits are large. More generally, one could consider the case where the probability of producing productive output is $p(e, m) = [\gamma e^\kappa + (1 - \gamma)m^\kappa]^{\frac{1}{\kappa}}$ with $\kappa \leq 1$ and $\gamma \in (0, 1)$. In this case the two actions are perfect substitute if $\kappa = 1$, and complements otherwise. To generate endogenous fluctuations it would be necessary that κ were sufficiently low.

4. The model is used on the presumption that the entrepreneur pays the evaluation costs first and lending occurs only afterwards. In the alternative case in which first financing occurs and then moral hazard takes place, the zero profit condition for the investor would depend on the entrepreneur effort. This would complicate the expression that defines the fraction of profit that must be given to the investor, as well as her optimal degree of control. However, the intuition that the investor monitors less when the entrepreneur puts more of his wealth in the project would continue to hold, so that the essential results of this paper would not be affected.

5. In the OLG model of Section, 4 the marginal productivity of capital is assumed to be constant. This assumption rules out the possibility that entrepreneur's effort depends also on the future price of capital. Though realistic, such an extension might give rise to multiple equilibria, in which the optimal effort supply of an entrepreneur at time t would depend directly on the degree of investor control, and indirectly on the effort decision of the other entrepreneurs, given that the actions of these entrepreneurs affect the amount of capital available in the economy at $t + 1$ and hence its price. Extending the model in this direction would certainly add another interesting element to the dynamics, but this would be unrelated to the strategic interaction between investors and entrepreneurs, the main focus of the paper.

6. Throughout the analysis we have maintained the assumption of a credit market where the supply of credit is infinitely elastic and hence the interest rate constant. This is a reasonable assumption if the economy under consideration is small and open. Allowing for the interest rate to vary, however, would not invalidate the results at all. In fact, what is required for the story of this paper is that entrepreneur debt obligation $\alpha_t = \left(\sqrt{2r_t(1 - w_t)c_m} \right) / \Pi\beta$ falls when he contributes a larger fraction of his wealth into the project. Evidently, this is possible even if the supply of credit is infinitely inelastic, as for example in Aghion *et al.* (1999) and Matsuyama (2004). In such alternative scenario, the interest rate also falls if the entrepreneur takes on less debt, reinforcing the effect emphasized in the paper.

6 Conclusion

This paper has offered a preliminary investigation into the link between credit market frictions and endogenous cycles. An extensive literature in macroeconomics has studied the relation between entrepreneurial net worth and firm investment to explain persistence and amplification of small shock to the economy. Little attention, instead, has been paid to the possibility that credit frictions generate instability and endogenous fluctuations. To highlight this connection, this paper has proposed a mechanism based on the joint interaction of borrowers and lenders incentives.

Starting with the premise that the profitability of investment projects depends upon the joint non-contractible actions of investors and entrepreneurs, the paper illustrates how borrowers and investors incentives may vary over the cycle. The model has been set-up in a way that the entrepreneur initiative is essential for selecting investment projects and that the investor control is crucial for selecting only profitable projects. Since there is a basic conflict of interest between the entrepreneur and the investor over the selection of projects, too much control may engender entrepreneur incentive to initiate investment, while too little control may jeopardize investment productivity. I have shown how this basic trade-off between entrepreneurial initiative and investor control can generate investment dynamics that mimic one arising from a standard model with credit friction, in which more entrepreneurial net worth leads to higher investment. I have also shown, however, that the same trade-off is capable of generating endogenous fluctuations, induced by an ongoing deterioration of project profitability. In particular when embedded into a dynamic model with overlapping generation it is possible to derive a simple condition for endogenous cycles. The condition takes the very simple form that the cost of monitoring for the investor (or the degree of the agency problem) is neither too high nor too low. Under this condition the economy either converge to its steady state in an oscillatory manner, or never reach the steady state and keep on cycling between periods of boom and recession.

Business cycles are inherently complex and the agency problem in this paper is certainly much too simple to do full justice to reality. Many important issues deserve more careful analysis in future research. First, while entrepreneurial private benefits are the source of divergent interest between firms and investors, the nature of these private benefits has been left unspecified. Modelling these benefits in greater details can open the way to more elaborate theories, with more convincing explanations why entrepreneurs may prefer the adoption of less productive investment technologies at different stages of the economic cycles. Second, the overlapping generation framework is a useful device to single out the dynamic consequences of the agency problem between lenders and borrowers. A framework richer in dynamics and in the specification of the details of private benefits may lead, however, to much interesting insights for the source of business fluctuations. At the moment the framework is too stylized to permit

meaningful quantitative analysis and evaluate the importance of the mechanism emphasized in this paper. These extensions are left for future research.

This paper has also neglected the normative question of what government policy can do to minimize fluctuations. In the dynamic version of the model, however, fluctuations are an efficient equilibrium outcome. This is so even though low productivity projects impair future generation net worth. In fact, when entrepreneurs select bad projects they still maximize their utility while keeping the investor on her break-even constraint. Room for government intervention is therefore limited to the case where the welfare of future generations is also taken into account. In this case the planner could restore efficiency by taxing rich young entrepreneurs so that their independence from the investor control would never be gained. Alternatively, the planner could tax investor revenues so to induce her to monitor more intensively and avoid that entrepreneur could select bad projects. The exact details of this policy options are however intricate and left for future work.

Finally, although, the main focus of this paper has been on the business cycle implications, the agency problem between entrepreneurs and investors, also has interesting cross-section and cross-country predictions. For example, at heart of the model is that investor incentive to control entrepreneurial behavior falls when the entrepreneur is able to provide more collateral. This mechanism suggests that in more capital intensive industries, the profitability of the investments should be lower and/or the amount of private benefits enjoyed by entrepreneurs larger than in industries with less tangible capital. A second prediction emanating from the model is that the profitability of investment should vary with respect to the lender's ability to monitor entrepreneurial activity. Countries differ extensively in terms of how their financing system works. Bank based financial systems require a very direct control with the borrower suggesting that more control is at work, at least for those firms that have less collateral to pledge. Similarly, a direct link between investors and entrepreneurs exists in system in which most of the financing occur through venture capitalists. Conversely, in markets that rely more on arm's length financing, control is less direct and the opportunities for misbehavior are larger. Insofar as banks and stock markets are fundamentally different in the way they process information and control borrowers, this paper has potentially something to say about the possibility that market-based rather than bank-based economies are more prone to instabilities and fluctuations. Careful empirical examination of these empirical predictions is also left for future work.

7 Appendix:

Proof of Proposition 1.

- (i) *Proof that $m > 0$ and $e > 0$ in $w \in (\hat{w}, \bar{w})$ where $\hat{w} = \max\{\underline{w}, \tilde{w}\}$.*

The equilibrium value of monitoring, after substituting in the value of α given by (3.15), is

$$m = \frac{\alpha\Pi}{c_m} = \sqrt{\frac{2r(1-w)}{c_m}} = \sqrt{\sigma(1-w)} \text{ where } \sigma = \frac{2r}{c_m}.$$

m is a decreasing function of w , in the interval (\hat{w}, \bar{w}) , and at $\underline{w} = 1 - \frac{\Pi^2}{2rc_m}$, and $\bar{w} = 1 - \frac{(\Pi-b)^2}{2rc_m}$ it is such

$$0 < \frac{\Pi-b}{c_m} = m(\bar{w}) < m(\underline{w}) = \frac{\Pi}{c_m} < 1$$

by Assumption 1. The equilibrium value of effort is given by,

$$\begin{aligned} e(w) &= \frac{(b-rw + m(\Pi-b) - m\alpha\Pi)}{c_e} \\ &= \frac{((b-r) + (\Pi-b)\sqrt{\sigma(1-w)} - r(1-w))}{c_e} \end{aligned}$$

Under Assumption 1, $e(w)$ is a concave and increasing function of w . At \bar{w}

$$e(\bar{w}) = \frac{(b-r)}{c_e} + \frac{(\Pi-b)^2}{2c_m c_e} > 0$$

Moreover, as argued in Section 3.7, e is positive for values of w such that the participation constraint of the entrepreneurs is satisfied, i.e. for $w > \hat{w} = \max\{\underline{w}, \tilde{w}\}$.

(ii) *Proof that p , is concave in (\hat{w}, \bar{w}) , and has a maximum at $w^* \in (\hat{w}, \bar{w})$.*
The level of productive investment is measured by:

$$p(e(w), m(w)) = em\Pi$$

After replacing the equilibrium value of $m(w)$ and $e(w)$:

$$p(w) = \frac{\Pi}{c_e} \left((\Pi-b)\sigma(1-w) + (b-r)\sqrt{\sigma(1-w)} - r(1-w)\sqrt{\sigma(1-w)} \right)$$

which is convenient to rewrite as

$$p(w) = \frac{\Pi}{c_e} \left(\lambda\sigma(1-w) + \kappa\sqrt{\sigma(1-w)} - r(1-w)\sqrt{\sigma(1-w)} \right) \quad (\text{A1})$$

where, by Assumption 1

$$\lambda = (\Pi-b) > 0 \text{ and } \kappa = (b-r) \geq 0.$$

Equation (A1) is increasing in $[0, w^*]$ and decreasing in $[w^*, \bar{w}]$, where w^* is the root of:

$$\frac{\partial p}{\partial w} = \frac{\Pi\sigma}{c_e} \left[\frac{3}{4}c_m\sqrt{\sigma(1-w)} - \left(\lambda + \frac{\kappa}{2\sqrt{\sigma(1-w)}} \right) \right] = 0$$

i.e.:

$$w^* = \frac{9c_m^2\sigma^2 - 6c_m\sigma\kappa - 8\sigma\lambda^2 - 4\sqrt{2}\sqrt{2c_m\sigma^2\kappa\lambda^2 + 2\sigma^2\lambda^4}}{9c_m^2\sigma^2} \equiv w^*(c_m, r, b, \Pi)$$

$p(w)$ is also concave function in $w \in (0, 1)$ since

$$\frac{\partial^2 p}{\partial w^2} = - \left(\frac{3c_m\sigma}{8\sqrt{\sigma(1-w)}} + \frac{\kappa}{4(\sigma(1-w))^{3/2}} \right) < 0$$

I now show that for parameter values satisfying Assumption A1 and A2,

$$\hat{w} < w^* < \bar{w}$$

(iia) *Proof that $w^* < \bar{w}$:*

Remember that $\bar{w} = 1 - \frac{\lambda^2}{2rc_m}$. Hence

$$w^* < \bar{w} = 1 - \frac{\lambda^2}{2rc_m}$$

if and only if

$$\frac{6c_m\sigma\kappa + 8\sigma\lambda^2 + 4\sqrt{2}\sqrt{2c_m\sigma^2\kappa\lambda^2 + 2\sigma^2\lambda^4}}{9c_m^2\sigma^2} > \frac{\lambda^2}{2rc_m}$$

or

$$6c_m\sigma\kappa + 4\sqrt{2}\sqrt{2c_m\sigma^2\kappa\lambda^2 + 2\sigma^2\lambda^4} > \lambda^2\sigma$$

which is always true, because

$$4\sqrt{2}\sqrt{2c_m\sigma^2\kappa\lambda^2 + 2\sigma^2\lambda^4} > \lambda^2\sigma$$

(iib) *Proof that $w^* > \hat{w} = \max\{\underline{w}, \tilde{w}\}$.*

It suffice to prove that $w^* > \tilde{w}$, since by Assumption 1, $\tilde{w} > \underline{w}$.

\tilde{w} is the root of entrepreneur's participation constraint:

$$(b-r) + (\Pi-b)\sqrt{\frac{2r(1-\tilde{w})}{c_m}} - r(1-\tilde{w}) = 0.$$

or

$$\kappa + \lambda\sqrt{\sigma(1-\tilde{w})} - \frac{c_m\sigma}{2}(1-\tilde{w}) = 0$$

which has as solution:

$$\tilde{w} = \frac{c_m^2\sigma^2 - 2c_m\sigma\kappa - 2\sigma\lambda^2 - 2\sqrt{2c_m\sigma^2\kappa\lambda^2 + \sigma^2\lambda^4}}{c_m^2\sigma^2} \equiv \tilde{w}(c_m, r, b, \Pi)$$

Hence $\tilde{w} < w^*$ iff

$$\frac{2c_m\sigma\kappa + 2\sigma\lambda^2 + 2\sqrt{2c_m\sigma^2\kappa\lambda^2 + \sigma^2\lambda^4}}{c_m^2\sigma^2} > \frac{6c_m\sigma\kappa + 8\sigma\lambda^2 + 4\sqrt{2}\sqrt{2c_m\sigma^2\kappa\lambda^2 + 2\sigma^2\lambda^4}}{9c_m^2\sigma^2}$$

or

$$6c_m\sigma\kappa + 5\sigma\lambda^2 + 9\sqrt{2c_m\sigma^2\kappa\lambda^2 + \sigma^2\lambda^4} > 2\sqrt{2}\sqrt{2c_m\sigma^2\kappa\lambda^2 + 2\sigma^2\lambda^4}$$

which holds true because $\kappa > 0$, $\lambda > 0$ and

$$9\sqrt{2c_m\sigma^2\kappa\lambda^2 + \sigma^2\lambda^4} > 2\sqrt{2}\sqrt{2c_m\sigma^2\kappa\lambda^2 + 2\sigma^2\lambda^4}.$$

(iii) *Proof that $i = em\Pi + e(1 - m)b$ is monotonically increasing in $w \in (\hat{w}, \bar{w})$*

It follows directly from point (i) and (ii).

Proof. of Lemma 2.

In the presence of an agency problem, i.e.

$$b > (1 - \alpha_t)\Pi\beta \tag{A2}$$

the optimal level of investor control and entrepreneurial effort are obtained by maximizing

$$u_E = (1 - e_t)rw_t + e_t [m_t(1 - \alpha_t)\Pi\beta + (1 - m_t)b] - c_e \frac{e_t^2}{2}, \tag{A3}$$

and

$$u_I = e_t \left\{ m_t\alpha_t\Pi\beta + (1 - m_t) \times 0 - c_m \frac{m_t^2}{2} \right\},$$

and are given by:

$$m_t = \min \left\{ \frac{\alpha_t\Pi\beta}{c_m}, 1 \right\}, \tag{A4}$$

and

$$e_t = \min \left\{ \frac{(b - rw_t) - m_t(b - (1 - \alpha_t)\Pi\beta)}{c_e}, 1 \right\}, \tag{A5}$$

where α_t is pinned down by the intermediary break-even condition,

$$\left\{ m_t\alpha_t\Pi\beta + (1 - m_t) \times 0 - c_m \frac{m_t^2}{2} \right\} = r(1 - w_t)$$

or

$$\alpha_t(w_t) = \frac{\sqrt{2r(1 - w_t)c_m}}{\Pi\beta} \leq 1. \tag{A6}$$

Replacing (A6) in (A4) and (A5), and assuming interior solutions, the equilibrium values of $m_t(w_t)$ and $e_t(m(w_t), w_t)$ can be conveniently rewritten as

$$m_t(w_t) = \sqrt{\sigma(1 - w_t)} > 0$$

and

$$e_t(m_t(w_t), w_t) = \frac{m_t \lambda - r(1 - w_t)}{c_e} > 0$$

where $\sigma = \frac{2r}{c_m}$, and $\lambda = \Pi\beta - b > 0$. In order to have positive investment entrepreneur effort must be positive, which occurs when the level of net worth is not too low,

$$w_t \geq 1 - \frac{2\lambda^2}{rc_m} \equiv \tilde{w}$$

Moreover, the agency problem between the investor and the entrepreneur exists if entrepreneur net worth is not too high,

$$w_t \leq 1 - \frac{\lambda^2}{2rc_m} \equiv \bar{w} \tag{A7}$$

where (A7) is obtained using (A2) and (A6). Assumption 4 ensures that $\tilde{w} > 0$ and $\bar{w} < 1$. The conflict of interest vanishes when

$$b < (1 - \alpha_t)\Pi\beta \tag{A8}$$

or, using the expressions above, when $w_t > \bar{w}$. When (A8) holds, maximization of (A3) leads to (4.5) in the text.

■
Proof. of Lemma 3.

The map

$$\phi(w_t) = (1 - w_t) \left[\sigma\lambda - r\sqrt{\sigma(1 - w_t)} \right] \delta, \tag{A9}$$

is zero at $\tilde{w}_t = 1 - \frac{2\lambda^2}{rc_m}$,

$$\phi(\tilde{w}_t) = \frac{2\lambda^2}{rc_m} \left[\frac{2r}{c_m}\lambda - r\sqrt{\frac{2r}{c_m} \frac{2\lambda^2}{rc_m}} \right] \delta = 0$$

Moreover its first derivative

$$\phi'(w_t) = \left[\sqrt{(1 - w_t)} \frac{3r\sigma}{2\sqrt{\sigma}} - \sigma\lambda \right] \delta$$

evaluated at \tilde{w}_t

$$\phi'(\tilde{w}_t) = \frac{r\lambda\delta}{c_m}$$

is larger than one if

$$c_m < r\lambda\delta \tag{C1}$$

which is condition (C1) in the Lemma. Hence under (C1), the maps start at zero at \tilde{w}_t with a slope larger than unity. Simple differentiation of (A9) gives $w^* = 1 - \frac{8\lambda^2}{9rc_m}$ as its critical point. $\phi(w_t)$ is strictly increasing for $w_t < w^*$ and strictly decreasing for $w_t > w^*$. At the maximum, the value of the function is

$$\phi(w^*) = \frac{8\lambda^2}{9rc_m} \left[\frac{2r}{c_m} \lambda - r \sqrt{\frac{2r}{c_m} \frac{8\lambda^2}{9rc_m}} \right] \delta = \frac{16}{27} \frac{\lambda^3}{c_m^2} \delta$$

The existence of at most one steady of the map $w_{t+1} = \phi(w_t)$ in the range (\tilde{w}, \bar{w}) is guaranteed by (C1) and the fact the the function is single peaked. A necessary and sufficient condition for the existence of a steady state is that $\phi(\bar{w}) < \bar{w}$, or

$$\frac{\lambda^3}{2c_m^2} \delta < 1 - \frac{\lambda^2}{2rc_m}$$

■

References

- [1] Aghion, P., P. Bacchetta, and A. Banerjee, 2003, “Financial Development and the Instability of Open Economies”, *Journal of Monetary Economics*, 51, 1077-1106.
- [2] Aghion, P., A. Banerjee, and T. Piketty, 1999, “Dualism and Macroeconomic Volatility”, *The Quarterly Journal of Economics*, 114, 1359-1397.
- [3] Aghion, P. and P. Bolton, 1992, “An Incomplete Contract Approach to Financial Contracting”, *Review of Economic Studies*, 59, 473-493.
- [4] Aghion, P. and J. Tirole, 1997, “Formal and Real Authority in Organization”, *Journal of Political Economy*, 105, 1-29.
- [5] Aghion, P., and G., Saint-Paul, 1998, “Virtues of Bad Times: Interactions between Productivity Growth and Economic Fluctuations”, *Macroeconomic Dynamics*, 2, 322-344.
- [6] Ang, J. S., R. Cole, and J. W. Lin, 2000, “Agency Costs and Ownership Structure”, *Journal of Finance*, 55, 81-106.
- [7] Azariadis, C., and B. Smith, 1997, “Financial Intermediation and Regime Switching in Business Cycles”, *American Economic Review*, 88, 516-536.
- [8] Bacchetta, P. and R. Caminal, 2000, “Do Capital Market Imperfections Exacerbate Output Fluctuations?”, *European Economic Review*, 44, 449-468.
- [9] Bernanke, B., and M. Gertler, 1989, “Agency Costs, Net Worth, and Business Fluctuations”, *American Economic Review*, 79, 14-31.

- [10] Bernanke, B., M. Gertler, and S. Gilchrist, 1996, "The Financial Accelerator and the Flight to Quality," *Review of Economics and Statistics*, 78, 1-15.
- [11] Bernanke, B., M. Gertler, and S. Gilchrist, 1999 "The Financial Accelerator in a Quantitative Business Cycle Framework", in John Taylor and Michael Woodford (eds.), *Handbook of Macroeconomics*, Amsterdam: North Holland.
- [12] Besanko, D., and G., Kanatas, 1993 "Credit Market Equilibrium with Bank Monitoring and Moral Hazard," *Review of Financial Studies*, 6, 213-232.
- [13] Billet, M., M. Flanery and J. Garfinkel, 1995 "The Effect of Lender Identity on a Firm's Equity Return," *Journal of Finance*, 50, 699-718.
- [14] Burkart, M., D. Gromb and F. Panunzi, 1997 "Large Shareholders, Monitoring, and the Value of the Firm", *Quarterly Journal of Economics*, 112, 693-728.
- [15] Caballero, R., and M. Hammour, 1994 "The Cleansing Effects of Recessions", *American Economic Review*, 84, 1350-68.
- [16] Caballero, R., and M. Hammour, 1996 "On the Timing and Efficiency of Creative Destruction," *Quarterly Journal of Economics*, 111, 805-52.
- [17] Casamatta, C., 2003, "Financing and Advising: Optimal Financial Contracts with Venture Capitalists", *The Journal of Finance*, 58, 2059-2085.
- [18] Carlstrom, C. and T. Fuerst, 1997, "Agency Costs, Net Worth, and Business Fluctuations: A computable General Equilibrium Analysis," *American Economic Review*, 87, 893-910.
- [19] Diamond, P., 1965 "Government Debt in a Neoclassical Growth Model," *American Economic Review*, 55, 1126-1150.
- [20] Diamond, D., 1991 "Monitoring and Reputation: The Choice between Bank Loans and Directly Placed Debt," *Journal of Political Economy*, 99, 689-721.
- [21] Gertler, M., 1992, "Financial Capacity and Output Fluctuations in an Economy with Multi-Period Financial Relationships", *Review of Economic Studies*, 59, 455-472.
- [22] Gompers, P., and Lerner, J., 1999, *The Venture Capital Cycle*, MIT Press, Cambridge, MA.
- [23] Gorton, G., and A. Winton, 2004, "Financial Intermediation" in Handbook of the Economics of Finance, edited by G. Constantinides, M. Harris and R. Stulz, Amsterdam: North Holland.

- [24] Hall, R., 2000 "Reorganization", *Carnegie Rochester Conference on Public Policy*, 52, 1-22.
- [25] House, C., 2004 "Adverse Selection and the Accelerator," forthcoming *Journal of Monetary Economics*.
- [26] Holmstrom, B., and J. Tirole, 1997 "Financial Intermediation, Loanable Funds, and the Real Sector," *The Quarterly Journal of Economics*, 112, 663-692.
- [27] Hubbard, G., 1998 "Capital Market Imperfections and Investment", *Journal of Economic Literature*, 36, 193-225.
- [28] Inderst, R., and H. Muller, 2005 "A Lender-Based Theory of Collateral", forthcoming *Journal of Financial Economics*.
- [29] James, C., 1987, "Some Evidence on the Uniqueness of Bank Loans", *Journal of Financial Economics*, 19, 217-233.
- [30] Jensen, M., 1986 "Agency Costs of Free Cash Flows, Corporate Finance and Takeovers," *American Economic Review*, 76, 323-329.
- [31] Kaplan, S., and P. Stromberg, 2003, "Financial Contracting Theory meets the real world: An Empirical Analysis of Venture Capital Contracts", *Review of Economic Studies*, 70, 281-315.
- [32] Kiyotaky, N., and J.H. Moore, 1997 "Credit Cycles", *Journal of Political Economy*, 105, 211-248.
- [33] Lown, C. and D. Morgan, 2004 "The Credit Cycle and the Business Cycle: New Findings Using the Loan Officer Opinion Surveys," forthcoming *Journal of Money, Credit and Banking*.
- [34] Manove, M., A.J. Padilla and M. Pagano, 2001 "Collateral vs. Project Screening: A Model of Lazy Banks", *Rand Journal of Economics*, 32, 726-44.
- [35] Matsuyama, K., 2004 "The Good, the Bad and the Ugly: An Enquiry into the Causes and Nature of Credit Cycles", *unpublished* Northwestern University.
- [36] Rajan, R.G., 1994 "Why Bank Credit Policies Fluctuate: A Theory and Some Evidence," *Quarterly Journal of Economics*, 109, 399-441.
- [37] Rajan, R.G., and A. Winton, 1995 "Covenants and Collateral as Incentives to Monitor," *Journal of Finance*, 50, 1113-1146.
- [38] Romer, P., 1986, "Increasing Returns and Long-Run Growth," *Journal of Political Economy*, 94, 1002-1037.

- [39] Ruckes, M., 2004, "Bank Competition and Credit Standards," *Review of Financial Studies*, 17, 1073-1102.
- [40] Stein, J. 2004 "Agency, Information and Corporate Investment" in Handbook of the Economics of Finance, edited by G. Constantinides, M. Harris and R. Stulz, Amsterdam: North Holland.
- [41] Suarez, J. and O. Sussman, 1997 "Endogenous Cycles in a Stiglitz-Weiss Economy", *Journal of Economic Theory*, 76, 47-71.
- [42] Thakor, A., 1996, "Capital Requirements, Monetary Policy, and Aggregate Bank Lending: Theory and Empirical Evidence," *The Journal of Finance*, 51, 279-324.