FIRM'S OPTIMAL CAPITAL ACCUMULATION PATH WITH ASYMMETRIC INFORMATIONS AND DEBT INSTEAD OF EQUITY FINANCE

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di
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Abstract

Two Euler equations are obtained from a firm's investment intertemporal dynamic model where debt finance is the only external source of funds and firms face borrowing constraints in the form of a limit to the maximum amount of outstanding debt. As suggested by the hierarchy of finance model they represent the optimal capital accumulation path for firms belonging to different financing regimes. The Euler equations differ for a discount factor function of the nominal interest rate on debt for liquidity constrained firms and of the rate of return on retentions for unconstrained firms. Then, when asymmetric information is a characteristic of the financial markets, liquidity constrained firms will be characterized by a lower optimal capital accumulation path than the unconstrained ones.

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1. Introduction

Modigliani and Miller (1958) showed that, under the assumption of perfect capital markets\footnote{Perfect capital markets means: competitive markets, no transaction costs, full and free information to all markets participants.}, financial conditions and investments decisions are independent; that is, only the cost of investment matters for investment spending. With perfect capital markets debt and equity issue may be considered as perfect substitutes for retained earnings, and firms should undertake any positive net present value investment project regardless of the source used to finance it.

The financial irrelevance proposition rests on the assumption of full information among the agents operating in financial markets. By contrast, as the new Keynesian approach has pointed out, once we consider the presence of capital market imperfections we cannot anymore make the assumption of perfect substitutability between internal and external sources of funds. Indeed, with asymmetric information a financing hierarchy among different sources of finance emerges, with internal sources preferred to the external ones. This financing hierarchy makes the availability of internal funds, that is liquidity, a primary determinant for investment decisions with some firms constrained in their investment spending by a shortage of internal funds.

In this paper I present a firm's investment dynamic intertemporal model where debt and retained earnings are the only available sources of funds and firms face a credit constraint in the form of a limit to the maximum amount of debt. Different Euler equations\footnote{The Euler equation approach for investments is used in Bond and Meghir (1994), Whited (1992) and Hubbard and Kashyap (1992).} may be obtained as firms face different financing regimes. In a hierarchy of finance model with retained earnings and debt two financing regimes are possible: in the first firms generate sufficient internal funds to finance their investments through retained earnings, while in the latter firms are liquidity constrained in the sense that internal funds are not sufficient to finance investment spending and issuing debt is needed. The evolution through time of firms' capital stock differs for firms belonging to different financing regimes through the discount factor of the expected marginal installation and purchasing costs of investing tomorrow. In particular for liquidity constrained firms the discount factor depends on the interest rate on debt, while for unconstrained firms it depends on the required rate of return on retentions. With asymmetric information, as interest rate on debt is expected to be higher than the rate of return on retentions, liquidity constrained firms will have a lower discount rate than the unconstrained ones. As a result liquidity constrained firms will be
characterized by a lower optimal capital accumulation path compared with unconstrained firms.

The paper is divided in three sections. Section 1 outlines how capital market imperfections due to asymmetric information give place to a financing hierarchy approach to corporate finance. Section 2 explains the theoretical and practical reasons for considering debt and not new shares issue as the appropriate alternative to retained earnings for investment finance and describes the hierarchy of finance model. Section 3 presents the optimization model of firm’s behaviour by which optimal capital accumulation paths are obtained for firms belonging to different financing regimes. Concluding remarks are provided in the last section.

1. From asymmetric information to a hierarchy of finance model for investments

Whether financial factors may affect a real phenomenon like investment has been questioned for a long time against the neoclassical view that only technological conditions of capital productivity and the cost of investment matter. Keynes (1936) first, and Minsky (1975) later, stressed the importance of financial and monetary conditions for investments and for macroeconomic performance in general, but literature about the link between finance and investment spending exploded only with the theoretical developments related to the new Keynesian approach. Indeed, new Keynesian macroeconomic models consider optimizing agents behaviour under a context of market imperfections, where these imperfections represent "a fundamental characteristic of decentralized market economies" (Fazzari, 1992).

Asymmetric information problems are the main source of capital market imperfections, and may be considered as an inherent characteristic of decentralized markets where agents specialize in particular economic activities and take informational advantages on their activities. The presence of asymmetric information among the agents in capital markets let emerge two kinds of effects: an adverse selection and a moral hazard effect. These effects influence both credit and equity markets, but because of the preference given to debt respect to equity issue in this paper, I’ll consider only asymmetric information effects in the credit market.

The adverse selection effect refers to a situation in which one side of the market can observe the quality of the goods traded while the other side have only some statistical knowledge (like the probability distribution function) about the quality of the goods. In the credit market the adverse selection effect stems from the informational advantage of borrowers about the real quality of investment projects that lenders should finance. As lenders cannot perfectly distinguish between good and bad borrowers, they will have to charge an interest rate reflecting the average quality of borrowers, with the result that high quality borrowers will pay an higher interest rate, while low quality borrowers will pay a lower interest rate than they should with full information (Mishkin, 1992). An average interest rate means that some high-quality borrowers with positive investment projects will be out of the credit market. In addition, the more the interest rate rises the more is the adverse selection effect, because only borrowers with the riskiest investment projects are willing to borrow at high interest rates, as they know that their probability of repaying loans are low. This mechanism suggests that the expected return to the lender, depending both on the interest rate charged and on the probability of repayment, will not monotonically grow with the interest rate level. Indeed, there will exists an interest rate which maximizes the expected return to the bank, because with higher interest rates the “riskiness” of the bank portfolio grows more than its expected return (this because at high interest rates the quality of borrowers is worst). So the debt market can be characterized by an equilibrium where the demands of funds exceed the supply (credit rationing, Stiglitz and Weiss, 1981) and where identical firms can be treated in different ways by banks, with somebody receiving a loan and somethings not. This means that the interest rate may not be market clearing in the credit market.

The problem of moral hazard (also known as the principal-agent problem) refers to a situation where neither the principal nor the agent have prior informational advantage but, once established the contract, the agent can take actions, not observable, contrary to the principal’s interest. This time in the credit market the problem concerns avoiding that borrowers may take activities contrary to the debtholders’ interest, undertaking investment projects in which the borrower gains much if successful, but the lender bears most of the loss if the project fails.

The presence of asymmetric information in capital markets seems to provide a theoretical rationale to explain firms’ preference for internal finance because of a ‘premium’ charged to external finance. This premium, stemming from imperfect information, makes external sources of finance available only at a higher cost than the internal ones, giving place to a hierarchy of finance approach to corporate finance, where investment decisions and financial conditions are no more independent. If internal and external finance are imperfect substitutes, some firms could be liquidity constrained in their investment decisions (that is, could postpone positive

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3 This is the “lemon problem” first described by Akerlof (1970).

4 Even other explanations like tax considerations, transaction costs, etc. may be considered as a source of financing hierarchy.
net present value investment projects) because of their financial structure\(^5\). When firms are liquidity constrained internal funds has a double effect on investments: it may signal movements in future investment opportunities (as a proxy for expected demand), and it may strengthen firm's internal net worth lowering the cost of external finance (Gertler, 1988). Thus liquidity constrained firms may provide a rationale for explaining the empirical success of investment models relating investments with cash flow or income (the 'accelerator effect'). Bernanke and Gertler (1989) and Greenwald and Stiglitz (1990) present models where an accelerator effect emerges as firm's financial conditions over the cycle contribute to amplify fluctuations in output\(^6\).

2. Debt over equity in a financing hierarchy model

There are both theoretical and empirical reasons for considering debt, and not new shares issue, the appropriate alternative to retained earnings for firms' investments financing.

Theoretical reasons explaining firm's preference for debt over equity emphasize signalling, free-rider and opportunity problems. Myers (1984) explains why, with asymmetric information, managers' decision to issue new shares may be interpreted as a negative signal about firm. Suppose that managers have better informations than investors about firm's investments profitability and investors require a premium to compensate them from finding "lemons": as new shares' market value may be different from what shares are really worth, managers may be reluctant in issuing undervalued shares. So equity issue will be interpreted by investors as a bad signal because they know firm's interest in issuing overpriced shares\(^7\). On the contrary, debt finance does not suffer for signalling problems because, issuing a security with a non-contingent repayment and bankruptcy provisions, a firm signals its will to assume the consequences of its investment decisions (Whited, 1992). Stiglitz (1988) stresses the free rider problem associate with imperfect information in capital markets. His argument stems from the different ability of debt holders and equity holders in controlling managers' actions because of the different dispersion of equity and debt among investors. While equities are widely dispersed, debt is usually kept by single investor (banks), making monitoring and controlling actions of debtholders easier. Moreover, banks are specialized in collecting informations about firms because of their role and possibility of engaging long-term relationship with customers and, as pointed out in Diamond (1984), they are even able to take monitoring actions at lower cost than individuals. In addition, the possibility of including collaterals in debt contracts and the tax deductibility of interest payment may let debt be respectively safer and cheaper than equity issue. Baroux (1988) suggests other possible reasons to consider equity issue as an occasional rather than a normal way of financing for firms. Indeed equity issue seems to be restricted to particular periods in firm's life due to insider power problems: the creation, a major development, a change in the basic activities, a privatisation ecc.. Thus, the normal way of financing for firms seems to rely on a mix between retained earnings and debt.

Another way to look at the preference for debt over equity issue is to consider literature analysing aggregate corporate financing patterns. Several studies consider aggregate corporate financing patterns for a single country, (Mayer (1988) for U.K. and MacKie-Mason (1990) and Taggart Jr. (1990) for U.S.), while some others compare financing patterns of different countries, (Mayer (1988, 1990)). Mayer (1988, 1990) finds in his international comparison a number of "regularities" suggesting that retentions are the dominant source of funds in all countries, banks are the dominant source for external finance, while new shares issue contribute for less than 10% to corporate financing in all countries. Taggart Jr. points his attention to corporations relative use of debt and equity financing finding a positive trend for short term debt and a considerable decline in stock issue. MacKie-Mason data on aggregate corporate financing in U.S. show that three-quarter of funds are internally generated and new share issues exhibit a downward trend (with increasing debt financing).

The situation for sources of funds of non-financial corporations in Italy in 1970-92 is summarized in table 1 and in figure 1: table 1 contains the average gross financing of non-financial corporations (as percentage of total funds) for the whole sample and for different sub-sample, while figure 1

\(^{5}\) The term financial structure comprehend availability of internal funds as well as "internal net worth" or "collateral" (as pointed out by Bernanke and Gertler, 1990).

\(^{6}\) Bernanke and Gertler (1989) develop a real business cycle model with asymmetric information between borrowers and lenders where the level of potential borrower net worth determine the agency costs of investments. As borrower net worth is expected to be procyclical, agency costs will moves counter-cyclically with the result of amplifying the fluctuations of investments, employment and output, that is an income-accelerator effect: on investment emerges because the wedge between internal and external funds is following output fluctuations. Greenwald and Stiglitz (1990) presents a model where macroeconomic failures in financial markets (equity and credit rationing) have macroeconomic consequences with the level of internal funds determining firm's behaviour and stimulating an accelerator-like effect.

\(^{7}\) This interpretation is consistent with the empirical evidence of a fall in stock prices when a stock issue is announced and with the timing of security issue in correspondence of periods when stock market prices are "high" (Myers, 1984).

\(^{9}\) The proportion of retentions on total source of funds are different across countries ranging from a 51% for Italy to 97% for U.K., with countries whose financial system is more developed (U.K. and U.S.) depending more from internal funding (Mayer, p.310, 1988).
presents the annual per cent of retained earnings, debt and new shares issue on total sources.

Table 1

<table>
<thead>
<tr>
<th>Sources of funds of non-financial corporations*</th>
<th>Italy, 1970-902</th>
<th>(Average % of Total Sources)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>38.1</td>
<td>27.7</td>
</tr>
<tr>
<td>Debt</td>
<td>51.1</td>
<td>61.6</td>
</tr>
<tr>
<td>Short-term debt</td>
<td>35.3</td>
<td>40.5</td>
</tr>
<tr>
<td>Long-term debt</td>
<td>15.8</td>
<td>21.1</td>
</tr>
<tr>
<td>New shares issue</td>
<td>10.8</td>
<td>10.6</td>
</tr>
</tbody>
</table>

*Source: OECD, Non-financial enterprises financial statistics.

The data shown in table 1 confirm for Italy the results obtained for other industrialised countries in previous works with a primary role for retentions and short term debt in corporate finance (about three quarter of total sources), and with long term debt and equity issue accounting only for a quarter of the total sources of funds. In figure 1 we account for the per cent evolution of the different sources of finance through all the time. Two features may be displayed about these data: a) equity issue represents quantitatively the less important source of fund for Italian firms, and b) the importance of retentions and debt as financing funds has changed during the sample period. Indeed, when we split the whole period in two sub-sample, taking the beginning of the eighties as a break point, we can see (table 1, columns (ii) and (iii)) that while debt represented the main firms' source of finance (about two-three of the financing needs on average) in the first decade, retentions became the favourite source of finance in the last one (half of the financing needs on average). A possible explanation for firms substituting debt with retained earnings may be related with a rising cost of debt following the period of tight monetary policy characterizing the beginning of the eighties.

From the argument above, we may think to a hierarchy of finance model for corporate finance where: a) the choice among the alternative sources of funds may be limited to retentions and debt (thus excluding equity issue), and b) firms finance their own investment spending exhausting first all their internal funds and then, only when this source is exhausted, issuing new debt. The hierarchy of finance model with only retentions and debt is illustrated in figure 2. The rate of return on investment projects and the interest rate on debt finance are measured on the vertical axis, while the investments and internal funds levels one are measured on the horizontal. The required rate of return $r$ represents the cost of finance from retained earnings, while the upward line shows the, increasing, cost of debt. In presence of bankruptcy costs, when debt finance increases, as the probability of bankruptcy rises and as this probability depends on the amount borrowed, the interest rate charged to borrowers will increase with the amount of debt. The downward-sloped line $D$ represent firms' investment opportunities, with higher investment opportunities represented by shift to the right. The interaction of firm's internal funds (measured by $F$ on the horizontal axis) with firm's investment demand gives place to different financing regimes: firm's internal funds may be high relative to firm's investment opportunities so that investments are financed only with retained earnings. Otherwise firm's internal funds may be low relative to firm's investment opportunities, so that investments are financed through retentions and new debt issue.

In this hierarchy of finance model firms may be liquidity constrained in two ways: first, without increasing interest rates on debt finance higher levels of investment spending could be reached, even with unchanged investment opportunities ($I'$ instead of $I$ in terms of figure 2). Indeed the investments projects postponed or forsaken, equal to ($I'$-$I$), have a rate of return lower than the cost of debt finance, but higher than the rate of return on retentions. Second, "a windfall increase in earnings implies that a higher level of investment spending may be financed before internal finance is exhausted" (Bond and Meghir, 1994). In terms of figure 2 it means that the level of internally generated funds becomes $F'$, with investment level $I'$ being again financed through internal funds.

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10 This opportunity cost of retentions is equal to the rate of return on a risky-asset comparable to equity.
3. A firm's investment dynamic model

The analysis of firm's investment demand must begin with the asset market arbitrage condition governing shareholders behavior. This condition states that investors, to hold shares, require that, in equilibrium, the expected return on equity (given by the ratio of dividends plus capital gains to the value of the firm) equals the return on a comparably-risky asset, that is:

\[ \bar{r}_t = \left( \frac{E_t(D_{t+1}) + E_t(V_{t+1})}{V_t} \right) \]

where \( \bar{r}_t \) is the return on a comparably-risky asset, \( V_t \) is the value of the firm at time \( t \), \( D_{t+1} \) is the after-tax dividends at time \( t+1 \) and \( E_t \) is the expected value operator conditional on information available at time \( t \). Rearranging \( [1] \) we obtain the following equation

\[ V_t = E_t(V_{t+1}) + E_t(D_{t+1}) / (1 + r_t) \]

whose forward solution yields the firm's time zero market value

\[ V_0 = E_0 \sum_{t=0}^{\infty} \frac{1}{(1 + r_t)^t} D_t, \]

where \((1 + r_t)^{-1}\) is the firm's discount factor. Firm's value is the present discounted sum of the expected after tax future dividends. The maximization of firm's market value is subject to four constraints. The first is the capital stock accounting identity

\[ K_t = (1 - \sigma) K_{t-1} + I_t, \]

where \( \sigma \) is the depreciation rate of capital goods, \( K \) is the capital stock at the end of time \( t \) and \( I \) is firm's investment at time \( t \).

The second constraint defines sources and uses of funds for a firm that issue no equity and is given by

\[ D_t + I_t = \Pi_t + \Delta B_t \]

where \( \Pi_t \) is the net revenue function, that is total revenue minus factors payments (labour costs and capital stock adjustment costs) and interests payments and \( \Delta B_t \) is new debt issue at time \( t \). The net revenue function then is:

\[ \Pi_t = F(K_t, L_t) - w_t L_t - \psi(K_t, I_t) - (1 + i_t - 1)B_{t-1} \]

with \( F(K_t, L_t) \) being the firm revenue function, \( w_t L_t \) the labour cost, \( \psi(K_t, I_t) \) the adjustment cost function and \((1 + i_t - 1)B_{t-1} \) the interests payment on outstanding debt. The third constraint states non-negativity of dividends

\[ D_t > 0, \]

while the last one concerns the existence of a limit on the maximum amount of debt obtainable by firms at time \( t \),

\[ B_t < B_t^* \]

with \( B_t^* \) representing the maximum amount of debt.

The discrete time Hamiltonian for the firm's maximization problem, after substituting \( [5] \) in \( [3] \), is:

\[ H_t = \{ F(K_t, L_t) - w_t L_t - \psi(K_t, I_t) - (1 + i_t - 1)B_{t-1} + B_t - p_t^I I_t \} - \lambda_t(K_t - (1 - \sigma)K_{t-1} - I_t) - \alpha_t \{ F(K_{t-1}, L_{t-1}) - w_{t-1} L_{t-1} - \psi(K_{t-1}, I_{t-1}) - (1 + i_{t-1})B_{t-1} + B_{t-1} - p_{t-1}^I I_{t-1} \} \]

The first order conditions for \( I_t, K_t, D_t \) and \( B_t \) for these maximization problem are the following:

\[ \frac{\partial H_t}{\partial I_t} \{ (1 - \alpha_t)(y(K_t, I_t) + I_t^2) - \lambda_t \} = 0 \]

\[ \frac{\partial H_t}{\partial K_t} \{ (1 - \alpha_t)F(K_t, L_t) - y(K_t, I_t) \} - \lambda_t + (1 - \sigma)(1 + r_t)^{-1}E_t \lambda_{t+1} + 1 = 0 \]

\[ \frac{\partial H_t}{\partial B_t} \{ (1 - \alpha_t) - (1 + r_t)^{-1}(1 + i_t)E_t(1 - \alpha_{t+1}) \} = 0 \]

if \( B_t > 0 \)

\[ \frac{\partial H_t}{\partial D_t} \alpha_t = 0, \quad \text{if } D_t > 0. \]

After substituting the value for \( \lambda_t \) in \( \partial H_t / \partial I_t \) (the first order condition for \( I_t \)) in the first order condition for \( K_t \) (that is \( \partial H_t / \partial I_t = \partial H_t / \partial K_t \)), the Euler equation, describing the optimal evolution of capital stock over time, is:

\[ \{ F(K_{t-1}, L_{t-1}) - y(K_{t-1}, I_{t-1}) \} + (1 - \sigma)(1 + r_t)^{-1}(1 - \alpha_t - 1)E_t(1 - \alpha_{t+1}) \]

\[ y(I_{t+1} + 1) + p_t^I I_{t+1} = (y(K_{t+1}, I_{t+1} + 1) + p_{t+1}^I) \]
The right-hand side of equation [10] shows the marginal installation and purchasing costs of investing today. The left-hand side comprehends two terms: the difference between the marginal change in production and installation costs due to a change in capital stock and the expected discounted value of the marginal installation and purchasing costs of investing tomorrow (that is the opportunity cost of investing tomorrow). Along the optimal path for capital stock firms must be indifferent between investing today or transferring their own resources to tomorrow.

With asymmetric information, as financial and real decisions are no more independent and a hierarchy of sources of funds emerges, firms will finance their investments first with retained earnings, and then, only after this source is exhausted, will issue new debt. As evidenced in the previous paragraph firms face a hierarchy of finance where two regimes are possible: a) investments are completely financed by retained earnings and positive dividends may be paid; b) retained earnings are not sufficient to finance firms' investments and new debt is issued (with debt becoming the marginal source of finance). Through the non-negativity constraints on dividends and debt, the complementary slackness conditions, two different Euler equations representing different firms' investment financing behaviour may be obtained.

**Regime 1:** \( D_t > 0 \) and \( B_t = 0 \). In this regime firms generate sufficient internal funds to finance their target level of investments and to pay positive dividends (they are unconstrained). By the complementary slackness conditions, if the non-negativity constraint on dividend is not binding, the other constraint must bind; that means \( c_t = 0 \) (the shadow value of an additional unity of internal finance is zero). With this value of the Kuhn-Tucker multiplier of dividends the Euler equation of type 1 firms is:

\[
(FK_t + L_t) \cdot [\psi(K_t, l_t)] + (1 + \sigma) [1 + i_t]^{-1} \cdot F_t [L_t, K_{t+1}, l_{t+1}] + \psi_t = (\psi_t)(K_{t}, l_t) + p_t \]

**Regime 2:** \( B_t > 0 \) and \( D_t = 0 \). In this regime firm's investment opportunities are high relative to its internal sources of funds, so the target investment level is reached by issuing new debt at a higher cost than internal funds. Here we can say that firm is liquidity constrained in the sense of a more expansive cost of funds (with respect to regime 1 firms). Again, if the new debt constraint is not binding, the other must bind, that is \( r_t = 0 \). The first order condition for borrowing may be expressed as

\[
(1 - \alpha_t)(1 + r_t)(1 + i_t)^{-1} = \psi_t(1 - \alpha_t + 1).
\]

so the Euler equation for type 2 firms is:

\[
[FK_t + L_t] \cdot \psi_t(K_{t}, l_{t+1}) + (1 - \alpha_t)(1 + i_t)^{-1} \cdot F_t [\psi_t(K_{t+1}, l_{t+1}) + p_t] = (\psi_t)(K_{t+1}, l_{t+1}) + p_t.
\]

Equations [11] and [13] show the optimal capital accumulation path for firm's with different marginal financing behaviour. These optimal paths differ for the discount factor of the expected marginal installation and purchasing costs of investing tomorrow. For firms in regime 1 the discount factor is \((1 + r_t)^{-1}\) with \( r_t \) the rate of return on retained profits, being the marginal financing cost for these firms. Regime 2 firms' discount factor is \((1 + i_t)^{-1}\), with \( i_t \), the nominal increasing interest rate on debt, being their marginal financing cost. It means that only when \( r_t = i_t \) the Euler equations for type 1 and type 2 firms will be the same. When it happens, internal and external sources of finance are perfect substitutes and investment spending is independent, within the limit of the maximum amount of debt, of any financial consideration (except its cost) as in the Modigliani-Miller theorem. But when retained earnings and debt cannot be considered as perfect substitutes, as in the case of asymmetric information, so that \( r_t \neq i_t \), liquidity constrained firms will be characterized by a lower optimal capital accumulation path than unconstrained firms.

The presence of firms with different optimal capital accumulation paths may have relevant consequences on aggregate investments. Indeed, internal funds level fluctuate over the cycle (procyclically) with the consequence that the proportion of constrained firms may change among booms and recessions. As firms' balance sheets conditions get worse during a recession and firms' internal funds therefore fall, there will be some firms whose new level of internal funds is no more sufficient to finance their own, unchanged, investment opportunities. In other words, in recession periods the proportion of constrained firms rise reducing investment spending and amplifying output fluctuations (via their lower optimal capital accumulation path). A propagation mechanism like the so-called 'financial accelerator effect' (Gertler, 1988) is likely to emerge.

**Conclusions**

In this paper I present a firm's investment dynamic model, derived in an optimizing framework with adjustment costs, where debt finance is the only external source of funds and firms face borrowing constraints in the form of a limit to the maximum amount of outstanding debt.
As suggested by the hierarchy of finance model, two financing regimes are considered, where retained earnings and debt are the marginal sources of funds for firms in regime 1 and 2 respectively. Given these firms’ financing regimes, two Euler equations governing the optimal capital accumulation path in every financing regime are obtained. Euler equations differ for the discount factor of the expected marginal installation and purchasing costs of investing tomorrow, where the discount factor depends on the rate of return on retentions (r1) for firms in regime 1 and on the nominal interest rate on debt (r2) for firms in regime 2. When asymmetric information is a characteristic of the financial markets and a hierarchy of the sources of funds emerges (that is, r1 > r2), financial conditions affect liquidity constrained firms’ investments spending. The Euler equation for liquidity constrained firms show that they will be characterized by a lower optimal capital accumulation path than the unconstrained ones; otherwise, when retained earnings and debt are perfect substitutes, that is r1 = r2, financing and investment decisions are independent, as evidenced by the equality of the capital accumulation paths.

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