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The Effect of Alternative Ownership Structures on Investment and Financial Constraints: An Empirical Investigation

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INTRODUCTION

In the functioning of market-oriented economic systems the enterprise is the entity where all factor use and final output decisions are made. As such, it has attracted the attention of both academic researchers, who try to explain its operation, and public policy-makers, who try to influence it. Given the importance of investment spending in the efficient allocation of capital, the analysis of firm decisions on investment in fixed capital constitutes an area in economic analysis that has been subject to both extensive theoretical and empirical work. Studies on the investment behavior of firms can be found in almost all areas of economics, such as macroeconomics, industrial organization, microeconomics, corporate finance, corporate governance, monetary economics, public economics and comparative economics. Indeed, it could easily be concluded that investment behavior is one of the most researched topics in economics.

Although the theoretical modeling of investment behavior[1] has a long history, the interest in the topic is still unabated, and conventional models (i.e., accelerator/neoclassical, Tobin's Q and the structural dynamic Euler equation framework) and their relative performance are continuously subject to empirical testing. Advances in both theoretical and applied economics as well as the increased availability of firm-level data have led to an improved understanding of factors that determine a firm's investment decisions. Early classical work on investment was based on highly stylized theoretical assumptions, which, as Gordon (1992) shows, have led to unsatisfactory empirical results when aggregated data have been used. For example, adopting the representative firm assumption has made researchers model whole industries as if they consisted of a single large firm and, subsequently, use industry-level data in drawing conclusions on individual firm behavior. When applied, for instance, to adjustment costs models such data have produced implausibly large values of adjustment costs parameters. Furthermore, the adoption of the perfect capital market hypothesis has led to neglecting financial factors as determinants of investment decisions.

[1] The use of the term investment in this dissertation exclusively means investment in fixed capital, i.e., investment in machinery and equipment, in constructing or renovating buildings or in buying or developing land. Other types of investments, such as investments in research and development, inventories, product upgrading and development, advertising, branding, market share, etc. are not the focus of this analysis. Furthermore, an important part of a firm's investment strategy is investment in human capital, i.e., investments in training and upgrading the workforce. While the importance of this type of investment is acknowledged, it is also not the focus of this dissertation.

The increasing availability of firm-level data has made it possible to account for the substantial heterogeneity across firms when analyzing investment behavior. Moreover, advances in the study of economics of information have highlighted the importance of liquidity constraints on investment decisions. Rather than being unlimited, the access to capital is determined by the degree of informational asymmetries and agency costs. These problems impose a premium on the cost of outside borrowing and consequently might lead to price and/or quantity constraints in raising external capital. The subsequent empirical work has focused on identifying indicators at the firm level, such as dividend payout ratios, bond rating, the degree of bank affiliation, membership in financial conglomerates, firm size, and firm age and/or ownership structure, that approximate for the severity of information problems and explain the observed differences in investment behavior across firms.

In the economic literature on investment behavior there is, however, one under-researched question, namely the role of different ownership structures on investment decisions. The reason seems to be that most of empirical studies are based on samples of large publicly traded firms where ownership is vastly dispersed and managers enjoy high degrees of discretion.[2] Under such conditions, the identity of shareholders does not seem to be of primary importance. Instead, the motivation of managers to act in the interests of shareholders is crucial. One such motivational tool is to reward them with equity ownership, which would make them internalize the costs of their actions. Yet, too large stakes owned by managers might accentuate moral hazard problems with outside investors of both equity and debt capital and subsequently make it more expensive to raise external capital. The question then becomes which is the optimal stake that insiders, i.e., managers, should hold in order to make them behave consistently with shareholders' objectives. The aim of empirical analysis is then to establish whether firms with differing degrees of insider (managerial) ownership display differences in investment behavior.

The objective of this dissertation is to investigate in detail the impact that different corporate governance structures have on capital allocation and investment in a transition economy context. Moreover, the study focuses on whether investment spending is affected by the availability of finance and whether some types of firms are affected by liquidity constraints more than others. It does so by first drawing explicit testable hypotheses originating from

[2]This is especially the case for samples drawn from Anglo-Saxon countries, i.e., from the US, the UK and Canada.

different lines of literature and then testing them empirically. The robustness of findings is checked through the application of alternative ways of modeling investment behavior. The empirical analysis is carried out using firm-level panel data from Estonia, collected and maintained at the Center for East European Studies at the Copenhagen Business School. As a result, the main contribution of this dissertation is largely empirical. From an academic point of view it presents a novel way of how financial variables enter a structural dynamic investment equation. Furthermore, it accounts for the effect of ownership structures in investment decisions through their role in mitigating or exacerbating informational asymmetries and agency costs. An empirical study, however, pretending to be significant should also offer implications for policy analysis. Therefore, the results of this dissertation should allow us to answer questions such as which ownership structure is inefficient in capital allocation, which ownership structure is more efficient in monitoring management and which ownership structure is inherently more likely to be financially constrained than the others. These answers, in turn, should provide directions for the focus of public policy.

As mentioned above, there already exists extensive empirical evidence for developed and developing countries showing that liquidity constraints are important determinants of investment spending. In contrast, much less evidence exists for transition economies. The primary culprit for this is data availability. As such, this study will contribute to the transition literature in several important directions. First, by providing evidence on the efficiency of capital allocation, it will contribute to the debate on the efficiency of the privatization process. Second, it will document the pervasiveness of liquidity constraints and their persistence over time. Third, by using data from one of the most advanced transition economies, it will assess the long-run viability of certain ownership forms. Fourth, it will add to the limited stock of evidence on these topics for transition economies. In a more general context, this study will contribute to the debate in the corporate governance literature on the effect of governance through ownership. In an environment such as the one in a transition economy, where institutions are weak and in continuous development, we expect the role of owners to be crucial in disciplining managers. Finally, the conclusions of the study will be pertinent to policy-makers in designing effective policies to promote successful restructuring on the part of firms.

This dissertation consists of three papers examining the relationship between investment, financial constraints and ownership structures. The first paper, titled “Corporate Governance

and Liquidity Constraints: The Sensitivity of Access to Capital to the Identity of Owners" addresses the important issue of how sensitive, if at all, is access to capital to the identity of owners. It does so by examining firms' investment behavior in a dynamic setting in the presence of adjustment costs, liquidity constraints and imperfect competition. The Euler equations in the presence of symmetric and quadratic adjustment costs and both debt and equity constraints are derived and estimated. Up-to-date econometric modeling of these constraints, however, is based on the ad hoc inclusion of variables affecting access to capital due to the fact that these variables do not explicitly enter the first order conditions of the firm's maximization problem. Here an alternative approach is followed that allows for an explicit solution of the Lagrangean multiplier related to the dividend constraint in terms of financial variables. Differently from the ad hoc approach, this approach leads to the inclusion of financial variables in the investment equation in first differences rather than in levels. Estimates carried out on a sample of firms from Estonia over the period 1993 through 1999 using Arellano and Bond's (1991) GMM technique confirm the importance of financial factors in determining investment rates and suggest that firms owned by insiders, especially non-managerial employees, are more prone to be liquidity constrained than others.

In the second paper the investment behavior and the determinants of liquidity constraints of a panel of Estonian companies over the period 1993 through 1999 are examined in a switching regression framework when sample separation is unknown and endogenous. Firms are assumed to operate either in a financially constrained or unconstrained regime. The actual regime the firm is in is determined by a switching or selection function, which depends on those variables that theoretically determine the wedge between internal and external finance, severity of information and agency problems and time-varying firm characteristics. This modeling strategy allows us to calculate the probabilities that firms operate in one or the other regime and, subsequently, provide evidence of the pervasiveness of financial constraints across firms and over time. The findings point to the existence of separate regimes in the investment behavior of financially constrained and unconstrained firms. In addition, the likelihood of being financially constrained is higher for young and smaller firms, as well as for those in which ownership is concentrated in the hands of insiders and the state. Furthermore, the existence of soft budget constraints lowers the probability of being financially constrained. When actual probabilities of operating in the financially constrained regime are calculated, it is found that they are quite high and more or less stable over the whole period under investigation.

Finally, in the third paper the credit-rationing hypothesis in privately held firms is investigated using an error correction specification. Economic theory argues at length that limited access to capital is one of the main obstacles to insider-owned firm creation. As insider owners, especially non-managerial employees, are generally not wealthy they would rely on external financing in securing the needed capital. However, a combination of the structure of property rights, asymmetric information and moral hazard results in a higher cost of capital and consequently credit rationing for these firms. In this paper, new and rich panel data for a large and representative sample of privately held Estonian firms are used to estimate the sensitivity of access to capital to differing ownership structures. The System GMM estimates confirm the importance of financial factors in determining investment rates and suggest that firms owned by insiders, especially non-managerial employees, are more prone to be liquidity constrained than others.

Corporate Governance and Liquidity Constraints: The Sensitivity of Access to Capital to the Identity of Owners

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Abstract:

New and rich panel data for a large and representative sample of firms are used to estimate the sensitivity of access to capital to differing ownership structures. The investment behavior of firms is examined in a dynamic setting in the presence of adjustment costs, liquidity constraints and imperfect competition. The empirical work is based on the derivation of Euler equations in the presence of symmetric and quadratic adjustment costs and both debt and equity constraints. Whereas the norm is to use ad hoc approaches to model these constraints, our alternative and more consistent approach leads to the inclusion of financial variables in the investment equation in first differences rather than in levels. Our GMM estimates confirm the importance of financial factors in determining investment rates and suggest that firms owned by insiders, especially non-managerial employees, are more prone to be liquidity constrained than others. Among the other groups, somewhat surprisingly, only domestic outsider-owned firms display sensitivity to both measures of the availability of finance, with manager-owned firms being sensitive to the availability of external finance, while state-owned firms are sensitive to the availability of internal finance.

Keywords: Corporate Investment, Corporate Governance, Adjustment Costs, Liquidity Constraints, GMM Estimates, Transition Economies

JEL Classification: C33, D21, D92, E22, G32, J54, P34.

1. Introduction

Because of the importance of investment spending in the efficient allocation of capital and subsequent firm performance, the analysis of firm decisions on investment in fixed capital constitutes an area in economic analysis that has been subject to extensive theoretical and empirical work. Although the theoretical modeling of investment behavior has a long history, interest in the topic is still unabated, and conventional models, i.e., accelerator/neoclassical, Tobin's Q and the structural dynamic Euler equation framework, as well as their relative performance, are continuously subject to empirical testing, as in, for example, Bond and Meghir (1994), Hu and Schiantarelli (1998), and Lizal and Svejnar (2002).

Moreover, advances in the economics of information have highlighted the importance of liquidity constraints for investment decisions. Rather than being unlimited, a firm's access to capital is determined by the degree of informational asymmetries and agency costs. These problems impose a premium on the cost of outside borrowing and, consequently, might lead to price and/or quantity constraints in raising external capital. The empirical work has focused on identifying indicators at the firm level, such as dividend payout ratios, bond rating, degree of bank affiliation, membership in financial conglomerates, firm size, and firm age and/or governance structure, that proxy for the severity of information problems and explain the observed differences in investment behavior across firms.[3]

Fundamentally, we provide new empirical evidence on a topic that has attracted the attention of theorists but for which there is little empirical evidence—the impact of investment on alternative governance structures. The study contributes to the literature in several aspects. First, from an academic point of view, it introduces and empirically tests a novel way of how financial variables enter a structural dynamic investment equation. Second, it accounts for the effect of governance structures in investment decisions through their role in mitigating or exacerbating informational asymmetries and agency costs. Therefore, the results of this analysis allow us to answer questions such as how pervasive liquidity constraints are in Estonia and which governance structure is inherently more likely to be financially constrained than others. These answers, in turn, provide directions for where public policy should focus in

[3] This literature, which started with the seminal study of Fazzari, Hubbard and Petersen (1988), is large and it would require a book in itself to review it in detail. Other studies in this area are, for example, Hoshi, Kashyap and Scharfstein (1991), Whited (1992), Oliner and Rudebuch (1992), Schaller (1993), Galeotti, Schianatarelli and Jaramillo (1994), Petersen and Rajan (1994), Bond and Meghir (1994), Hubbard, Kashyap and Whited (1995), Kaplan and Zingales (1997), Hu and Schianrarelli (1998), Hadlock (1998), Cleary (1999) and Goergen and Renneboog (2001).

terms of designing effective policies to promote the successful restructuring of firms. Third, by using data from one of the most advanced transition economies, it assesses the long-run viability of certain ownership forms. This is an important issue in light of the continuing debate in the transition literature on the efficiency of various ownership forms resulting from the extensive privatization process in almost all transition economies, Estonia included.[4] Fourth, it adds to the limited stock of evidence on these topics for transition economies. Finally, in a more general context, it contributes to the debate in the corporate governance literature on the effect of governance through ownership.

2. Governance Structures, Investment and Liquidity Constraints

Although it is quite extensive, the western literature on investment behavior does have not much to say on the role of different governance structures on investment decisions. The reason seems to be that most of the empirical studies are based on samples of large publicly traded firms where ownership is vastly dispersed and managers enjoy a high degree of discretion.[5] Under such conditions, the identity of shareholders does not seem to be of primary importance. Instead, the motivation of managers to act in the interests of shareholders is crucial. One such motivational tool is to reward managers with equity ownership, which makes them internalize, at least partially, the costs of their actions. Yet, too-large stakes owned by managers might accentuate moral hazard problems for outside investors of both equity and debt capital and subsequently make it more expensive to raise external capital. The question then becomes: what is the optimal stake that insiders, i.e., managers, should hold in order to make them behave consistently with shareholders' objectives? The aim of the empirical analysis is then to establish whether firms with differing degrees of managerial ownership display differences in investment behavior.[6]

[4] The term transition economies denotes all the countries of Central, Eastern and Southeastern Europe as well as those of the ex-Soviet Union, which, in the late 1980s and early 1990s, started political, economic and social reforms aiming at transforming their societies from one-party centrally planned systems to multi-party market-oriented ones.

[5] This is, especially, the case for samples drawn from Anglo-Saxon countries, i.e., from the US, the UK and Canada.

[6] There are, however, studies that have analyzed the role of alternative governance structures on investment behavior. For instance, Hoshi, Kashyap and Scharfstein (1991) analyze the role that membership in industrial groups, which are characterized by extensive crossholding, plays in the investment behavior of Japanese firms. Furthermore, Goergen and Renneboog (2001) investigate how ownership concentration in the hands of institutional investors affects liquidity constraints for a sample of companies listed on the London Stock Exchange.

One exception to this trend in the western literature are the empirical studies on employee-owned or labor-managed firms. The theoretical literature on labor management is extensive and has provided testable hypotheses on a variety of issues, including the investment behavior of these firms. Unfortunately, employee-owned firms in established market economies are not widespread and, moreover, are confined to specific industries. Consequently, there are few empirical studies on the topic. Furthermore, the samples used in most of them do not consist of both labor- and outsider-owned firms, making it impossible to perform comparative analyses and draw conclusions on the differences in behavior across ownership types.

At the end of the 1980s, transition economies faced a big challenge. Years of heavy investment in fixed capital not only did not produce much-needed economic growth, but also had left firms with obsolete and inefficient levels of capital. The challenge for these firms was to adopt to a market-oriented economic system through the reallocation of resources and restructuring. The process could be divided into defensive restructuring, i.e., closing loss-making activities or shedding hoarded labor in order to cut costs, and deep or strategic restructuring, i.e., upgrading existing products, developing new products and massive investment to replace the existing old capital. While defensive restructuring is important in the short-run, the success of transition as a process will depend on the degree of strategic restructuring, which in itself will depend on firms' ability to raise enough capital to carry out the needed investment. Yet, the economic environment in a transition economy is characterized by an infantile state of capital markets and weak financial institutions. Under these conditions it is expected that liquidity constraints will be pervasive and will affect most firms in the economy, albeit to different degrees. Furthermore, these constraints are expected to be more pronounced at the start of transition and become less important over time as both capital markets and banking and non-banking financial institutions develop.

One of the most important reforms undertaken by all transition economies has been the transfer of ownership from the state to private owners. Nevertheless, while the debate on choosing between state and private ownership was rather easily settled in favor of private ownership, the debate on which form of private ownership is the most efficient is still ongoing. The balance of the debate prefers outsider over insider ownership.[7] This position,

[7] In fact, advice and policy prescriptions offered at the beginning of transition to respective governments hardly mentioned insider ownership, especially employee ownership, as a viable way to transform enterprises. When it was mentioned its negative effects were envisaged, while its positive effects were overlooked. See for example

however, has not prevented the emergence of various ownership structures where insiders,[8] i.e., employees and/or managers, have majority or dominant ownership or, even when they possess minority ownership, enjoy substantial degrees of control. The existence of such diverse governance structures allows us, at least in principle, to test various theoretical propositions regarding the efficiency of different owners in capital allocation and in monitoring management.

Various theoretical arguments point to firms under insider ownership facing a higher likelihood of being more constrained in raising capital than others. The literature on employee ownership stresses a host of factors such as members' wealth position, their time horizon, risk attitudes, goal structure and the structure of property rights[9] in the firm that make employee owners prefer taking the residual in the form of higher income rather than investing it in the firm. This preference, along with employee owners' potential aversion to accepting new members, leads to a potential goal conflict between insiders and outside providers of both equity and debt capital. In addition, the fact that most of these firms are small and not listed in the stock markets exacerbates informational asymmetries and makes the access to desired capital more difficult. The net effect of the interaction of these factors could be that outside investors might be reluctant to invest in employee-owned firms or, when they do invest, the risk premium they charge is substantial. Overall, disincentives to invest internally and barriers to raise capital externally might lead to employee-owned firms under-investing.

The literature on managerial ownership stresses that an initial increase in managerial ownership is beneficial because it better aligns the interests of managers and shareholders

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Borensztein and Kumar (1991), Lipton and Sachs (1990), Blanchard, Dornbuch, Krugman, Layard and Summers (1991), Boycko et al. (1993), OECD (1993) and the World Bank Development Report (1996).

[8] Some clarification is in order here with respect to the terminology we use. The term "insiders" used in the literature on transition economies refers to both managers and employees who in one way or another have become owners or shareholders of the enterprises where they worked before the start of transition. For those not familiar with this literature the use of this term might be confusing given that the same term is used in the more traditional analysis of western firms to refer only to managers. In the paper whenever we use the term "insiders" we refer to both managers and employees.

[9] The traditional analysis of employee ownership assumes that employee-owned firms are characterized by collective ownership and non-transferable individual rights. An important development in transition economies is that, in most cases, employee owners are share owners, i.e., they own part of the firm on an individual basis and are able to trade shares on capital markets. However, these firms still retain a strong degree of collective ownership by imposing limits on share trading. Evidence of this is provided by, for instance, Kalmi (2002) for Estonia. In a field survey of firms under insider ownership the author reports that in only 6% of his sample there are no restrictions on share trading. Furthermore, in 92% of the cases insiders are asked to offer their shares first to current shareholders.

and, consequently, lowers managerial discretion.[10] However, at high levels, managerial ownership is associated with entrenchment and a divergence of interests between managers and shareholders. These factors might result in a firm facing a higher price for external finance and, consequently, relying more on internal funds to finance valuable investment projects.

In transition economies, managerial shareholding in post-privatization ownership configurations, in the form of majority, dominant or minority shareholders, is substantial. The possibility of entrenchment and subsequent rent seeking or asset stripping behavior on the part of managers has been an argument against managerial ownership, as stressed in, for instance, Earle and Estrin (1996). The likelihood of this happening depends to a large extent on managers' outside career opportunities and portfolio diversification, the way they obtain shares and the efficiency of the market for corporate control. When outside career opportunities do not exist and managers have invested most of their human and financial capital in the firm, they will try to hold on to their equity share by following policies, including investments, which will increase their job security. Furthermore, a manager's behavior might be fundamentally different depending on whether he/she acquires the firm through a managerial buy-out (MBO) or gets it either for free or in the framework of a voucher-funded privatization. If the ownership is gained through one of the latter two cases, the manager might perceive it as a windfall gain and consume it faster than earned income, as pointed out, for instance, by Djankov (1999). On the contrary, MBOs serve as screening mechanisms that allow only highly qualified, growth-oriented[11] managers to become owners.[12] In addition, independently of the way they gain ownership, managers will have incentives to pursue their interests at the expense of minority shareholders. Finally, markets for corporate control serve as disciplining devices for managers. However, as Earle and Estrin (1996) point out, in an environment of high uncertainty and infantile capital markets, informational asymmetries might lead to adverse selection problems in the market for corporate control. These arguments imply that, in a transition economy environment, ownership concentration in the hands of managers is likely to lead to managers'

[10] The models on which these conclusions are based start from zero managerial ownership and then consider the dynamics once managerial ownership increases. However, the definition of low and high managerial ownership should not be taken as meaning majority (dominant) versus minority managerial ownership. High managerial ownership could be considered a stake as low as 10%.

[11] In contrast to standard managerial theories, the term growth-oriented in this context does not refer to empire-building for personal satisfaction but rather people devoted to restructuring and reform.

[12] The financing of a MBO often requires external financing and only qualified managers are able to raise external finance.

entrenchment, which in itself exacerbates informational asymmetries and leads to more expensive external finance and less investment.

Based on these arguments we formulate our first two hypotheses as follows:

Hypothesis 1. The investment behavior of employee-owned firms is characterized by a positive and significant correlation of investment with measures of internal funds and a negative and significant correlation of investment with measures of external funds.

Hypothesis 2. The investment behavior of manager-owned firms is characterized by a positive and significant correlation of investment with measures of internal funds and a negative and significant correlation of investment with measures of external funds.

The arguments up to now have been presented in the insider-versus-outsider framework. However, the identity of outside owners is also important with respect to investment behavior and liquidity constraints. As such, we have to distinguish between the different types of owners that comprise this group. For the purposes of this study we classify outside owners into three sub-groups: the state, foreign owners and domestic outside owners. Differences in investment behavior among these firms arise, to a large extent, from the ability of their owners to curb managerial discretion.[13]

When majority or dominant owners are foreigners who possess enough experience and resources to engage in effective monitoring, managerial discretion is kept at minimal levels. Furthermore, given that foreign owners have access to their parent company's resources and/or to international capital markets, we conjecture that the investment behavior of foreign-owned firms is not constrained by the availability of either internal or external finance. When majority or dominant owners are domestic outsider investors, the degree of effective monitoring depends on the identity, number and size of investors. Depending on the combination of these factors several scenarios might arise. On the one hand, if ownership is concentrated in the hands of a few big institutional investors with experience, resources and low coordination costs, then effective monitoring will arise. On the other hand, if ownership is concentrated in the hands of a large number of small investors, possibly individuals, then

[13] Other factors that determine the differences in investment behavior among these firm types are differences in access to capital and cost of capital.

managers are more likely to enjoy substantial discretion in pursuing their objectives. In between these two situations lie a host of other scenarios resulting in different degrees of managerial discretion.

Finally, when ownership is concentrated in the hands of the state managers will possess virtual control of the firm and enjoy high degrees of discretion in pursuing their interests.[14] As such, they could engage in unprofitable investment projects or even in projects with negative present value that are valuable to them and lead to their entrenchment. Moreover, high managerial discretion accentuates the degree of asymmetric information and makes external finance more expensive. The outcome of managerial discretion is a reliance on internal funds, which results in investment being highly sensitive to the availability of internal finance.

These arguments on the identity of outside owners lead us to formulate two other hypotheses as follows:

Hypothesis 3. The investment behavior of foreign firms is consistent with the standard models of investment in the absence of liquidity constraints.

Hypothesis 5. The investment behavior of state-owned firms is characterized by a positive and significant correlation of investment with measures of internal funds.

3. Modeling Investment and Financial Constraints

The model developed below is similar in nature to the ones of Whited (1992) and Bond and Meghir (1994). The firm, at every point in time, maximizes the discounted present value of future after-tax dividends as follows:[15]

$$\max_{K_t, L_t, B_t} \quad E_t \sum_{s=1}^{\infty} \beta_{t+s} \cdot D_{t+s} \,. \tag{1}$$

[14] As Shleifer and Vishny (1997) point out, state ownership can be viewed as a relationship between a principal and two agents. The principal is the individuals (citizens), who are the ultimate owners of the firm. Being dispersed, they have no ability or resources to monitor the state, i.e., the politicians and bureaucrats, who act as the first agent and who in themselves have to monitor managers, the second agent. Both agents usually have objectives quite different from those of the principals and they can easily collude to pursue their objectives at the expense of the principal.

[15] Except for the time index, the firm's maximization problem has to be written with a firm identification index. Given that it plays no role in altering the solution to the problem, in order not to complicate notation that index is dropped.

In the above problem t represents a time index, E_t denotes the expectation operator that is taken based on all the information available at time t, $\beta_{t+s} = 1/(1+\theta_s)$ is the discount factor at time s with θ_s being the nominal discount factor at time s and $\beta_t = 1$ at time t, and D_t stands for after-tax dividends at time t. The problem is solved subject to five constraints. The first is the flow of funds constraint as follows:

$$D_t = (1-\tau)\cdot\left[p_t \cdot F_t(K_t, L_t) - w_t \cdot L_t - p_t \cdot G(K_t, I_t) - r_{t-1} \cdot B_{t-1}\right] + B_t - B_{t-1} - p_t^I \cdot I_t\,, \qquad (2)$$

where

τ - the corporate income tax rate,

p_t - the output price,

K_t - capital stock at time t,

L_t - labor input employed at time t,

w_t - price of labor employed at time t,

I_t - investment at time t,

r_t - interest rate paid on debt at time t,

B_t - amount of outstanding debt at time t, and

p_t^I - investment price the firm faces at time t corrected for tax and depreciation deductions.

In the above constraint the after-tax dividends represent the difference between total revenue and total costs. The former depends on the production function $F(K_t.L_t)$ as well as output price, while the latter includes not only input costs but also the cost of servicing debt as well as losses incurred in changing capital stock, represented by the adjustment cost function $G(K_t, I_t)$.[16] Here the production function is assumed to depend on current period capital and labor, i.e., the capital stock becomes immediately productive.[17] Furthermore, it is assumed

[16] In this set-up the adjustment cost function depends only on capital stock and investment at a given point in time. Given that during capital installation labor might need to be temporarily reallocated or trained, then the adjustment cost function will also depend on labor. Here the assumption is that labor is costlessly adjusted and relaxing this assumption will not affect the results. Estrin and Svejnar (1993) develop a model of wage determination where the adjustment cost depends on both capital and labor.

[17] Another possibility would be to include the material costs of production separately as production function arguments. As it will complicate notation and not change the results, they are left out.

that the production function is concave in both arguments and twice continuously differentiable. These conditions are sufficient for first order conditions to lead to a unique solution. The adjustment cost function is assumed to be convex, i.e., it gets costlier to change capital stock quickly.

The second constraint the firm faces is the capital accumulation constraint. This constraint models the capital stock at every moment in time being equal to the sum of new capital in place, represented by investment during that period, and the fraction of capital inherited from the previous period as follows:

$$K_t = I_t + (1-\delta)\cdot K_{t-1}, \tag{3}$$

where δ is the economic depreciation rate that is assumed to be constant over time and across firms.

Two further constraints the firm faces are inequality constraints. The first of them requires that dividends in a given period are non-negative:

$$D_t \geq 0. \tag{4}$$

In a situation where the firm hits its debt limit this constraint means that the firm cannot enjoy unlimited equity financing. In the maximization problem this constraint is associated with the Kuhn-Tucker multiplier λ_t.

In the debt market firms find themselves constrained in two directions: they might face either credit rationing or higher cost of debt.[18] In a transition economy context, given the fierce competition for limited available funds, we expect that it is more likely that firms face quantity restrictions rather than price discrimination. In this model it is assumed that firms face a credit ceiling as follows:

$$B_t \leq B_t^*, \tag{5}$$

[18] Both regimes might exist simultaneously. However, modeling both of them leads to identification problems in the estimation procedure (see Barran and Peeters, 1998).

where B_t^* is the maximum amount of debt a firm can borrow at a given time. Although the debt ceiling itself might be a function of a firm's characteristics, as argued, for instance, by Whited (1992), at least in the short-run it could be considered fixed. In the maximization problem this constraint is associated with the Kuhn-Tucker condition γ_t.

Finally, as is customary in the literature, the transversality condition, i.e., the condition that prevents the firm from borrowing money and paying back its debt at the end of the period, is imposed as follows:

$$\underbrace{\lim}_{T\to\infty}\prod_{s=0}^{T-1}\beta_s \cdot B_T = 0. \tag{6}$$

This condition means that asymptotically the value of debt must be zero, otherwise, at the end of the firm's lifecycle, some positive unpaid debt would remain. Before presenting the solution to the model a short note on the appropriateness of the choice of the firm's objective function, represented by equation (1), is necessary. While dividend (or profit) maximization is a good approximation of firm behavior for certain groups of firms, it might not, however, be appropriate for others. It is often argued that "labor-managed" or "employee-owned" firms would maximize income per worker rather than profit or dividends as such. The substantial insider power, especially employee power, in transition economies would make dividends per worker maximization seem the more appropriate objective function than total dividend maximization. Consequently, the analysis is also carried out assuming an alternative objective function, as follows:

$$\max_{K_t, L_t, B_t} \; E_t \sum_{s=1}^{\infty} \beta_{t+s} \cdot \frac{D_{t+s}}{L_{t+s}}, \tag{7}$$

where the maximization is over dividends per worker. Dividends here are viewed as the total income insiders get from running the firm, including wages. This means that the gross dividends in equation (2) can be re-written as the total revenue net of adjustment and debt servicing costs but not net of wage outlays. The constraints facing the firm remain the same except for the non-negativity of dividends that now becomes the non-negativity of dividends

per worker. In the empirical analysis below explicit tests are performed to determine whether the behavior of firms under different ownership structures is better represented by one objective function or the other.

We present first the model solution assuming that firms maximize the discounted present value of total dividends. As outlined above, in this case the firm's problem, at any point in time t, is to maximize the objective function (1) subject to constraints (2), (3), (4), (5) and (6). In order to reduce the number of multipliers in the model, constraints (2) and (3) are substituted in the objective function, while constraint (6) is left out. Then, after taking derivatives with respect to labor, capital and debt, setting them equal to zero and re-arranging the terms, the following first order conditions (FOC) are obtained:

$$F_L(K_t, L_t) = \frac{w_t}{p_t}, \tag{8}$$

$$1 + \lambda_t = \beta_{t+1} \cdot \left[(1-\tau) \cdot r_t + 1\right] \cdot E(1 + \lambda_{t+1}) + \gamma_t, \tag{9}$$

$$F_K(K_t, L_t) - G_K(K_t, I_t) - G_I(K_t, I_t) - \frac{p_t^I}{p_t \cdot (1-\tau)} = E\frac{1+\lambda_{t+1}}{1+\lambda_t} \cdot \beta_{t+1} \cdot \frac{(1-\delta)}{p_t} \cdot \left[p_{t+1} \cdot G_I(K_{t+1}, I_{t+1}) + \frac{p_{t+1}^I}{1-\tau} \right]. \tag{10}$$

In the above FOCs F_K, F_L, G_K, G_I are the derivatives of the production function and the adjustment cost function with respect to capital, labor and investment, respectively. Equation (8) shows that the marginal product of labor is equal to the real wage. Equation (9) shows that firms equate the discounted marginal value of dividends over time taking also into account the debt constraint. Equation (10) relates to the capital allocation along the optimal path. The right-hand side of the equation shows the marginal cost of investing in the next period, while the left-hand side shows the cost of not investing today or, differently, the opportunity cost of postponing investment until tomorrow. For the firm to be indifferent between investing today or tomorrow, these two costs need to be equal.

In order to analyze the effect of the debt constraint on optimal capital allocation, equation (9), after some manipulations, is transformed as follows:

$$\beta_{t+1} = \frac{1-\frac{\gamma_t}{1+\lambda_t}}{1+r_t\cdot(1-\tau)}\cdot\frac{1+\lambda_t}{E(1+\lambda_{t+1})}. \tag{11}$$

Substituting equation (11) into equation (10), the following is obtained:

$$F_K(K_t,L_t)-G_K(K_t,I_t)-G_I(K_t,I_t)-\frac{p_t^I}{p_t\cdot(1-\tau)} = \frac{1-\frac{\gamma_t}{1+\lambda_t}}{1+r_t\cdot(1-\tau)}\cdot\frac{(1-\delta)}{p_t}\cdot \left[p_{t+1}\cdot G_I(K_{t+1},I_{t+1})+\frac{p_{t+1}^I}{1-\tau}\right]. \tag{12}$$

Under the assumption of perfect capital markets the term $\frac{\gamma_t}{1+\lambda_t}$ is zero and the discount factor is the classical one with the nominal discount factor equal to the after-tax return on debt, $\theta_t = (1-\tau)\cdot r_t$. For debt-constrained firms the more constrained the firm is the higher the value of the debt multiplier γ_t. The effect of a binding debt constraint today is similar to that of a higher nominal discount rate since investing today is more important than tomorrow.

The importance of financial constraints in optimal capital allocation is tested using equations (8), (10) and (12). In order to derive the estimating equations the above model needs to be parameterized with respect to the marginal product of capital, marginal adjustment costs of capital and investment, and determinants of financial constraints. Finally, a structure on the unobserved expected values must be imposed in order to make the model able to be implemented in terms of observable variables.

In parameterizing the marginal product of capital the approach of Bond and Meghir (1994) is adopted. Assuming only that the production function is linear homogenous in its arguments,[19]

[19] It might be argued that the linear homogeneity of the production function is a restrictive assumption to characterize firms operating in a transition economy. It is possible that especially new firms might operate in the increasing-returns-to-scale region. In a separate analysis with the same dataset we found no evidence of this, so linear homogeneity seems a good approximation.

i.e., assuming no specific functional form, after totally differentiating with respect to inputs it can be written as:

$$F(K_t, L_t) = F_K(K_t, L_t) \cdot K_t + F_L(K_t, L_t) \cdot L_t \,. \tag{13}$$

Re-arranging the terms, using equation (8) to substitute for the marginal product of labor and assuming that firms enjoy market power in the output market[20] but are price takers in the input markets, the following specification is obtained:

$$F_K(K_t, L_t) = \frac{F(K_t, L_t)}{K_t} - \frac{\eta \cdot W_t \cdot L_t}{K_t} \,. \tag{14}$$

In equation (14) W_t represents the real wage while parameter η stands for the inverse of the mark-up parameter $(1 - 1/e)$ where e denotes the absolute value of the firm's elasticity of the demand curve. If the firm enjoys no market power then the parameter η will be unity. η is one of the parameters to be estimated in the empirical analysis.

Assuming a functional form for the adjustment cost function is problematic. Adjustment costs include buying and installation costs of new capital, dismantling costs of old capital, lost output in the process, as well as the effect of a host of factors that lead to obstacles to optimal factor allocation. An example of the latter would be strong insider power that would divert resources towards higher wages and cause under-investment. Knowing the structure of adjustment costs will be ideal in specifying the right functional form. Unfortunately, this is not the case. The literature on adjustment costs identification and specification issues is large as summarized in, for example, Hammermesh and Pfann (1996). It has focused more on the labor adjustment costs but the conceptual issues are the same.

The adjustment cost function assumed here is the quadratic one, introduced by Summers (1981) and since then adopted by many others, such as Poterba and Summers (1983),

[20] In this setup assuming both market power and increasing returns to scale would have led to a non-identification of the adjustment cost parameter. In choosing between returns to scale and market power the existence of market power seems the better assumption due to the weak competitive environment in a transition economy.

Chirinko (1987), Whited (1992), Bond and Meghir (1994) and Barran and Peeters (1998), as follows:

$$G(K_t, I_t) = \frac{1}{2} \cdot a \cdot \left(\frac{I_t}{K_t} - b \right)^2 \cdot K_t, \tag{15}$$

where a is the adjustment cost parameter while b is the optimal investment/capital ratio. The major criticism regarding this functional form is that it is too restrictive. This has led researchers to adopt other functional forms and see how they improve the fit of the estimated equations. Whited (1998) and Chatelain and Teurlai (2001) adopt a power series approximation of the adjustment cost function and are not able to reject the over-identifying restrictions when a fourth power function is assumed. However, the inclusion of such a function only marginally improves the fit of the regression.

Taking the partial derivatives of equation (15) with respect to both capital and investment and performing some algebraic manipulations the following marginal functions are obtained:

$$G_i(K_t, I_t) = a \cdot \left[\left(\frac{I}{K} \right)_t - b \right] \text{ and} \tag{16}$$

$$G_K(K_t, I_t) = \frac{G(K_t, I_t)}{K_t} - a \cdot \left(\frac{I}{K} \right)_t^2 + a \cdot b \cdot \left(\frac{I}{K} \right)_t. \tag{17}$$

The last step in parameterizing the model is to find an expression that incorporates financial constraints into the model. This means that the terms involving Lagrangean multipliers in equations (10) and (12) should be explicitly expressed in terms of variables that approximate financial constraints. Although economic theory places strong emphasis on the role of financial constraints on a firm's investment decisions, up-to-date econometric modeling of these constraints is based on an ad hoc inclusion of variables affecting access to capital.[21] The justification for this approach could be understood in the words of Whited (1992): "since the first order conditions do not provide an analytical solution" for the term including Lagrangean

[21] This approach has been followed in the investment literature by, among others, Hubbard and Kashyap (1992), Whited (1992), Hubbard, Kashyap and Whited (1995) and Barran and Petters (1998).

multipliers. Here the approach of Chatelain (1998, 2000) is adopted that allows for an explicit solution of the Lagrangean multiplier related to the dividend constraint in terms of financial variables.

Denoting $\Omega = \frac{1+\lambda_{t+1}}{1+\lambda_t}$ in equation (10), it is shown that Ω is a function of variables that affect the choice of optimal investment in the financially constrained and unconstrained regimes. Maximizing the objective function (1) at time t in the presence of financial constraints with respect to investment and re-arranging the first order conditions the following expression is obtained:

$$1+\lambda_t = \frac{\phi_t}{p_t^I + p_t \cdot (1-\tau) \cdot G_I\left(K_t, I_t^C\right)}, \tag{18}$$

where ϕ_t denotes the Lagrangean multiplier related to the capital accumulation constraint and I_t^C denotes investment under the financially constrained regime. In the absence of financial constraints, i.e., $\lambda_t = 0$, the capital accumulation multiplier is given by the following:

$$\phi_t = p_t^I + p_t \cdot (1-\tau) \cdot G_I\left(K_t, I_t^{UC}\right), \tag{19}$$

where I_t^{UC} denotes investment under the no financial constraints regime. Repeating the same analysis for time $t+1$, obtaining the equivalents of equations (18) and (19), respectively, and substituting into the expression for Ω, the following expression results:

$$\Omega = \frac{p_{t+1}^I + p_{t+1} \cdot (1-\tau) \cdot G_I\left(K_{t+1}, I_{t+1}^{UC}\right)}{p_{t+1}^I + p_{t+1} \cdot (1-\tau) \cdot G_I\left(K_{t+1}, I_{t+1}^C\right)} \cdot \frac{p_t^I + p_t \cdot (1-\tau) \cdot G_I\left(K_t, I_t^C\right)}{p_t^I + p_t \cdot (1-\tau) \cdot G_I\left(K_t, I_t^{UC}\right)}. \tag{20}$$

Two things must be noticed about equation (20). First, all the variables that affect the choice of investment under the constrained and unconstrained regimes also affect Ω. Second, these variables affect Ω in their first differences rather than in levels.[22] In case the firm is not financially constrained, i.e. in a Miller-Modigliani world, the optimal level of investment in

[22] The approach in the literature is that Ω is specified as a function of levels of cash flow and debt variables normalized by capital stock or assets.

the presence of adjustment costs will be a function of its long-run capital stock and the user cost of capital. Differently from when the firm is financially constrained, the factors influencing the optimal amount of investment can be seen by setting the flow of fund constraints (2) equal to zero.[23] Substituting the adjustment cost function, dividing by K_t, denoting $\Delta B_t = B_t^* - B_{t-1}$, $CF_t = p_t \cdot F_t(K_t, L_t) - w_t \cdot L_t - r_{t-1} \cdot B_{t-1}$ and re-arranging the terms, a second order equation in investment/capital ratio is obtained as follows:

$$(1-\tau) \cdot p_{t\cdot} \frac{a}{2} \cdot \left(\frac{I}{K}\right)_t^2 + \left(p_t^I - (1-\tau) \cdot p_t \cdot a \cdot b\right) \cdot \left(\frac{I}{K}\right)_t -$$

$$-\left(\frac{\Delta B_t}{K_t} + (1-\tau) \cdot \frac{CF_t}{K_t} - \frac{(1-\tau) \cdot p_{t\cdot} a \cdot b^2}{2}\right) = 0 . \qquad (21)$$

In the expression in parentheses the first term represents the ratio of change in debt to capital, while the second is the ratio of the firm's cash flow to capital after the variable inputs and debt services are paid for. The solution to this equation results in a non-linear relationship between investment/capital ratio and cash flow and debt change. Moreover, it should be noted that the parameters of the relationships between investment/capital ratio and cash flow and debt change depend on the structural model parameters such as the adjustment costs parameters, output and investment goods prices, corporate income tax and the price markup parameter. In order to obtain a linear relation, we evaluate equation (21) at point $a = 0$, i.e., in the absence of adjustment costs. An expression of investment/capital ratio as function of financial variables is obtained as follows:

$$\left(\frac{I}{K}\right)_t^C = c_1 \cdot \frac{\Delta B_t}{K_t} + c_2 \cdot \frac{CF_t}{K_t} + c_3 \cdot \left(\frac{\Delta B_t}{K_t}\right)^2 + c_4 \cdot \left(\frac{CF_t}{K_t}\right)^2 . \qquad (22)$$

The squared terms are included to capture any potential non-linear relationship. Incorporating the factors that determine the firm's constrained and unconstrained investment levels in equation (20), a final expression for Ω is obtained as follows:

[23] It should be mentioned that firms might sometimes find it worthwhile to pay positive dividends even when they are financially constrained. However, under the binding debt constraint the firm can be represented as paying no dividends.

$$\Omega = z_o + z_1 \cdot \left(\frac{\Delta B_{t+1}}{K_{t+1}} - \frac{\Delta B_t}{K_t} \right) + z_2 \cdot \left(\frac{CF_{t+1}}{K_{t+1}} - \frac{CF_t}{K_t} \right) + z_3 \cdot \left(\frac{\Delta B_{t+1}}{K_{t+1}} - \frac{\Delta B_t}{K_t} \right)^2 + z_4 \cdot \left(\frac{CF_{t+1}}{K_{t+1}} - \frac{CF_t}{K_t} \right)^2 , \quad (23)$$

where the constant z_o captures the effect of the missing user cost of capital data determining the unconstrained level of investment.

The next step in the analysis is the derivation of the estimating equations. In the financially unconstrained regime Lagrangean multipliers on dividend constraints are zero, which leads to $\Omega = 1$ in equation (10). Then, substituting equations (14), (16) and (17) into equation (10) and assuming that expectations are formed rationally,[24] the following equation to be estimated is obtained:

$$\left(\frac{I}{K} \right)_{t+1} = \alpha_o + \alpha_1 \cdot \left(\frac{S}{K} \right)_t + \alpha_2 \cdot \left(\frac{W \cdot L}{K} \right)_t + \alpha_3 \cdot \left(\frac{I}{K} \right)_t + \alpha_4 \cdot \left(\frac{I}{K} \right)_t^2 + f_i + s_{t+1} + \varepsilon_{t+1} , \quad (24)$$

where S denotes the output net of adjustment costs, $W \cdot L$ denotes the firm's wage outlays, f_i denotes firm fixed effects, s_{t+1} denotes time effects that capture general macroeconomic shocks common to all firms and ε_{t+1} is the forecasting error term. The coefficients α are functions of adjustment costs parameters as well as a markup price parameter as follows:

$$\alpha_o = \frac{p_t^I}{p_t \cdot a \cdot \beta_{t+1}^* \cdot (1-\tau)} - \frac{p_{t+1}^I}{p_{t+1} \cdot a \cdot (1-\tau)} - \frac{b}{\beta_{t+1}^*} + b ,$$

$$\alpha_1 = -\frac{1}{\beta_{t+1}^* \cdot a} ,$$

$$\alpha_2 = \frac{\eta}{\beta_{t+1}^* \cdot a} ,$$

[24] This leads to the substitution of expected values with actual ones and the definition of the error term as the difference between the actual value at any given time t and the expected one at time t+1, given the information at time t. As rational expectation hypothesis means that agents do not make systematic mistakes, then the error term is a random variable with zero mean.

$$\alpha_3 = \frac{1+b}{\beta^*_{t+1}},$$

$$\alpha_4 = -\frac{1}{\beta^*_{t+1}} \text{ and}$$

$$\beta^*_{t+1} = \frac{\beta_{t+1} \cdot (1-\delta) \cdot p_{t+1}}{p_t}.$$

When financial constraints are present, then equation (24) is augmented by equation (23) to obtain the estimable equation under financial constraints as follows:

$$\left(\frac{I}{K}\right)_{t+1} = \alpha_o + z_o + \alpha_1 \cdot \left(\frac{S}{K}\right)_t + \alpha_2 \cdot \left(\frac{L}{K}\right)_t + \alpha_3 \cdot \left(\frac{I}{K}\right)_t + \alpha_4 \cdot \left(\frac{I}{K}\right)_t^2 + f_i + s_{t+1} +$$

$$+ z_1 \cdot \left(\frac{\Delta B_{t+1}}{K_{t+1}} - \frac{\Delta B_t}{K_t}\right) + z_2 \cdot \left(\frac{CF_{t+1}}{K_{t+1}} - \frac{CF_t}{K_t}\right) + z_3 \cdot \left(\frac{\Delta B_{t+1}}{K_{t+1}} - \frac{\Delta B_t}{K_t}\right)^2 + z_4 \cdot \left(\frac{CF_{t+1}}{K_{t+1}} - \frac{CF_t}{K_t}\right)^2 + \zeta_{t+1}. \quad (25)$$

If financial constraints matter, then estimating equation (24), the over-identifying restrictions[25] will be easily rejected. In this case the inclusion of financial variables in equation (25) should significantly improve the fit of the regression.

As discussed above the objective function (1) might not be the appropriate one since it does not take into account insider power that can cause firms to maximize the discounted present value of dividends per worker rather than the discounted present value of total dividends as such. In order to account for the substantial insider power that is an inherent feature of some transition economies, including Estonia, the objective function is modified with firms assumed to maximize the discounted present value of dividends per worker as expressed in equation (7). Substituting then equation (7) for equation (1) and carrying out the maximization problem as above, the following estimating equation, equivalent to equation (24), i.e., when there are no financial constraints, is obtained:

[25] That is, the null hypothesis that the parameter vector being estimated is the true one against the alternative hypothesis that the model is mis-specified.

$$\left(\frac{I}{L}\right)_{t+1} = \alpha_o \cdot \left(\frac{K}{L}\right)_{t+1} + \alpha_1 \cdot \left(\frac{S}{L}\right)_t \cdot \frac{K_{t+1}}{K_t} + \alpha_2 \cdot d_t \cdot \frac{K_{t+1}}{K_t} + \alpha_3 \cdot \left(\frac{I}{L}\right)_t \cdot \frac{K_{t+1}}{K_t} + \alpha_4 \cdot \left(\frac{I}{K}\right)_t^2 \cdot \frac{K_{t+1}}{L_t} +$$
$$+ \alpha_5 \cdot \frac{K_{t+1}}{L_t} + f_i + s_{t+1} + \varepsilon_{t+1}, \qquad (26)$$

where d_t is the total income per worker at time t. Interpretation of coefficients α_1 through α_4 is the same as those in equation (24).

Accounting for financial constraints in the model would again require an explicit expression for the term involving the shadow values of dividends. Repeating the same analysis as above, the expression for Ω is the same as the one in equation (20). In this case finding an expression for the constrained level of investment amounts to setting the flow of fund constraints equal to zero, i.e., the expression for dividends per worker equal to zero. Dividing by K_t, substituting the adjustment cost function and re-arranging the terms, the following expression is obtained:

$$\frac{1}{L_t}\left[\begin{array}{l}(1-\tau)\cdot p_{t\cdot}\frac{a}{2}\cdot\left(\frac{I}{K}\right)_t^2 + \left(p_t^I - (1-\tau)\cdot p_t \cdot a \cdot b\right)\cdot\left(\frac{I}{K}\right)_t - \\ -\left(\frac{\Delta B_t}{K_t} + (1-\tau)\cdot\frac{CF_t}{K_t} - \frac{(1-\tau)\cdot p_{t\cdot}a\cdot b^2}{2}\right)\end{array}\right] = 0, \qquad (27)$$

where $\Delta B_t = B_t^* - B_{t-1}$ and $CF_t = p_t \cdot F_t(K_t, L_t) - r_{t-1}\cdot B_{t-1}$. The expression in equation (27) is the same as the one in equation (21), except for the multiplication by $1/L_t$. This means that the solution to the equation when adjustment costs are zero would be the same as the one for equation (21), except that the variables would be in per unit of labor instead of per unit of capital. Consequently, the expression for Ω is the same as in equation (23) with variables divided by labor. Including it in equation (26), the estimating equation of a firm that maximizes the discounted present value of dividends per capita in the presence of financing constraints is the following:

$$\left(\frac{I}{L}\right)_{t+1} = \alpha_o \cdot \left(\frac{K}{L}\right)_{t+1} + \alpha_1 \cdot \left(\frac{S}{L}\right)_t \cdot \frac{K_{t+1}}{K_t} + \alpha_2 \cdot d_t \cdot \frac{K_{t+1}}{K_t} + \alpha_3 \cdot \left(\frac{I}{L}\right)_t \cdot \frac{K_{t+1}}{K_t} + \alpha_4 \cdot \left(\frac{I}{K}\right)_t^2 \cdot \frac{K_{t+1}}{L_t} +$$

$$\alpha_5 \cdot \frac{K_{t+1}}{L_t} + f_i + s_{t+1} + z_o + z_1 \cdot \left(\frac{\Delta B_{t+1}}{L_{t+1}} - \frac{\Delta B_t}{L_t}\right) + z_2 \cdot \left(\frac{CF_{t+1}}{L_{t+1}} - \frac{CF_t}{L_t}\right) + z_3 \cdot \left(\frac{\Delta B_{t+1}}{L_{t+1}} - \frac{\Delta B_t}{L_t}\right)^2 +$$

$$+ \; z_4 \cdot \left(\frac{CF_{t+1}}{L_{t+1}} - \frac{CF_t}{L_t}\right)^2 + \xi_{t+1}. \qquad (28)$$

Two main competing hypotheses are tested through the estimation of equations (24), (25), (26) and (28). The first hypothesis regards the question whether firms act as standard profit (dividends) maximizers or profit (dividends) per worker maximizers. This means discriminating between equations (24) and (25) on the one hand and (26) and (28) on the other hand as being the relevant ones in explaining a firm's investment behavior. The second hypothesis considers whether financial constraints matter in a firm's investment decisions or not. This leads to comparing the performance of equations (24) or (26) on the one hand to that of equations (25) or (28) on the other hand. Before presenting the results, however, in the next section we discuss the sample used in estimation.

4. Data and Sample Description

The data used in this paper consist of annual firm-level observations from a large sample of Estonian firms over the period 1993 through 1999. The sample is created through a combination of data obtained from surveys and from standard firm financial statements reported to the Estonian Statistical Office. The aim of surveys is to obtain information on ownership configurations which is not available in standard financial statements. The firms included in the survey scheme are selected as a stratified random sample based on size and industrial affiliation. The survey information is then augmented with financial information from balance sheet and income statements, such as current and fixed assets, current and long-term liabilities, equity, sales, expenditures, wages and salaries, inventories, gross and net profit, R&D expenditure, expenditure on capital goods, investment, etc. The merging of all this information creates an unbalanced panel data set with missing observations to be used in the analysis.

The list and definitions of variables used in the analysis are given in Table 1. Most of the variables are self-explanatory and are standard definitions when balance sheet and income

statement data are used. The last two, however, pose specific problems and their definition needs to be carefully considered before any analysis is performed. Filer and Hanousek (2002) stress that firms are often misclassified among ownership groups because important information contained in ownership variables is overlooked. As this paper attempts to assess the effect of different corporate governance structures on firm behavior, it is important to discuss in detail how these structures are defined.

In the literature, ownership is considered to be the right to residual returns, i.e., to what remains after the factors of production have been compensated for their contribution. In addition, some authors, for example Hansmann (1996), argue that control rights should also be included in the definition of ownership. This however brings up the issue, stressed for instance by Aghion and Tirole (1997), of whether formal or real control needs to be taken into account. For example, Kalmi (2002) presents case study evidence that in employee-owned firms managers exercise real control. Measuring control, however, and especially distinguishing formal versus real control in the data used in this paper is not possible. Establishing this relationship, or the lack of it, would require data, for instance, on owners' board representation, on voting rules, share classes and the voting behavior of different groups of owners, which are not available. Bearing this in mind, for the purposes of this analysis ownership is defined in terms of the percentage of shares held by each group of owners.

Based on the respective shareholdings, six broad groups of owners are defined as follows: state, foreign, domestic outsiders, former employees, incumbent employees and managers. A further division of each group, especially foreign and domestic outsider owners, into sub-groups based on the identities of owners, would have been desirable. Unfortunately, this is not possible with the data in hand. A common pitfall in defining ownership stakes for all these groups is that no correction is made for a potential cross-holding of shares, as the identity of the enterprises that hold shares in each other is not known. This problem is more pronounced in the case of state and foreign owners and, as such, might understate the real share held by these owners. More specifically, assume that the state owns 30% of the shares in a given enterprise, while a domestic private enterprise owns the rest. In this case the enterprise would be classified as being domestic outsider-owned. However, the domestic enterprise might itself be, let say, 80% owned by the state. Consequently, the share that the state owns in the first enterprise is much larger than 30% and the enterprise is mistakenly classified as domestic

outsider-owned. Similarly, due to the specifics of privatization legislation,[26] foreigners typically invest in an enterprise through another domestic holding registered in Estonia. This practice, too, will assign the shares held by the domestic enterprise as being held by domestic outsiders. In addition, this problem might be present also in the case of insider ownership when insiders, in order to acquire an enterprise, establish first another company that officially takes over the enterprise to be privatized. Although it might exist,[27] in the case of insiders this problem is much less extensive than in the case of state and foreign owners. Overall, the ownership shares of state and foreign owners are represented only by their direct holdings in respective enterprises.

Except for this general problem, two more specific problems arise in the construction of insider ownership and domestic outsider ownership. The former problem has to do with the distinction of employees and managers as well as with the percentage of employees being owners. The distinction between employees and managers depends on the individual enterprise's classification of middle-level managers. There might be cases when the number of managers is overstated. So, for example, in 1995 the mean of managerial employees in the sample is 6. It is not uncommon, however, for an enterprise to report having more than 50 managers and one enterprise even reported having 127 managers out of a labor force of 411. The issue of the relative number of employee owners is, however, more problematic. How would, for example, an enterprise where only two or three employees own shares be classified? Kruse and Blasi (1997) argue that at least 50% of employees have to own shares for the enterprise to be considered employee-owned. This definition is a bit restrictive as it excludes enterprises with substantial employee ownership. In order to capture the important degrees of employee ownership that lead to potential real control within firms, for the purposes of this study an enterprise is classified as employee-owned when more than 10% of employees and no less than 5 employees own shares. If these conditions are not satisfied then the enterprise is classified as manager-owned. In sum, managerial holdings are defined as the sum of direct shareholdings of managerial employees, as indicated by the respondents, and of direct holdings of non-managerial employees if these comprise less than 10% of the total number of non-managerial employees.

[26] When privatization through auctions started, domestic outsiders had the possibility to pay by installments and through vouchers, while foreigners did not have this possibility. Later on this was changed, but in the meantime, it created incentives for foreigners to bypass the law and acquire enterprises through established domestic holdings.

[27] Kalmi (2002) presents some evidence of this phenomenon occurring in the privatization of state and collective farms.

The last, but not the least, serious problem is the distinction among different owners that make up the domestic outsider group. Two groups of domestic outsider owners emerge from the data: institutional domestic outsiders, i.e. other Estonian enterprises and institutions, and individual domestic outsiders. This distinction might not be of relevance if individual outside investors were "real" outsiders, i.e., they were private individuals who had invested in the enterprise due to financial considerations and would, consequently, display behavior not different from any institutional investor. Yet, quite often, individual investors are people who either have been previously employed by the enterprise or have close connections with enterprise insiders. In this context, former employees are of particularly practical importance. They are often why ownership structure might change, i.e. an enterprise might shift from insider-owned to outsider-owned without a single share changing hands. This is because when employees either retire or quit the enterprise, but still hold their shares, they are then re-classified as outsiders instead of insiders. Nevertheless, even after leaving the enterprise, it could be conjectured that, although they no longer have wage claims on the firm, they could display behavior similar to that of their former peers, possibly due to close relations with them.[28] This scenario has strong implications for enterprises where former employees dominate domestic outsider shareholding. These enterprises will more likely display behavior similar to that of insider-owned ones than to that of "real" outsider-owned ones.

Thus, it becomes important to distinguish the identities of individual investors and separate former employees from the rest. This is not an easy undertaking as neither the number of individual shareholders nor their connections to the enterprise are known. Starting with the assumption that outsider ownership closely connected with insider ownership always occurs jointly with insider ownership, we classify an enterprise as owned by former employees if all of the following four conditions[29] apply in a given year: 1) the dominant owners are domestic outsiders, 2) domestic individual owners own a larger share than domestic institutions, 3) insiders, i.e., managers and employees, initially, i.e., at the time of privatization, owned more than 50% of shares and 4) insiders still own more than 10% of shares. If any of these conditions are not satisfied then the enterprise is classified as owned by domestic outsiders.

[28] This does not however preclude the possibility that they, for example, might ally themselves with a core institutional investor or other individual investors and consequently exercise their ownership and control rights as "real" outsiders.

[29] These criteria are selected among alternative definitions to minimize errors. This does not mean, however, that all errors are eliminated and we acknowledge that there are errors in both directions.

A final note regards the grouping of firms into ownership categories. As presented in Table 1, for the purposes of the analysis, two criteria are employed to group firms into categories, i.e. majority-owner and dominant-owner. According to the majority-owner criterion, as applied in the literature for example by Jones and Mygind (1999), a firm is classified into an ownership category if the respective owner owns more than 50% of shares. It is expected that owning more than 50% of the shares would give owners enough voting rights to influence the decision-making process. Nevertheless, there are cases when certain decisions require more than a simple majority and even a majority owner would have to engage in coalition building to have these decisions passed. Furthermore, given groups of owners could exercise considerable influence and control even when they own shares below the 50% threshold. Finally, a more practical drawback of this method is that when several owners are present, simple majorities do not exist. This will artificially exclude these firms from the analysis. Given this, in order to maximize the number of firms falling into a given category, the dominant owner criterion is used. According to this criterion, a firm is classified into an ownership category if the respective owner owns more shares than any other owner. By applying this criterion, a firm where employees own, for example, 30% of the shares, and no other owner owns more than that, will be classified as employee-owned.[30] While this might not be the best classification criterion, it is difficult to discriminate between the two criteria, as well as others one could design, under the conditions of a lack of information on the real degree of influence and control.

The data-related issues discussed above are not unique to this particular dataset. Currently, to the best of our knowledge, in no study using data from transition economies, and more generally in most of studies in the corporate governance literature, have the authors been able to account for the cross-holding of shares or discriminate between formal and real control. In spite of these limitations, the data used in this paper possess certain advantages compared to data used by most other authors, which would make this study of particular relevance to the transition literature. First, the use of surveys allows us to define a broad spectrum of ownership groups. In most of the previous studies the authors divide the firms in their samples

[30] One drawback of this classification criterion is it does not take into account the distinction between ownership and control. More specifically, a firm owned 30% by a single foreign owner and 70% by 1000 domestic owners each owing an equal share will be classified as domestic outsider-owned but be controlled by the foreign owner as the cost of organizing the domestic owners would be too large. Unfortunately, we possess no data on the number of owners in each of our ownership categories and as such are not able to make distinctions between ownership and control.

into state, foreign and domestic private firms. Even when some authors are able to identify insider owners, they do not distinguish between employees and managers. Second, the use of different waves of ownership data allows us to capture dynamics that are not possible to capture when shorter data series are used.[31] Finally, the combination of ownership with economic and financial data allows us to better measure the effect of unobserved firm characteristics on firm behavior.

Another issue that needs to be addressed before any analysis is carried out is the errors and inconsistencies in data collection and reporting. Examples of such errors are firms reporting zero labor force or capital or sales, or reporting ownership shares whose sum is lower or higher than 100. Consequently, prior to using the data set, a check against inconsistencies and erroneous data is performed using the following seven criteria:

- The firm's capital at the beginning and the end of the period should be positive.
- Investment should be non-negative.
- Investment should be smaller than end-of-period capital stock.
- Sales should be positive.
- The average employment per year should be positive and equal to or greater than 10.
- Labor cost in a given year should be positive.
- Ownership shares should add up to 100.

The application of all these criteria leads to a drop of about 21 percent of observations, leaving 3833 observations over the period 1993 through 1999. More specifically, applying the first criterion leads to 36 firms being dropped in 1993, 35 in 1994, 40 in 1995, 28 in 1996, 45 in 1997, 13 in 1998 and 60 in 1999. Furthermore, 121 observations are deleted due to negative investment,[32] 335 due to having employment less than 10,[33] 12 due to zero labor cost, 16 due to zero net sales and 6 due to having investment larger than capital at the end of the period. Finally, an additional 315 observations, belonging to firms in real estate,

[31] Only the data used by Lizal and Svejnar (1998, 2002) cover a long enough time span that allows the authors to capture appropriate dynamics.

[32] Negative investment or dis-investment is the outcome of strategic restructuring of a firm that leads to downsizing or the elimination of unproductive assets. While processes and determinants of dis-investment are of interest in themselves, they are not the focus of this study and as such the respective observations, about 3% of the sample, are dropped from the analysis.

[33] A firm is dropped from the analysis if it shows as having employment less than 10 in any given year. For instance, if a firm has 8 employees in 1995 but more than 10 in all other years it is dropped from the sample in all years.

education, health and public administration industrial branches, are dropped from the analysis. The final sample then includes a total of 3294 observations broken down as follows: 498 observations in 1993, 498 in 1994, 545 in 1995, 514 in 1996, 480 in 1997, 402 in 1998 and 357 in 1999.

Table 2 provides information on the distribution at a given point in time and evolution over time of the number of firms that fall in a given ownership category using the dominant ownership classification. Focusing on the 1995 sample, it is apparent that in more than 22% of cases insiders, i.e., employees and managers, or former insiders are dominant owners. This provides evidence for the importance of insider ownership during the early years of transition. Determining whether this is the outcome of the privatization process or of the entrepreneurial spirit that leads insiders to establish their own companies requires data on the origin of the firms. From the respondents' replies a lot of firms show as new. Yet, this might partly be due to the fact that insiders establish a company that takes over the assets of a former state-owned enterprise. In this case it would be a mistake to classify the firm as new. Unfortunately, the data do not allow discriminating between these cases. Foreign-owned companies comprise around 12% of the sample, with most of them being new companies established as joint ventures in the early 1990s, while "real" domestic outsider-owned firms comprise around 18% of the sample. Finally, state-owned firms comprise around 48% of the sample, with 232 firms being 100% in state ownership and 30 firms mostly in private hands but with the state still holding the dominant position.[34] It would be interesting to compare this ownership distribution with the economy-wide one prevailing in Estonia in 1995. This is, unfortunately, not possible because official data from statistical yearbooks do not provide detailed classification of ownership shares held by different owners as defined above. Furthermore, although the official data distinguish between state, foreign and private firms, it is not clear which definition is used to classify firms in a given group. For example, the Estonia Statistical Yearbook (1995) states that, by the second half of 1995, 87% of enterprises in Estonia were private. It is highly likely that enterprises with even a small involvement of private capital are classified as private, leading to a probable overstatement of the true degree of private ownership.

[34] If the focus of the analysis had been simply the effect of private ownership versus state ownership these firms would have been classified as private. As the identity of private owners, however, matters in explaining differences in observed behavior, these firms end up being classified as state-owned.

It is argued in the literature, for instance by Aghion and Blanchard (1998), that insider ownership, especially employee ownership, is an intermediate ownership form and will over time disappear in favor of more flexible and efficient forms dominated by outside investors. Inability to secure enough external funding and, consequently, to carry out the necessary investment in order to remain competitive is among the arguments often cited that will drive ownership dynamics. Looking at the ownership dynamics then provides crucial evidence on the importance of these claims. In Table 2 it is apparent that the number of state- and employee-owned firms steadily decreases, while the number of domestic outsider- and manager-owned firms increases, over time. While the decrease in the number of state-owned firms over time is expected due to the continuation of the privatization process, the decrease in the number of employee-owned firms seems to underline the suspicion that in the long-run this ownership structure is not viable and will be dissolved in favor of others. As for the increase in the number of manager-owned firms, an argument often made is that it might be mostly caused by the concentration of ownership in the hands of managers in insider-owned firms, i.e., by the shift of ownership rights from employees to managers. Evidence on these claims is provided by transition matrixes, as used for example by Jones and Mygind (1999), which plots ownership structures at two different points in time against each other. An example is given in Table 3, where the ownership categories in 1995 are plotted against the ownership categories in 1999.

The table, for example, shows that, out of 61 state-owned firms in 1995, in 1999 32 are privatized to domestic outsiders, 6 to employees, 3 to former employees, 9 to foreign investors and 11 to their managers. Overall, over the whole 5-year period, there were significant changes to ownership structures. Reading the matrix diagonally, which shows the number of firms that remained within the same ownership category over the given period, we see that the share of firms remaining in the same ownership category is not higher than 31% for any group of firms. The group that experiences the most changes is that of former employees, with no firms being dominated by former employees in 1995 and still dominated by them in 1999. The general pattern is that domestic outsider ownership, foreign ownership and managerial ownership increase over time, while employee and state ownership decrease. There have been sharp increases in the number of firms owned by managers (from 61 to 84), by foreigners (from 57 to 73) and domestic outsider investors (from 94 to 119). There was also a substantial switching of ownership among these groups. So, for example, 21 firms switched from domestic outsiders to foreigners and 28 from domestic outsiders to managers.

Furthermore, 15 firms switched from foreigners to managers, while 14 from managers to foreigners. Contrary to what might be expected, the number of manager-owned firms did not increase due to the shift of ownership from employees to managers. In fact, in only 13 cases managers took ownership over from employees or former employees. Except for the 15 cases managers took over from foreigners, they also took over from domestic outsiders in 28 cases and the state in 11 cases. Instead, the number of firms owned by employees decreases from 44 to 29, with most of the change coming from the switch from employee-owned firms to domestic outsider-owned ones. Interestingly, only 4 firms remained in employee ownership both in 1995 and in 1999. Finally, the number of firms owned by former employees increases, from 10 to 29, although none of them survived as such for the whole period.

Overall, some important facts emerge from these transitions. First, state firms privatized after 1995 end up mostly in the hands of outsider investors, i.e., domestic outsiders and foreigners, with employees and former employees being the least preferred option. Second, there is little employee or former employee activity in taking over firms once they are in private hands. Third, domestic outsiders, foreigners and managers are quite active in the market for corporate control, with continuous acquisitions and cessations across groups. This finding is in contrast to the arguments that the market for corporate control is underdeveloped. Fourth, the concentration of ownership from employees to managers, although existing, is not the driving force behind the rise in managerial ownership. Finally, former employees hang on to their dominating ownership position for some time after they have left the firm, but ultimately renounce it.

After presenting the sample composition and ownership dynamics, we turn now to the variables of interest. Table 4 presents the summary statistics of the most relevant variables used in the analysis. The general facts that emerge from this table are that investment levels are high relative to capital stock, with the investment/capital ratio ranging from 0.17 in 1993 to 0.34 in 1995, that average employment decreases while real wage increases over time, that cash flow is positive and that short-term debt increases over time and that cash flow and short-term debt are approximately of the same magnitude in all years but 1996. The increase in debt after 1995 is consistent with the general increase of lending to the private sector during this period in Estonia. Furthermore, up to 1997, the sum of cash flow and short-term debt is less than investment suggesting that firms might have had access to other sources of capital such as short-term trade credit and/or long-term debt.

This conjecture is supported by the last two rows of the table that show current payables and long-term liabilities, which include long-term loans as well as any other long-term debt a firm accumulates. The rate of growth of long-term liabilities is not high, except for the last year, suggesting that long-term liabilities do not constitute an important source of capital over the stated period. Current payables, however, are quite high and higher than investment over the whole period. Another important feature of Estonian firms during this period is that, on average, they have become more capital-intensive as demonstrated by the increase in capital and decrease in employment.

5. Estimating Strategy and Empirical Results

The estimation of the dynamic linear equations (24), (25), (26) and (28) suffers from a series of problems that, if unaccounted for, will lead to inconsistent estimates. The first problem is the potential correlation of right hand side variables with firm fixed effects. Due to the inclusion of the lagged dependent variable as an explanatory variable and its clear correlation with firm fixed effects, the estimation of the parameters of the model using Ordinary Least Squares (OLS) in levels will be inconsistent. One way to account for this inconsistency is to estimate the model using the Within Group estimator. However, as Sevestre and Trognon (1996) show, in short panels the Within Groups estimator produces inconsistent results and the degree of inconsistency bias is negatively related to the time horizon of the panel. Two further methods designed to correct for these inconsistencies are the Instrumental Variables (IV) estimator and Generalized Method of Moments (GMM) estimator. In both methods the aim is to find a set of instruments that ought to be asymptotically uncorrelated with disturbances, or their transformations, and be asymptotically correlated with the right-hand side variables. Depending on the assumption of the exogeneity of right-hand side variables and of the behavior of disturbances, several estimators have been proposed in the literature. Here we use Arellano and Bond's (1991) GMM estimator.[35]

[35] Alternative estimators would be Balestra and Nerlove's (1966) and Anderson and Hsiao's (1982). The former relies on the assumption of the non-correlation of right-hand side variables, other than the lagged dependant variable, with firm fixed effects. As in the investment equation this assumption is likely to be violated, so the Balestra-Nerlove estimator would produce inconsistent estimates. Anderson and Hsiao correct for the inconsistency by writing the model in first differences. Their estimator, however, is not fully efficient, as stressed by Baltagi (1995), in that it does not take fully into account the structure of the differenced residuals.

In short, their GMM estimator is a two-step procedure. The first step is an IV estimation that provides the estimated residuals. As the consistency of estimates will depend on the right choice of instruments it is important to ensure their validity. A test of instrument validity is Sargan's difference test presented in detail in Hall (1999). In a nutshell, this test is based on the difference of Sargan's statistic between the model estimated with all available instruments (i.e., with more degrees of freedom) and the model estimated with fewer instruments. Under the null hypotheses that the subset of instruments is the valid one, the test statistic has a chi-square distribution with degrees of freedom equal to the difference of the degrees of freedom of the two models. If the value of the difference is larger than a pre-specified value, a more parsimonious set of instruments will be rejected in favor of a larger one.

Then, in the second step, the GMM estimator of the parameters is obtained by using the vector of the estimated residuals from the first step and minimizing, with respect to the parameters of the model, a quadratic form function of the consistent estimates. The model performance is tested through Sargan's statistic (also denoted as the J-statistic). Under the null hypothesis of the parameter vector being the correct one the product of the minimized value of the objective function and the number of observations has a chi-square distribution with $T \cdot k - p$ degrees of freedom, where T is the number of cross sectional units, k is the number of instruments in a given year and p is the number of parameters to be estimated. The null is rejected when the value of the test statistic is greater than some pre-specified value, usually taken to correspond to a 5% right-hand tail of the distribution.

The results reported below are obtained using Arellano and Bond's (1991) GMM procedure in STATA 8. Inference on coefficients is based on one-step procedure results, while inference on model specification on two-step procedure results. This is due to a downward bias in standard errors for small samples when the two-step procedure is applied. The standard errors of the underlying parameters of the model, i.e., the adjustment cost parameter, the optimal investment/capital ratio and the market power parameter, are then calculated using the delta method with analytical first derivatives. For ease of exposition the presentation of results is divided into sub-sections according to the hypotheses tested.

5.1 Tests on Neoclassical Investment Models and on Instrument Validity

The first tests performed are those regarding the validity of neoclassical models of investment demand in which financial variables play no role in investment decisions, such as those expressed by equations (24) and (26), and the validity of instrument sets. The results are reported in Table 5. In columns two through four, i.e., in Model 1 through Model 3, we report the results of estimating equation (24), i.e., with the maximization of the discounted present value of total dividends as the firm's objective function for different instrument sets. In addition, in columns five through seven, i.e. Model 4 through Model 6, we report the results of estimating equation (26), i.e., with the maximization of the discounted present value of dividends per worker as the firm's objective function for different instrument sets. The first set of instruments, used to estimate Model 1 and Model 4 in the table, includes variables S_t/K_t, $(W \cdot L)_t/K_t$, I_t/K_t and $(I_t/K_t)^2$ lagged three periods and more. The second set of instruments, used to estimate Model 2 and Model 5 in the table, includes all instruments from the first set as well as industry dummies, while the third set of instruments, used to estimate Model 3 and Model 6 in the table, includes all instruments from the second set as well as ownership and firm size dummies. Sargan's difference test shows that the addition of industry, ownership and size dummies as instruments does not significantly improve model performance. All these tests soundly reject the larger sets of instruments in favor of the smaller one. For instance, in discriminating between the first and the second sets of instruments in estimating equation (24), Sargan's difference test is 9.61 and is distributed as chi-squared with 7 degrees of freedom. The critical value of chi-squared distribution with 7 degrees of freedom is 14.07. These values lead to the acceptance, at high probability levels, of the null that the smaller subset of instruments is the right one. A similar interpretation of the results of the other test statistics leads to the acceptance of the more parsimonious set. The inclusion of financial variables in the instrument sets does not modify this conclusion. Furthermore, different tests that are not reported here performed with different lag structures of both real and financial instrumental variables do not produce significantly different results. Consequently, in the subsequent analysis all third and more lags of real and financial variables are used as instruments.

Focusing only on Model 1 and Model 4, which were selected from the instrument validity tests above, we see however that their overall performance is not satisfactory. The null hypothesis of the parameter vector being the right one is soundly rejected for both models at the 5% significance level, as seen in columns two and five in Table 5. For instance the value

of Sargan's test statistic for Model 1 is 29.64 and its respective P-value 0.019, while the values for Model 4 are 27.12 and 0.026, respectively. These tests indicate the failure of the standard neoclassical model of investment and imply model misspecification due to the omission of important variables. The next step in the analysis would then be the inclusion of financial variables as right hand side variables as the potential source of misspecification.

5.2 Tests on the Importance of Financial Variables

If firms face liquidity constraints, financial variables are important determinants of investment decisions. Moreover, even if liquidity constraints are not binding at any particular point in time, they are expected to affect firms' current investment decisions. This argument, made for instance by Jaffe and Stiglitz (1990), implicitly assumes that firms are forward looking and, as such, they alter their investment policies when they anticipate that liquidity constraints will bind in the future. One way how a firm modifies its investment policies subject to these latent constraints is to accumulate internal liquidity over time, which would then be used to finance investment projects when the firm hits its credit barrier. This phenomenon, which we refer to as the "cash accumulation" approach,[36] implies that investment rates would be sensitive to a broad range of internal funds such as profit, cash and/or short-term assets. In addition, it implies that investment rates would be sensitive not only to current measures of internal liquidity but also to their past levels. This discussion then points to the exclusion of financial variables from neoclassical models of investment estimated in the previous sub-section as one potential source of the resulting misspecification. If this is true, the inclusion of financial variables in investment equations should lead to the non-rejection of the over-identifying restrictions.[37] With respect to our specifications, augmenting equations (24) and (26) with financial variables leads to equation (25), when firms maximize the discounted present value of total dividends, and equation (28), when firms maximize the discounted present value of dividends per worker, being the two equations of interest.

[36] In the literature this type of liquidity is also called "buffer stock liquidity".

[37] The non-rejection of the over-identifying restrictions, however, does not necessarily mean that the model is correctly specified. As Hall (1999) emphasizes, there are two sets of moment conditions in GMM estimation: the identifying and over-identifying moments. The former set cannot be tested, because these restrictions are satisfied by sample moments, while the second set is tested through Sargan's statistic. As long as the identifying restrictions cannot be tested there remains a potential source of violation of population moment conditions. The non-rejection of over-identifying restrictions is then suggestive of the importance of the included variables in the model specification.

The estimation results of these equations are reported in Table 6. In the table, Model 1 and Model 2 refer to specifications of equation (25) with alternative definitions of internal funds. More specifically, in Model 1 the sum of cash flow, short-term assets and revenue from the sale of non-current assets is used as a measure of internal funds, while in Model 2 the sum of value added, short-term assets and revenue from sale of non-current assets is used as measure of internal funds. Similarly, Model 3 and Model 4 refer to specifications of equation (28) with the sum of cash flow, short-term assets and revenue from the sale of non-current assets, and the sum of value added, short-term assets and revenue from the sale of non-current assets used as measures of internal funds, respectively.[38] The inclusion of cash and short-term assets as measures of internal funds is done to partially account for the "cash accumulation" phenomenon. The performance of all models, as shown by the values of Sargan's statistics, improves substantially with the inclusion of financial variables. All over-identifying restrictions are accepted at high significance levels. For instance, the Sargan's test statistic for Model 1 is 19.72, which is smaller than the critical value of 23.69 of chi-squared distribution with 14 degrees of freedom. These values lead to the non-rejection of the null hypothesis that the parameter vector is the right one. Similar conclusions are reached for the other models reported in the table. These results suggest that financial variables play a role in a firm's investment decisions and, as such, should be included in any investment equation specification. A further test of model performance is the second order autocorrelation test presented in the third-from-the-last row of Table 6. The methodology developed by Arellano and Bond (1991) assumes that there exists first order autocorrelation in the residuals but no second order autocorrelation. The presence of second order autocorrelation would then imply that parameter estimates are inconsistent.[39] The values of the test statistic show that this is strongly rejected at high probability levels. A final measure of model performance is the reported adjusted R-squared. Comparing this indicator across specifications in Table 5 and Table 6 we see that the inclusion of financial variables leads to a higher adjusted R-squared. Although the value of the adjusted R-squared is, at best, around 20%, indicating that there is still a high proportion of investment variation unexplained, it is in line with the other results obtained in the literature, with an exception being the study of Lizal and Svejnar (2002), who find an adjusted R-squared of 0.969.

[38] The numbering of models in Table 6 and on is different from the numbering of models in Table 5. Model 1 and Model 2 in Table 6 and on are versions of Model 1 in Table 5, while Model 3 and Model 4 in Table 6 and on are versions of Model 4 in Table 5.

[39] Arellano and Bond (1991) discuss this issue in more detail.

With respect to parameter estimates the main feature is that, although they mostly have the expected sign, they are mainly insignificant. The exception to this are the estimates of the adjustment cost parameter and the optimal investment/capital ratio with minimal adjustment costs that are positive and highly significant in all specifications. The positive sign and significance of the adjustment cost parameter confirms the importance that these costs have in designing investment policies. The economic importance of this parameter becomes clear through an example. Assuming that parameter b is equal to zero, then for the average firm in our sample with an investment/capital ratio equal to 0.26, a value of α equal to 2.564, and corresponding to Model 1, adjustment costs are around 33% of total investment expenditures. If, however, the firm is assumed to operate under Model 3, i.e., with a value of α equal to 1.974, then the relative size of adjustment costs to investment expenditures is around 25%. These results are in line with those obtained, for instance, by Lichtenberg (1988) who finds that adjustment costs range between 21% and 35% of investment expenditures. In contrast, Whited (1992) finds that for his sample these costs are around 10% of investment expenditures. Finally, in his study on a transition economy, Lizal (1998) finds insignificant values of adjustment cost parameters across different specifications. The other parameter of interest in the table is the optimal investment/capital ratio with minimal adjustment costs. Its positive sign is in contrast with the results obtained by Bond and Meghir (1994), who find very high negative values for this ratio,[40] and Barran and Peeters (1998), who find mostly negative but insignificant values of this parameter, but is in line with the results of other studies such as Whited (1992) and Lizal (1998), who find high positive and significant values of this parameter.

The third structural parameter of the underlying model to be estimated is the market power parameter. In contrast to the adjustment costs and optimal investment/capital ratio parameters, the estimates of this parameter are of the right sign but mostly insignificant. Given that the market power parameter η stands for the inverse of the mark-up parameter $(1-1/e)$, where e denotes the absolute value of the firm's elasticity of demand curve, a significant value greater than one confirms that firms exercise some monopoly power. All our estimates are well above unity and it would be tempting to conclude that, on average, all firms in Estonia are characterized as exercising monopoly power. Only in Model 3, however, the parameter is significant at the 10% significance level, with all the other estimates being insignificant. This

[40] In this case it would be optimal for firms to disinvest rather than invest.

makes it difficult to interpret the results as well as to compare them with those of other studies that find significant values of these parameters.

The importance of financial variables in improving model performance is in sharp contrast with their non-significance across all specifications. This outcome, however, could be affected by the aggregation over groups of firms with different sensitivities to financial constraints. More specifically, certain types of firms might not face financial constraints, while some others might. As discussed in Section 2, it is expected that insider-dominated firms are more financially constrained than the rest. Furthermore, state-owned firms might be sensitive to financial constraints when their traditionally soft budget constraints are no longer in place. In addition, firms with high managerial discretion display positive sensitivities to internal funds reflecting either the effect of agency costs and the moral hazard or managers' reluctance to raise external funds or managers' empire building preferences. In order to be able to discriminate between these hypotheses, the effect of ownership structures on investment behavior will have to be explicitly accounted for. This is done in the next sub-section.

As the last step in the analysis in this sub-section, we report the results of testing the hypothesis of whether firms act as standard profit (dividends) maximizers or profit (dividends) per worker maximizers. In terms of the models reported in Table 6 this means testing whether firm behavior is better described by Model 1 versus Model 3 or by Model 2 versus Model 4. Testing, however, is not straightforward, given that the competing models are non-nested, i.e., none of the models can be obtained from the other by simply imposing parameter restrictions.[41] Here we apply Davidson and MacKinnon's (1981) J-test to discriminate between the models in question. In short, the test procedure is the following: estimate the alternative model, use the fitted values of the alternative model as an additional regressor in the basic model and then test the significance of the additional term using the respective t-test. If the additional term is significant, then the basic model is rejected in favor of the alternative one. This procedure is further complicated by the fact that in model selection there is no natural basic model. In fact, interchanging the roles of the two models, all four possibilities, i.e., reject both, reject either one or reject neither, could occur. Davidson

[41] Literature surveys on alternative ways of testing non-nested hypotheses can be found in Gourieroux and Monfort (1994) and Pesaran and Weeks (2001).

and MacKinnon (1981), however, conclude that as the sample size increases, the probability that the wrong model will not be rejected decreases.

We first apply the J-test to discriminate between Model 1 and Model 3 in Table 6. When Model 1 is estimated with the fitted values from Model 3 as an additional regressor, a p-value of 0.024 is obtained for the additional regressor implying that, at the 5% significance level, Model 1 should be rejected in favor of Model 3. However, when the roles are reversed, i.e., Model 3 is estimated with the fitted values of Model 1 as an additional regressor, the p-value of 0.047 is obtained for the additional regressor. Thus, we are also able, at the 5% significance level, to reject Model 3 in favor of Model 1. Similar conclusions are reached when Model 2 and Model 4 are tested against each other. One potential explanation why the results of these tests are inconclusive is that, in the sample, we have aggregated across firms with different objective functions such that the behavior of some of them can be better explained by, for instance, Model 1, while the behavior of some others can be better explained by the alternative Model 3. Given that we have argued that insider-owned firms, especially employee-owned firms, could be better characterized as if they maximize dividends per worker instead of total dividends, it is important then to test the hypothesis separately for firms under different ownership structures. These tests are also performed and reported in the next sub-section.

5.3 Tests of the Impact of Ownership Structures on Financial Constraints

In analyzing the effect of ownership structures on a firm's investment behavior and the degree of financial constraints, two approaches could be adopted. In the first approach the whole sample is pooled together and dummy variables, which take the value of one if a firm belongs to a given ownership and zero otherwise, are introduced. These dummies are then included in the regression with one of them left out to serve as a control group. Furthermore, all dummies are interacted with all other real and financial variables in the regression allowing not only the intercepts but also slopes to differ across groups. The coefficients in front of the ownership dummies and the respective interacted variables will then be interpreted as the marginal effects of a given ownership structure over the control group's ownership structure. A major problem in estimating such specifications with ownership variables as right-hand side variables is the endogeneity of ownership, i.e., in equilibrium different owners will determine their optimal ownership share based on various firm characteristics, among which is the

firm's investment needs. A potential solution to the problem is the use of instrumental variables, i.e., the endogenous variables in the model, the ownership dummies in our case, are instrumented with a set of variables that are correlated with them but not with the error term. There are, however, two problems with this method.

The first problem has to do with the quality of the instruments, while the second has to do with the functional form adopted. In general, finding appropriate instruments for ownership dummies is difficult. The literature concerning the determinants of ownership structures is large and it has identified several factors influencing the choice of optimal ownership shares, such as firm size, productivity, profitability, capital intensity, financing requirements or firm quality. In principle, all these variables could serve as instruments for the endogenous ownership dummies. The application of the instrumental variable approach requires all these instruments to be uncorrelated with the unobserved variables. In structural investment equations, however, all factors mentioned will be correlated with unobserved firm specific shocks to investment and, as such, will still be correlated with the error terms. Then, the use of such bad instruments, as Angrist and Krueger (2001) point out, will still lead to biased parameter estimates.

Instead of using the potential instruments to substitute for the endogenous ownership dummies in the regression, a two-step procedure could be adopted. At the beginning, the firststage predicted probabilities of a firm being under a given ownership structure are generated, through the estimation of a probit or logit regression, and then, in the second stage, these predicted probabilities are included in the main regression instead of the ownership dummies. While this approach sounds appealing, it has a drawback in that the use of nonlinear first-stage predicted values in the second stage equation will not generate consistent estimates unless the nonlinear model happens to be specified exactly right, thus leading to misspecification bias.[42] However, getting the functional form of ownership equations right is not trivial. As mentioned above, financing requirements are one of the determinants of optimal ownership shares. What matters, however, for a forward-looking firm are not only current financing requirements but also future requirements. Assume, for instance, that two similar firms are randomly allocated to managers. In the process of financing restructuring both firms will have to raise capital, but one might need more funds than the other. If the

[42] For a more detailed discussion of this point as well as of the dangers of the instrumental variables approach to estimation see Angrist and Krueger (2001).

manager of this firm expects that his/her credit constraint will be binding in the future, then he/she might decide to issue equity that will subsequently dilute his/her ownership share. A fully specified model of ownership determinants will have to contain measures of such future financing requirements.

Given the problems with the instrumental variable approach, the second approach in analyzing the effect of ownership structures on a firm's investment behavior and the degree of financial constraints consists of the division of the sample into several sub-samples according to the ownership groups defined and the estimation of the relevant specifications for every sub-sample separately. Other than avoiding the pitfalls of the instrumental variable approach, this approach also gives us the possibility to test the hypothesis on the existence of different objective functions across groups of firms. This approach is adopted here by dividing the sample into five sub-samples as follows:[43] state-owned, domestic outsider-owned, foreign-owned, manager-owned and employee-owned firms. As the number of observations for former employee-owned firms does not allow an independent analysis of this group, these firms are included in the employee-owned firms group. In the interpretation of results we then focus on the differences in respective coefficients across ownership groups, which provide unbiased estimates of the true differences. The results of the estimating equations are similar to those in the previous sub-section and are reported in Tables 7.1 through 7.5.

Regarding model performance, it is seen that the over-identifying restrictions tested through Sargan's test are accepted at high probability levels, while the second order autocorrelation test is always rejected. An exception to this pattern is Model 3 for domestic outsider-owned firms in which case the over-identifying restrictions are just accepted at the 10% significance level.[44] Also, the adjusted R-squared are comparable across equations and range from around 16% to around 22%. Worth noting is the fact that the adjusted R-squared for state owned and domestic outsider owned groups are usually below 20%, while for the other groups they are usually above 20%. Finally, model adequacy is also confirmed by the rejection of the null that all coefficients are jointly zero.

[43] In order to maximize the number of observations in each group we use the dominant owner definition to separate the sample.
[44] In fact, the p-value for this model is 0.09738, which, strictly speaking, leads to the rejection of the model as mis-specified.

Turning to the estimates of structural parameters we see that the adjustment cost parameter and the optimal investment/capital ratio are, as expected, generally positive and significant across all equations, while the market power parameter is significant only in the case of domestic outsider-owned and foreign-owned firms. The estimates of the adjustment cost parameters imply a different relative size of adjustment costs to investment expenditures across ownership groups. Assuming that parameter b is zero and evaluating the size of adjustment costs at the mean investment capital ratio for each group, we find that the adjustment costs for foreign-owned firms vary between 16% and 19% of investment expenditures, for domestic outsider-owned firms between 20% and 22%, for manager-owned firms between 29% and 36%, for employee-owned firms between 30% and 36% and for state-owned firms between 27% and 34%. When optimal investment/capital ratios are compared with their sample means across ownership groups we find that state-owned firms have the lowest deviation of actual versus optimal investment rate, while manager- and employee-owned firms have the highest. This suggest that, even accounting for the non zero value of b in calculating adjustment costs, manager- and employee-owned firms will face large adjustment costs relative to investment expenditures. Finally, the estimates of the market power parameter are insignificant for state-owned, manager-owned and employee-owned firms. An exception is the estimate of this parameter in Model 1 for manager-owned firms, which is positive and significant. The value of 0.93, however, is close to unity, implying no market power. In contrast, the values of this parameter for domestic outsider- and foreign-owned firms are positive, significant and well above unity, indicating that these firms operate in the elastic portion of their demand curve and enjoy monopoly power. The values of the parameter are larger for foreign-owned firms than for domestic outsider-owned firms across all specifications.

Important differences in investment behavior across ownership groups emerge while inspecting the estimates of financial variable coefficients. Comparing the coefficients across groups, several things are worth noting. First, as expected, different types of firms display different sensitivities to measures of financial constraints. As seen in Table 7.3, the estimates of all coefficients of financial variables for foreign-owned firms are insignificant, indicating that these firms are not constrained in any sense in their investment behavior. Given that foreign-owned firms in Estonia might be either subsidiaries or joint ventures with foreign partners, it is highly possible that profits earned in other countries could be invested in Estonia and the other way around. As such, the measures of internal funds and debt as defined

here will not be the relevant ones for these firms. Instead, measures of global funds across different markets where these firms operate will be needed to describe their behavior. Unfortunately, we possess data neither on the relations of these firms with their parent companies, if any, nor on their access to international capital markets.

Moreover, as expected, other types of firms, albeit to differing degrees, display sensitivity to the availability of internal and/or external finance. Manager-owned firms are the only ones not displaying significant sensitivity to the availability of internal funds, while state-owned, domestic outsider-owned and employee-owned firms all display positive and significant sensitivity to measures of internal funds, implying different degrees of financing constraints. Among the latter three groups, the sensitivity is highest for employee-owned firms and then for state-owned firms. For instance, the estimate of the internal funds parameter for Model 1 for employee-owned firms is 0.052. This estimate is 30% larger than the one for state-owned firms and almost twice as large as the one for domestic outsider-owned firms. The differences in estimates vary from model to model, but the pattern remains the same. The estimate of the internal funds squared parameter, included to capture potential non-linearities, is significant only for employee-owned firms,[45] indicating that for these firms the availability of internal finance is crucial in investment policies.

One argument against the interpretation of coefficients of cash flow and value added as indicators of financing constraints is that they also proxy for future investment opportunities. However, if measures of cash flow or value added are equally correlated with future opportunities across all firm types, then the differences in these coefficients are unbiased indicators of differences in financing constraints. This is tested by estimating an equation with sales as a dependent variable and different lags of cash flow, ownership dummies and their interaction with lagged cash flow variables as independent variables. The results, not reported here, showed that cash flow predicts future sales across all firms and that the effect is larger for foreign and domestic outsider-owned firms than for the other types. This finding supports our conjecture that differences in internal funds parameter between, for example, employee-owned or state-owned firms and foreign-owned firms are a good predictor of financing constraints.

[45] There is one exception in Model 3 for state-owned firms, where the coefficient is significant at the 10% significance level.

Further evidence of financial constraints comes from the inspection of coefficients of external finance variables. In this case, state-owned firms display no sensitivity to the availability of external finance, as shown by the insignificant coefficients of debt and its squared parameters. This could serve as an indicator that state-owned firms are not as constrained as might be conjectured in raising external finance, i.e. they might be operating under a soft budget constraints regime. Alternatively, it could be conjectured that, due to the high price they might have to pay for external finance, they rely mostly on internal funds to finance their investment, as expressed by the positive and significant coefficient of internal funds parameters, and, as such, have not yet hit their credit limit. Finally, the significant coefficient of internal finance and the insignificant coefficient of external finance could also be interpreted as evidence of managerial discretion and their preferences against outside control. In contrast, all other domestic-owned firms, that is, domestic outsider-owned, manager-owned and employee-owned, seem to have hit their debt limit in that, whenever significant, higher levels of debt are associated with lower investment rates. The sensitivities are highest, in absolute value, for employee-owned firms and then for domestic outsider-owned firms across all specifications. Interestingly, the case of manager-owned firms is the opposite to that of state-owned firms, in that they show significant sensitivity to the availability of external finance but insignificant sensitivity to the availability of internal funds.

A general fact emerging from inspecting the tables is that financial constraints operate both through debt and the availability of internal funds, although the coefficients of internal funds are significant more often than those of external finance. A final observation is that the results are robust to the alternative definitions of internal funds, i.e., the use of cash flow or value added, as well as to the assumption on the firm's objective function. This means that while their magnitude and significance changes across different specifications, their sign remains the same.

The last step of the analysis in this sub-section is testing whether firms under different ownership structures have different objective functions. As in the previous sub-section, given the non-nested nature of the competing models, the tests are carried out using Davidson and MacKinnon's (1981) J-test for non-nested alternatives. The results of the test are reported in Table 8. The table should be read as follows. The cells in column "Model 1" show the t-test on the significance of the fitted values from Model 3 that are added as an additional regressor in Model 1, while the cells in column "Model 3" show the t-test on the significance of the

fitted values from Model 1 that are added as an additional regressor in Model 3. The interpretation is similar for Model 2 and Model 4. The test results show that for state- and manager-owned firms we are able to reject both models as correct ones. However, under alternative definitions of internal funds, we conclude that foreign and domestic outsider-owned firms behave consistently with the profit (dividends) maximization hypothesis, while employee-owned firms behave consistently with the dividends per worker maximization hypothesis. These conclusions provide support against treating all the firms as being similar and pooling them in one sample.

6. Conclusions and Policy Implications

Strategic restructuring is identified as one of the pillars on which rests the success of transition. It in turn depends to a large extent on firms' ability to carry out the necessary investment by raising large amounts of capital while operating under hard budget constraints. Furthermore, a good investment climate is a precondition for achieving sustainable long-term economic growth and poverty reduction. In this paper we have investigated whether the investment spending of firms in Estonia is affected by liquidity constraints as well as whether the degree of such constraints differs across firms under different governance structures. The analysis is carried out by explicitly modeling firms' investment behavior in a dynamic setting in the presence of quadratic adjustment costs and debt and equity constraints. A major advantage of this Euler equation approach is that it allows an estimation of the effects of financial constraints on the inter-temporal allocation of investment, which avoids the measurement issues involved when an explicit investment demand equation has to be assumed. After deriving the optimal rule for capital accumulation from the firm's dynamic optimization problem, the up-to-date econometric modeling of liquidity constraints is based on an ad hoc inclusion of variables affecting access to capital, due to the fact that these variables do not explicitly enter the first order conditions of the firm's maximization problem. In this paper, however, we follow the approach of Chatelain (1998, 2000) that allows for an explicit solution of the Lagrangean multiplier related to the dividend constraint in terms of financial variables. Differently from the ad hoc approach, this approach leads to the inclusion of financial variables in respective investment equations in first differences rather than in levels.

While we argue that the identity of owners matters in the severity of liquidity constraints that firms face, current and future financing needs are also important determinants of the choice of optimal ownership structures. This two-way causality leads to the endogeneity of ownership structures with respect to investment rates, which, if not accounted for, would result in biased estimates. Two potential ways to correct for it are the use of instrumental variables and the use of the predicted values from an equation modeling the determinants of ownership structures. Both of these, however, are problematic. On the one hand, the use of instrumental variables is complicated by their potential correlation with firm-specific shocks to investment, leading to biases of an unknown nature. On the other hand, the use of predicted values from a first-step regression of ownership shares or dummies on various factors that influence the choice of ownership structures requires that the regression specification is exactly right for the second step estimates to be consistent. These considerations lead us to adopt the following estimation strategy: divide the sample into sub-samples of firms belonging to a given ownership class, estimate investment equations separately for each group and focus on the differences in estimated coefficients across groups.

The empirical results underline several important points. First of all, the adjustment cost parameter and the optimal investment/capital ratio with minimal adjustment costs are positive and significant across all groups and across all specifications. Second, only for foreign and domestic outsider-owned firms the market power parameter is significant and well above unity, indicating that these firms enjoy some monopoly power. Third, financial variables, used as proxy for the degree of liquidity constraints, play a significant role in a firm's investment decisions. Although all coefficients of internal and external funds are insignificant when the Euler equations are estimated for the whole sample, the inclusion of financial variables improved the performance of estimated equations in terms of not being able to reject the hypothesis that they are correctly specified.

Fourth, the degree of liquidity constraints varies with firm ownership structure. We consistently find that, on average, all non-foreign-owned firms face some liquidity constraints either through positive and significant coefficients of internal funds variables or through negative and significant coefficients of external funds variables. The behavior of foreign-owned firms, however, is consistent with the Euler equation specification in the absence of liquidity constraints. These findings provide support for the hierarchy of finance arguments and are consistent with the belief that successful restructuring in a transition economy is

dependent on the availability of finance. Focusing on coefficient differences across groups, we find that the sensitivity of investment to the availability of internal and external finance is stronger for employee-owned firms. From the other groups, somewhat surprisingly, only domestic outsider-owned firms display sensitivity to both measures of the availability of finance, with manager-owned firms are sensitive to the availability of external finance, while state-owned firms are sensitive to the availability of internal finance. The results on domestic outsider-owned firms imply that these firms could suffer from high levels of managerial discretion and control. All in all, the results provide support for almost all the hypotheses outlined in Section 2. Only in the case of manager-owned firms do we not find support for the hypothesis of a positive and significant correlation between investment rates and measures of internal funds. Furthermore, we find evidence that, on average, employee-owned firms are more financially constrained than the other types.

Finally, we provide evidence that firm behavior in a transition economy cannot be analyzed by invoking the representative firm approach. The results of Davidson and MacKinnon's (1981) J-tests for non-nested alternatives reject the hypothesis that employee-owned firms can be modeled as profit maximizers. Curiously, the tests do not reach a clear conclusion with respect to state-owned and manager-owned firms, implying that their behavior is consistent with both profit maximization and profit per worker maximization. The results imply that, due to firm heterogeneity, pooling all firms in one sample for the purpose of the analysis would result in a mis-specification bias.

The paper contributes to the literature in several important aspects. First, it provides more evidence in support of the financing hierarchy hypothesis.[46] Second, it adds to the stock of limited evidence on the role of liquidity constraints on firm behavior in a transition economy. Third, it is among the few studies, such as the ones by Lizal (1998) and Lizal and Svejnar (2002), which make a comprehensive analysis of the effect of various ownership structures on firm investment behavior. The special advantage of this paper compared to others is the possibility of the identification of insider owners, both managers and employees, which allows us to test various propositions related to their behavior. In most of the other studies, due to data unavailability, authors use a state- and private-owned or state-, private- and foreign-owned division. A study that investigates similar issues for Estonian firms using

[46] Studies listed in footnote 1 have found evidence consistent with this hypothesis.

company accounts data is Masso (2002). The author, however, focuses only on the differences between foreign and Estonian domestic firms. As such, this study offers a better picture of the processes that characterize the Estonian transition.

The robustness of the results, however, needs to be further tested by employing both larger samples and better measures of access to capital. As already mentioned, in short time panels the GMM estimates suffer from semi-consistency. As transition proceeds and data become more and more available, it will be possible to make use of longer time panels that will lead to better estimates. In addition to the estimation strategy, it is often argued that the use of financial variables to proxy for liquidity constraints is not perfect in that they also convey information on future profitability. In our case, both profit and revenue from the sale of non-current assets might fall into this category. If, for instance, the latter variable is correlated with the lack of future growth opportunities, then it would not be a perfect measure of liquidity constraints. To separate these effects, data on the type of assets sold would be needed. If the assets sold are not related to a firm's core operations, then it is likely this action represents restructuring rather than a lack of growth opportunities. The reverse might be true if assets sold belong to the firm's core operations. Furthermore, given the arguments on the separation of ownership and control, measures of control and the degree of monitoring need to be employed in order to be able to account for the effect of unobservables such as managerial discretion on investment behavior.

A continuous and lively debate in the transition literature is the efficiency and viability of various ownership structures. The arguments in the debate could be well summarized in Hansmann's (1996) survivorship test, which says that if a given organizational form does not survive, then it must have been at a comparative disadvantage compared to other forms. One of the organizational structures that, on various theoretical grounds, has been pinpointed as inefficient and as such subject to extinction is employee-owned firms. The theoretical arguments have given rise to empirical work that tries to assess the inefficiency of employee-owned firms. Estonia is one of the countries where employee ownership has been in decline, as indicated also by our data presented in Table 2. Kalmi (2002) makes a thorough analysis of the degeneration of these firms and finds that the structural bias towards extinction[47] and the insufficient motives of incumbent insiders to extend ownership to new employees are the

[47] This bias is caused by the property rights designation within the firm and the imperfection of the market for shares.

main reasons that drive their decline. Our results emphasize the degree of liquidity constraints as a further factor that potentially accentuates the decline of employee ownership. Indeed, Kalmi's (2002) and our sets of conclusions are complementary and provide the strongest evidence yet on the causes of employee ownership degeneration. In addition, a major contribution of this paper is that it is probably the first to provide robust evidence for the arguments that employee-owned firms do face larger liquidity constraints than other types of firms. While this result is relevant for Estonia and other transition countries with high incidence of employee ownership, the overall evidence on the impact of alternative ownership structures on a firm's policies is also pertinent to the broader corporate governance literature, which attempts, among other things, to ascertain the costs and benefits of governance through ownership.

These results imply a role for public policy in increasing the level of investment by influencing the environment firms operate in through policy measures such as the provision of fiscal incentives, the development of capital markets and the financial system and improvements in access to capital. Fiscal incentives in the form of lower corporate taxes and/or exemption of retained earnings used for investment from taxes, i.e. taxes will be paid only on the level of profits above that of investments, will stimulate investment through an increase in the availability of internal funds. Indeed, since 2000 retained earnings are exempt from taxation in Estonia. While it is still early to assess the full effects of such a policy, it is expected that in the long run it will result in higher capital stock. For instance, Masso (2002), citing unpublished work done using a model based on Tobin's Q, states that the long run effect of this policy is expected to bring about an increase in capital stock of 6.1%. There is a possibility, however, that such policies might produce undesirable effects. Under the conditions when managers enjoy high degrees of discretion, an increase in the availability of internal finance simply offers them more resources at their disposal to pursue their own interests at the expense of those of the other shareholders. Instead of relaxing the constraints, the outcome of this policy might then be over-investment. These potential costs, as well as the fact that the provision of fiscal incentives depends on the government's budget constraints, imply a limited role for fiscal policies. As such, they must be combined with other policies designed not only to relax liquidity constraints but also to mitigate agency conflicts within the firm by curbing managerial discretion.

One way to achieve both objectives is to follow policies to further develop capital markets and the financial sector, i.e., banking and non-banking institutions. Estonia's capital market, although growing, is small, and as such its future will lie in alliances with other stock exchanges. The first step in this direction was the creation of the pan-Baltic stock exchange in early 2000. The subsequent membership of Estonia in the European Union in 2004 has also opened European capital markets to Estonian companies. However, those likely to benefit from the stock market, at least in the short term, are large firms. More important for Estonian firms in general is the development of the banking sector and other non-banking institutions, such as investment funds, venture capital funds, mutual funds and credit unions. The banking system in Estonia is consolidated and well regulated. Nevertheless, it is mostly involved in financing the government rather than the private sector. Here there is space to introduce legislation that would increase bank incentives to extend loans to private companies. Similar steps need to be taken to increase non-banking institutions' participation in financing the private sector, which until now has been marginal. A possible way would be to provide tax breaks to such institutions that would be contingent on the amount of loans they extend to private companies, especially to those encountering difficulties in raising finance.

An alternative way for governments to relax liquidity constraints for certain types of firms is to provide direct subsidies to them. This policy, however, is likely not to be efficient for two reasons. First, to the extent that governments are not more efficient than the private sector in identifying firms with binding versus non-binding constraints, it could exacerbate the lemon problems. Yet, as Janda (2005) points out, the provision of the support to the right type of firm alleviates credit rationing and the provision of credit support across the board to all types of firms could decrease the lemon problem, too. Second, it could soften recipients' budget constraints and lead to inefficient capital allocation. Indeed, the available evidence points to no effect of government subsidies on firm growth. For instance, Demirguc-Kunt and Maksimovic (1996) find that government subsidies to industry do not increase the proportion of firms growing faster than predicted. Finally, a faster way of injecting capital into firms is to promote the inflow of foreign direct investment either in the form of fully foreign-owned subsidiaries, established through greenfield investment or the acquisition of an Estonian state- or private-owned company, or partnerships with domestic capital. The latter is of particular interest for Estonian private companies in need of fresh funds for investment. Given that foreign owners have access to global capital markets, this will enable Estonian companies to gain access to sources of funds that are otherwise either inaccessible or too costly.

The measures outlined above are not likely to improve the situation unless they are applied in combination with each other. The actual set of policy measures to be applied at a particular moment in time will depend on general macroeconomic conditions and the stage of institutional development. Successive Estonian governments have been very active in designing policies to improve firms' access to capital. Results of this paper suggest, however, that there is still latitude for public policy action.

Table 1. Variable Definitions

Variable	Definition
Investment	The sum of investments in reconstruction, expansion and acquisition of buildings, in the construction of new buildings and other business related projects, in buying new machinery, equipment and means of transportation and in buying and improving land.
Capital	The book value of non-current tangible assets. It is calculated as the average of the value of these assets at the beginning and at the end of the year.
Employment	The average number of employees per year. The study has excluded all firms with fewer than 10 employees.
Labor Cost	The sum of wage and salaries in a given year.
Average Wage	The ratio of labor cost to average employment in a given year.
Sales	Net sales per year as stated in a firm's income statement.
Profit	Net profit per year as stated in a firm's income statement. This is profit left after all taxes are paid.
Cash Flow	The sum of depreciation allowances and net profit.
Value Added	Two definitions of value added are adopted. The first is the sum of depreciation allowances, net profit, labor cost and expenditures for social tax and health insurance. The second includes all these variables as well as financial costs.
Debt	The sum of short-term loans.
Current Liabilities	The sum of short-term loans and payables to suppliers and or customers.
Total Liabilities	The sum of short- and long-term loans and other short- and long-term liabilities.
Short-Term Assets	The sum of cash, short-term receivables and short-term securities.
Financial Cost	The net of financial income accrued and financial cost incurred during a given year.
Extra Revenue	Revenue obtained from the sale of non-current tangible assets over a given period.
Industry Groups	Seven broad industry groups are defined as follows: 1. agriculture and fishing, 2. mining, food products, textile and leather, 3. wood products, paper products, coke, petroleum, chemicals, rubber, plastic, non-metallic, basic metals and machinery and equipment production, 4. electrical, optical and transport equipment production, 5. energy and construction, 6. wholesale and retail trade and 7. transport.
Size Groups	Firms are divided into three size groups according to their average employment. The first group includes firms with 49 or fewer employees, the second includes firms with more than 49 employees and fewer than 101, and the third group includes firms with 101 employees or more.
Ownership Groups	Six ownership groups are defined according to the owner as follows: state, foreign, institutional domestic outsiders, former employees, incumbent employees and managers.
Ownership Categories	Two definitions of ownership categories are adopted: majority and dominant ownership. A firm is considered to be majority owned if any of the six ownership groups owns more than 50% of capital. A firm is considered to be dominantly owned by the owner who holds the largest share.

Table 2. Ownership Distribution over Time according to Dominant Owner[1]

Year / Ownership Group	1993	1994	1995	1996	1997	1998	1999	Total
Domestic Outsiders	81	94	97	110	95	90	119	686
Employee	48	54	47	41	27	26	29	272
Former Employees	0	0	11	14	19	15	16	75
Foreign	42	60	63	68	67	59	72	431
Managers	45	53	65	76	81	71	84	475
State	228	181	262	204	172	123	6	1,176
No Answer	54	56		1	19	18	31	179
Total	498	498	545	514	480	402	357	3294

[1]A firm is considered to be dominantly owned by the owner who holds the largest share.

Table 3. Transition Matrix for Ownership Changes between 1995 and 1999 according to Dominant Owner[1]

Ownership Group 1999 / Ownership Group 1995	Domestic Outsider	Employee	Former Employee	Foreign	Manager	State	Total
Domestic Outsider	30	8	6	21	28	1	94
Employee	15	4	4	10	10	1	44
Former Employee	4	0	0	2	3	1	10
Foreign	18	6	0	17	15	1	57
Manager	20	5	3	14	17	2	61
State	32	6	3	9	11	0	61
Total	119	29	16	73	84	6	327

[1]A firm is considered to be dominantly owned by the owner who holds the largest share.

Table 4. Means and Standard Deviations of Principal Variables over Time

Year / **Variables**[1]	1993	1994	1995	1996	1997	1998	1999	Obs.[2]
Investment	2150 (12363)	2245 (18844)	3371 (22029)	3007 (17249)	2634 (15504)	3407 (14019)	4547 (19549)	3283
Capital	12250 (51023)	9740 (48137)	9771 (45305)	10329 (47218)	10411 (47756)	11200 (49623)	16816 (43022)	3294
Sales	21773 (63301)	21502 (61562)	30377 (93119)	24269 (69179)	27573 (77562)	27989 (63535)	32816 (88789)	3294
Employment[3]	196 (414)	166 (340)	164 (388)	161 (393)	157 (276)	137 (282)	124 (228)	3294
Real Wage[4]	14.42 (17.11)	16.46 (10.91)	13.31 (7.73)	21.04 (30.59)	21.92 (17.28)	22.96 (14.63)	28.37 (18.33)	3294
Cash Flow	805 (7530)	649 (8801)	1103 (10008)	658 (12607)	1678 (14428)	1994 (18195)	2932 (17328)	3294
Debt	867 (2692)	891 (4112)	1389 (3974)	1701 (4007)	1717 (3664)	2276 (3885)	2962 (4127)	3294
Current Payables	5516 (23301)	4848 (21130)	3804 (11895)	4334 (12503)	4363 (10672)	4605 (12843)	5445 (15750)	3294
Long-Term Liabilities	2595 (14961)	2702 (19652)	3143 (12450)	3433 (12048)	3820 (13874)	4469 (12052)	6863 (16384)	3294

[1]All the variables except employment are expressed in thousands of Estonian kroons and in 1993 prices.
[2]This number is the sum over the whole sample with non-missing values for the respective variable.
[3]Average number of employees in a given year.
[4]Real average wage per employee.

Table 5. GMM Estimates of Investment Functions with Real Instruments[a]

Model **Parameters**	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Adjustment Cost Parameter, a	2.956 (1.11)	2.765 (0.87)	2.548*** (1.39)	2.137 (1.09)	1.919 (1,17)	2.054 (0.76)
Optimal Investment-Capital Ratio, b	0.16* (7.34)	0.16* (12.42)	0.19* (5.26)	0.24* (4.81)	0.29* (3.96)	0.28* (3.43)
Market Power Parameter, η	1.01*** (1.37)	0.984 (1.19)	1.12* (2.76)	1,10 (0.92)	1,24 (0.53)	1,18 (0.68)
F-test 5% Critical Value	19.47 1.94	25.32 1.94	34.65 1.94	9.97 1.83	11.31 1.83	18.98 1.83
Sargan's Statistic Degrees of Freedom P-value	29.64 14 0.019	39.25 21 0.034	42.19 26 0.047	27.12 14 0.026	29.84 21 0.11	47.32 26 0.031
Sargan's Difference Test Degrees of Freedom P-value	- - -	9.61 7 0.38	12.55 12 0.58	- - -	2.72 7 0.87	17.48 12 0.39
Second Order Autocorrelation Test P-value	- 0.001 0.98	- 0.04 0.96	- 0.21 0.86	- 1.23 0.26	- 1.47 0.28	- 1.39 0.19
Number of Observations	1559	1559	1559	1557	1557	1557
Adjusted R-Squared	0.12	0.09	0.10	0.10	0.10	0.11

[a] Values in brackets denote respective t-statistics. Each model is estimated with time dummies, whose estimates are not reported. The t-statistics of adjustment cost, optimal investment/capital ratio and market power parameters are calculated using the delta method with analytical first derivatives. Model 1, Model 2 and Model 3 correspond to specifications derived assuming the firm maximizes the discounted present value of total dividends, while Model 4, Model 5 and Model 6 correspond to specifications derived assuming the firm maximizes the discounted present value of dividends per worker. In estimating Model 1 and Model 4 S_t/K_t, $(W \cdot L)_t/K_t$, I_t/K_t and $(I_t/K_t)^2$ lagged three periods and more are used as instruments. The above set of instruments as well as industry dummies are used to estimate Model 2 and Model 5. Finally, all these instruments plus time and firm size dummies are used to estimate Model 3 and Model 6. All regressions include the inverse of Mill's ratio to account for sample selection bias.

* Denotes significance at the 1% significance level.

* * Denotes significance at the 5% significance level.

* * * Denotes significance at the 10% significance level.

Table 6. GMM Estimates of Investment Functions with Real and Financial Instruments[a]

Model **Parameters**	Model 1	Model 2	Model 3	Model 4
Adjustment Cost Parameter, a	2.564* (3.98)	2.186* (5.59)	1.974** (2.28)	2.049* (2.96)
Optimal Investment-Capital Ratio, b	0.16* (5.71)	0.16* (7.52)	0.28* (5.32)	0.23* (3.51)
Market Power Parameter, η	1.23 (0.78)	1.17 (0.99)	1.29*** (1.59)	1.12 (1.19)
Internal Funds Parameter	0.039 (0.11)	0.025 (0.32)	0.021 (1.17)	0.020 (1.01)
Internal Funds Squared Parameter	0.0001 (0.87)	0.0002 (1.03)	0.0001 (1.16)	0.0001 (1.21)
External Funds Parameter	- 0.042 (- 1.12)	- 0.001 (- 0.69)	0.035 (0.98)	0.0003 (0.09)
External Funds Squared Parameter	- 0.004 (- 0.21)	- 0.0001 (- 0.06)	- 0.009 (- 1.08)	- 0.0001 (- 1.09)
F-test 5% Critical Value	12.76 1.75	19.32 1.75	17.48 1.67	19.97 1.67
Sargan's Statistic Degrees of Freedom P-value	19.72 14 0.16	20.02 14 0.13	15.45 14 0.26	17.31 14 0.19
Second Order Autocorrelation Test P-value	- 0.87 0.37	- 0.92 0.36	- 0.65 0.28	- 0.75 0.30
No. of Observations	1287	1287	1285	1285
Adjusted R-Squared	0.207	0.197	0.214	0.178

[a] Values in brackets denote respective t-statistics. Each model is estimated with time dummies, whose estimates are not reported here. Internal funds are measured by the sum of cash flow, short-term assets and revenue from sale of non-current assets in Model 1 and Model 3, and by the sum of value added, short-term assets and revenue from sale of non-current assets in Model 2 and Model 4. External funds, in all models, are measured by the amount of outstanding debt. The t-statistics of adjustment cost, optimal investment/capital ratio and market power parameters are calculated using delta method with analytical first derivatives. Model 1 and Model 2 correspond to specifications derived assuming the firm maximizes the discounted present value of total dividends, while Model 3 and Model 4 correspond to specifications derived assuming the firm maximizes the discounted present value of dividends per worker. Instrument sets include all real and financial variables lagged three periods or more. All regressions include the inverse of Mill's Ratio to account for sample selection bias.

* Denotes significance at the 1% significance level.

* * Denotes significance at the 5% significance level.

* * * Denotes significance at the 10% significance level.

Table 7.1 GMM Estimates of Investment Functions for State-Owned Firms with Real and Financial Instruments[a]

Model **Parameters**	Model 1	Model 2	Model 3	Model 4
Adjustment Cost Parameter, a	2.739* (4.22)	2.534* (7.50)	2.137*** (1.55)	2.212** (1.96)
Optimal Investment-Capital Ratio, b	0.21** (2.02)	0.24*** (1.32)	0.24* (4.18)	0.27* (5.09)
Market Power Parameter, η	0.87 (0.94)	0.91 (1.12)	1.03 (0.79)	0.96 (1.19)
Internal Funds Parameter	0.04* (3.23)	0.029** (2.30)	0.02* (4.47)	0.01** (1.97)
Internal Funds Squared Parameter	0.0012 (0.98)	0.0002 (1.08)	0.0009*** (1.32)	0.0003 (0.77)
External Funds Parameter	- 0.004 (- 0.68)	- 0.001 (- 0.99)	- 0.001 (- 1.00)	- 0.00002 (- 0.93)
External Funds Squared Parameter	0.0002 (0.86)	0.0002 (0.65)	0.0004 (0.75)	0.0003 (1.02)
F-test 5% Critical Value	12.34 1.75	34.98 1.75	27.57 1.67	42.12 1.67
Sargan's Statistic Degrees of Freedom P-value	21.76 14 0.12	19.65 14 0.16	17.46 14 0.20	17.14 14 0.19
Second Order Autocorrelation Test P-value	0.46 0.64	0.52 0.60	- 1.06 0.29	- 0.79 0.44
No. of Observations	303	303	303	303
Adjusted R-Squared	0.191	0.173	0.201	0.157

[a] Values in brackets denote respective t-statistics. Each model is estimated with time dummies, whose estimates are not reported here. Internal funds are measured by the sum of cash flow, short-term assets and revenue from sale of non-current assets in Model 1 and Model 3, and by the sum of value added, short-term assets and revenue from sale of non-current assets in Model 2 and Model 4. External funds, in all models, are measured by the amount of outstanding debt. The t-statistics of adjustment cost, optimal investment/capital ratio and market power parameters are calculated using the delta method with analytical first derivatives. Model 1 and Model 2 correspond to specifications derived assuming the firm maximizes the discounted present value of total dividends, while Model 3 and Model 4 correspond to specifications derived assuming the firm maximizes the discounted present value of dividends per worker. Instrument sets include all real and financial variables lagged three periods or more. All regressions include the inverse of Mill's Ratio to account for sample selection bias.

* Denotes significance at the 1% significance level.

* * Denotes significance at the 5% significance level.

* * * Denotes significance at the 10% significance level.

Table 7.2 GMM Estimates of Investment Functions for Domestic Outsider-Owned Firms with Real and Financial Instruments[a]

Model **Parameters**	Model 1	Model 2	Model 3	Model 4
Adjustment Cost Parameter, a	1.923** (1.67)	1.745*** (1.28)	1.784** (1.71)	1.787** (1.65)
Optimal Investment-Capital Ratio, b	0.19* (7.27)	0.21* (4.39)	0.31** (2.29)	0.29* (4.01)
Market Power Parameter, η	1.25* (3.79)	1.19* (5.76)	1.31* (3.71)	1.27* (2.67)
Internal Funds Parameter	0.027** (1.32)	0.020* (3.99)	0.018* (3.73)	0.026*** (1.28)
Internal Funds Squared Parameter	0.0001 (0.18)	0.0003 (1.17)	0.00008 (0.29)	0.00002 (1.02)
External Funds Parameter	- 0.022* (- 3.00)	- 0.0054* (- 3.92)	0.00013 (0.18)	0.00002 (1.06)
External Funds Squared Parameter	- 0.002 (- 1.16)	- 0.001* (- 4.27)	- 0.0005 (- 0.12)	- 0.000001 (- 0.77)
F-test 5% Critical Value	12.65 1.75	12.94 1.75	21.28 1.67	29.36 1.67
Sargan's Statistic Degrees of Freedom P-value	20.57 14 0.13	21.08 14 0.11	21.34 14 0.10	21.06 14 0.11
Second Order Autocorrelation Test P-value	0.45 0.64	0.46 0.64	- 0.79 0.44	- 0.81 0.43
No. of Observations	241	241	240	240
Adjusted R-Squared	0.186	0.189	0.198	0.191

[a] Values in brackets denote respective t-statistics. Each model is estimated with time dummies, whose estimates are not reported here. Internal funds are measured by the sum of cash flow, short-term assets and revenue from sale of non-current assets in Model 1 and Model 3, and by the sum of value added, short-term assets and revenue from sale of non-current assets in Model 2 and Model 4. External funds, in all models, are measured by the amount of outstanding debt. The t-statistics of adjustment cost, optimal investment/capital ratio and market power parameters are calculated using the delta method with analytical first derivatives. Model 1 and Model 2 correspond to specifications derived assuming the firm maximizes the discounted present value of total dividends, while Model 3 and Model 4 correspond to specifications derived assuming the firm maximizes the discounted present value of dividends per worker. Instrument sets include all real and financial variables lagged three periods or more. All regressions include the inverse of Mill's Ratio to account for sample selection bias.

* Denotes significance at the 1% significance level.

* * Denotes significance at the 5% significance level.

* * * Denotes significance at the 10% significance level.

Table 7.3 GMM Estimates of Investment Functions for Foreign-Owned Firms with Real and Financial Instruments[a]

Model **Parameters**	Model 1	Model 2	Model 3	Model 4
Adjustment Cost Parameter, a	1.385* (4.73)	1.196* (5.64)	1.285* (3.62)	1.287* (4.08)
Optimal Investment-Capital Ratio, b	0.17** (2.27)	0.17* (2.97)	0.33* (4.47)	0.24* (4.07)
Market Power Parameter, η	1.38** (1.78)	1.29** (2.09)	1.35** (2.29)	1.31*** (1.62)
Internal Funds Parameter	0.004 (0.28)	0.0009 (1.03)	0.0002 (0.75)	0.0004 (0.17)
Internal Funds Squared Parameter	0.0001 (1.01)	0.00001 (0.86)	0.0002 (0.97)	0.00002 (0.47)
External Funds Parameter	- 0.00001 (- 0.37)	- 0.0001 (- 0.67)	0.00002 (1.09)	0.00001 (1.23)
External Funds Squared Parameter	0.0004 (1.15)	0.0002 (1.16)	- 0.0001 (- 0.98)	- 0.0001 (- 1.03)
F-test 5% Critical Value	15.76 1.75	12.47 1.75	29.32 1.67	27.16 1.67
Sargan's Statistic Degrees of Freedom P-value	20.96 14 0.12	18.02 14 0.19	17.45 14 0.19	16.58 14 0.21
Second Order Autocorrelation Test P-value	-0.86 0.37	- 0.90 0.36	- 0.43 0.66	- 0.40 0.67
No. of Observations	254	254	254	254
Adjusted R-Squared	0.218	0.208	0.222	0.212

[a] Values in brackets denote respective t-statistics. Each model is estimated with time dummies, whose estimates are not reported here. Internal funds are measured by the sum of cash flow, short-term assets and revenue from sale of non-current assets in Model 1 and Model 3, and by the sum of value added, short-term assets and revenue from sale of non-current assets in Model 2 and Model 4. External funds, in all models, are measured by the amount of outstanding debt. The t-statistics of adjustment cost, optimal investment/capital ratio and market power parameters are calculated using the delta method with analytical first derivatives. Model 1 and Model 2 correspond to specifications derived assuming the firm maximizes the discounted present value of total dividends, while Model 3 and Model 4 correspond to specifications derived assuming the firm maximizes the discounted present value of dividends per worker. Instrument sets include all real and financial variables lagged three periods or more. All regressions include the inverse of Mills Ratio to account for sample selection bias.

* Denotes significance at the 1% significance level.

* * Denotes significance at the 5% significance level.

* * * Denotes significance at the 10% significance level.

Table 7.4. GMM Estimates of Investment Functions for Manager-Owned Firms with Real and Financial Instruments[a]

Model **Parameters**	Model 1	Model 2	Model 3	Model 4
Adjustment Cost Parameter, a	2.313** (1.22)	2.085** (1.21)	1.932* (3.09)	1.978* (4.18)
Optimal Investment-Capital Ratio, b	0.12** (1.11)	0.13** (1.20)	0.25** (1.92)	0.21* (2.67)
Market Power Parameter, η	0.93*** (1.62)	0.87 (1.18)	1.02 (0.76)	1.09 (0.97)
Internal Funds Parameter	0.018 (0.74)	0.012 (0.92)	0.0001 (1.12)	0.0001 (0.07)
Internal Funds Squared Parameter	0.003 (0.97)	0.0002 (1.07)	0.0001 (1.12)	0.00004 (0.10)
External Funds Parameter	- 0.021* (- 3.26)	- 0.003** (- 1.6)	- 0.0037 (- 0.27)	- 0.0001 (- 0.79)
External Funds Squared Parameter	- 0.0009* (- 3.85)	- 0.0002** (- 2.28)	- 0.0003 (- 0.37)	- 0.0002 (- 0.57)
F-test 5% Critical Value	9.64 1.75	10.27 1.75	13.54 1.67	16.93 1.67
Sargan's Statistic Degrees of Freedom P-value	14.08 14 0.42	13.78 14 0.43	8.75 14 0.84	7.79 14 0.86
Second Order Autocorrelation Test P-value	-1.04 0.29	- 1.05 0.28	- 1.07 0.28	- 1.06 0.28
No. of Observations	277	277	276	276
Adjusted R-Squared	0.209	0.204	0.216	0.201

[a] Values in brackets denote respective t-statistics. Each model is estimated with time dummies, whose estimates are not reported here. Internal funds are measured by the sum of cash flow, short-term assets and revenue from sale of non-current assets in Model 1 and Model 3, and by the sum of value added, short-term assets and revenue from sale of non-current assets in Model 2 and Model 4. External funds, in all models, are measured by the amount of outstanding debt. The t-statistics of adjustment cost, optimal investment/capital ratio and market power parameters are calculated using the delta method with analytical first derivatives. Model 1 and Model 2 correspond to specifications derived assuming the firm maximizes the discounted present value of total dividends, while Model 3 and Model 4 correspond to specifications derived assuming the firm maximizes the discounted present value of dividends per worker. Instrument sets include all real and financial variables lagged three periods or more. All regressions include the inverse of Mills Ratio to account for sample selection bias.

* Denotes significance at the 1% significance level.

* * Denotes significance at the 5% significance level.

* * * Denotes significance at the 10% significance level.

Table 7.5 GMM Estimates of Investment Functions for Employee-Owned Firms with Real and Financial Instruments[a]

Model / **Parameters**	Model 1	Model 2	Model 3	Model 4
Adjustment Cost Parameter, a	3.017* (2.56)	2.842* (2.92)	2.524** (1.76)	2.494* (2.42)
Optimal Investment-Capital Ratio, b	0.11** (2.09)	0.12** (2.15)	0.18* (5.38)	0.17* (4.37)
Market Power Parameter, η	0.82 (0.78)	0.97 (1.13)	0.94 (1.21)	1.07 (1.16)
Internal Funds Parameter	0.052* (3.68)	0.032* (4.24)	0.025* (3.75)	0.027* (3.07)
Internal Funds Squared Parameter	0.002*** (1.64)	0.002*** (1.47)	0.0015** (2.24)	0.0013*** (1.99)
External Funds Parameter	- 0.051** (- 1.78)	- 0.013** (- 1.75)	- 0.0047** (- 1.57)	- 0.0019 (- 1.89)
External Funds Squared Parameter	- 0.012** (- 1.84)	- 0.002** (- 2.39)	- 0.0015** (- 1.92)	- 0.004*** (- 1.19)
F-test 5% Critical Value	9.45 1.75	8.67 1.75	15.25 1.67	17.87 1.67
Sargan's Statistic Degrees of Freedom P-value	21.07 14 0.11	19.38 14 0.16	9.24 14 0.79	9.19 14 0.81
Second Order Autocorrelation Test P-value	-1.03 0.27	- 1.06 0.28	- 1.07 0.28	- 0.92 0.31
No. of Observations	212	212	212	212
Adjusted R-Squared	0.205	0.202	0.209	0.194

[a] Values in brackets denote respective t-statistics. Each model is estimated with time dummies, whose estimates are not reported here. Internal funds are measured by the sum of cash flow, short-term assets and revenue from sale of non-current assets in Model 1 and Model 3, and by the sum of value added, short-term assets and revenue from sale of non-current assets in Model 2 and Model 4. External funds, in all models, are measured by the amount of outstanding debt. The t-statistics of adjustment cost, optimal investment/capital ratio and market power parameters are calculated using the delta method with analytical first derivatives. Model 1 and Model 2 correspond to specifications derived assuming the firm maximizes the discounted present value of total dividends, while Model 3 and Model 4 correspond to specifications derived assuming the firm maximizes the discounted present value of dividends per worker. Instrument sets include all real and financial variables lagged three periods or more. All regressions include the inverse of Mills Ratio to account for sample selection bias.

* Denotes significance at the 1% significance level.

* * Denotes significance at the 5% significance level.

* * * Denotes significance at the 10% significance level.

Table 8. Results of Testing for the Existence of Different Objective Functions across Ownership Groups Using the Davidson and MacKinnon J-Test for Non-Nested Models[a]

Model **Ownership Group**	With Cash Flow as a Measure of Internal Funds		With Value Added as a Measure of Internal Funds	
	Model 1	Model 3	Model 2	Model 4
State	t = 7.78* (0.000)	t = 12.34* (0.000)	t = 6.29* (0.000)	t = 13.19* (0.000)
Foreign	t = 0.52 (0.602)	t = 9.25* (0.000)	t = 0.53 (0.593)	t = 12.97* (0.000)
Domestic	t = 1.23 (0.198)	t = 6.97* (0.000)	t = 1.28*** (0.100)	t = 8.21* (0.000)
Manager	t = 6.48* (0.000)	t = 5.12 (0.000)	t = 7.12* (0.000)	t = 9.54* (0.000)
Employee	t = 14.36* (0.000)	t = 0.64 (0.486)	t = 11.72* (0.000)	t = 0.24 (0.808)

[a] In this table we report the results of testing whether firm behavior across ownership groups is better characterized by the maximization of the discounted present value of total dividends or by the maximization of the discounted present value of dividends per worker. When cash flow is included in measures of internal funds, Model 1 corresponds to firms maximizing the discounted present value of total dividends, while Model 3 corresponds to firms maximizing the discounted present value of dividends per worker. The same interpretation holds for Model 2 and Model 4 when value added is included in measures of internal funds. The t-statistic corresponds to the fitted values of the alternative model added as an additional variable in the basic model, which is the one identified in the respective column. For instance, Model 1 is the basic model in column "Model 1" and in each case it is augmented by the fitted values of Model 3, the alternative model. Similarly, Model 3 is the basic model in column "Model 3" and in each case is augmented by the fitted values of Model 1, the alternative model. Numbers in brackets are the respective p-values. A significant coefficient of the fitted values leads to the rejection of the respective basic model in favor of the alternative one.

* Denotes significance at the 1% significance level.

* * Denotes significance at the 5% significance level.

* * * Denotes significance at the 10% significance level.

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Corporate Investment and the Determinants of Financial Constraints when Sample Splitting Criteria Are Unknown and Endogenous

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Abstract

Unlike previous empirical work on transition economies, to analyze investment behavior and the determinants of liquidity constraints we use a switching regression framework when sample separation is unknown and endogenous and firms are assumed to operate either in a financially constrained or financially unconstrained regime. The actual regime is determined by a switching or selection function, which depends on those variables that theoretically determine the wedge between internal and external finance, the severity of information and agency problems and time-varying firm characteristics. By using new panel data for Estonian companies from 1993 through 1999 we find that: (i) separate regimes exist in investment behavior, (ii) the likelihood of being financially constrained is higher in firms that are recently privatized, small and where ownership is concentrated in the hands of insiders and the state, (iii) soft budget constraints lower the probability of a firm being financially constrained, (iv) the actual probabilities of operating in a financially constrained regime are calculated to be quite high and essentially stable during 1993-1999 (0.52-0.57 for state owned firms, 0.40-0.46 for domestic owned firms and 0.53-0.57 for employee owned firms), and (v) ownership structure affects investment beyond its indirect effects through financial constraints.

Keywords: Corporate Investment, Liquidity Constraints, Insider Ownership, Transition, Switching Regression, Soft Budget Constraint.
JEL Classification: C33, D21, D92, E22, G32, J54, P21.

1. Introduction

Since the start of transition, it has been recognized that enhancing the rate of investment was of central importance for firms that needed to become more competitive. Equally, it has long been accepted that access to capital is an important determinant of the rate of investment. While an empirical literature has begun to emerge that investigates issues surrounding liquidity constraints in firms' investment decisions, our main motivation for this paper is that the dominant strategies used in the empirical investment literature suffer from several shortcomings. By using new panel data for Estonian firms during the period 1993 to 1999, we respond to some of these deficiencies. More specifically, we employ improved sample splitting criteria for separating firms into financially constrained and unconstrained. In addition we ensure that the implementation of these improved sample splitting criteria are integrated with an appropriate theoretical modeling of investment, as well as the adoption of pertinent empirical strategies. We test whether separate regimes exist for firms that are financially constrained or unconstrained and we also compare the investment-cash flow sensitivities for firms in these regimes. The use of panel data allows us to tackle problems such as selectivity and aggregation bias and measurement error.

This paper is of particular interest in that we provide evidence on the impact of the severity of information asymmetries and agency costs and the existence of soft budget constraints on the likelihood of firms being financially constrained. Moreover, by calculating the probabilities of firms' operating in a financially-constrained regime we are able to provide evidence of the pervasiveness of financial constraints across groups of firms and their persistence over time in an advanced transition economy such as Estonia. Furthermore, we provide evidence on differences in propensity to invest by ownership structure as well as broad support for the hypothesis about whether firms in transition economies behave similarly to those in advanced market economies.

The point of departure for standard empirical approaches is the recognition both of the importance of liquidity constraints in firms' investment decisions and also that the effect of liquidity constraints is not evenly distributed across firms with some firms facing higher costs when raising capital than others. These arguments lead to a financing hierarchy or pecking order hypothesis whereby, when undertaking investments, financially constrained firms first

prefer internal financing to more expensive external financing and then, if external financing is needed, prefer low-risk debt financing to new equity issues. In testing this hypothesis empirical research usually follows a strategy in which, initially, a standard investment demand model (e.g., accelerator, neoclassical or Tobin's Q) is augmented with financial variables to proxy for the degree of financial constraints. Alternatively, structural investment equations are derived from the optimization of the firm's objective function under debt and equity constraints, and the sample is divided, a priori, into financially constrained and unconstrained firms using alternative classification criteria. Finally, separate equations are estimated for each group of firms. Support for the financing hierarchy hypothesis is provided if financial variables present in investment equations are found to be significant for financially constrained firms, but insignificant for financially unconstrained firms.

Yet this empirical strategy has its problems. In this paper we address the biases that arise in testing for the presence of financial constraints, independently of how investment decisions are modeled, when the sample splitting criteria that are used may be inappropriate. In most of the empirical literature a single quantitative or qualitative indicator, such as dividend payout ratios, bond rating, degree of bank affiliation, firm size, firm age, or ownership structure, is used to partition firms into those that are or are not potentially financially constrained. The implication of these approaches is that the estimation results would be highly sensitive to the criteria and threshold values chosen. The conflicting findings in the existing literature, as reviewed for example in Schianterelli (1996), provide ample support for this implication.

Another and perhaps a more important consideration is that, independently of the number of indicators used in partitioning the sample or in choosing the threshold values, a firm is exogenously classified as financially constrained or not. In addition, firms are kept in that regime over the whole sample period**.** In general, the partition indicator will be correlated with the dependent variable, which causes endogenous selection problems. The ad hoc selection of partition criteria is, therefore, likely to cause what might be called static misclassification. Furthermore, as financial constraints change, over time firms might move from one regime to the other. Thus, even if the classification method avoids problems of static misclassification, over time the issue of what might be called dynamic misclassification arises. This issue becomes more important as the time period under consideration lengthens. In the paper, both the static and dynamic misclassification problems are tackled by

introducing a switching regression approach with endogenous and unknown sample separation.

In the next section we discuss our data and the definitions of variables employed in the analysis. This is followed by an account of the estimating approach and the specifications we use in the empirical analysis. In the fourth section, estimation results are reported and discussed. In the last part we conclude and discuss some implications of our findings.

2. Sample Description and Variable Definitions

The degree and pervasiveness of liquidity constraints will depend to a large extent on the stage of development of the financial system. As such, we start this section with a brief account of the evolution of the financial system in Estonia since the start of transition. The financial system, consisting of the banking system, capital markets and legal infrastructure, is an important pillar of a market-based economy, as it plays the intermediate role in mobilizing the economy's savings and channeling them to productive needs. As part of the transition towards such a system, Estonia needed not only to liberalize its existing centralized financial system, but also to build new institutions and develop the regulatory and supervisory framework. The liberalization, which happened early on in transition, included the abolishment of subsidies and direct credits, of controls on interest rates and on capital movements. Institution-building started with the establishment of the Estonian Central Bank in 1990[48] and the adoption of a two-tier banking system. The latter measure led to the creation, between 1989 and 1992, of 42 commercial banks,[49] mostly small, undercapitalized and owned by connected large enterprises. However, a serious banking crisis during 1992-1993 caused industry consolidation through a wave of mergers and liquidations. This led not only to a substantial decrease in the number of banks, as documented in Table 1, but also to high market concentration. For example, in 1996 and 1997 the six largest banks owned 80% and 90% of total assets, and 70% and 78% of share capital of domestic banks, respectively.[50]

[48] Although it started functioning as a central bank only after independence, with the local branch of a Soviet bank carrying out the central bank duties up to that time.
[49] EBRD Transition Report 1994.
[50] EBRD Transition Reports 1996 and 1997.

By 1997, the state's share in the banking system had already been reduced to zero, as reported in Table 1.[51]

A further feature of the Estonian banking sector is the increased foreign presence as shown by the number of foreign-owned banks over the total number of banks as well as by the share of foreign owned assets in the banking system. For instance, Mygind (2000) states that the share of assets owned by foreign partners in the Estonian banking system rose from 15% in 1994 to 61% in 1998. In addition to consolidation, the banking crisis also led to increased regulation and tighter supervision in order to improve the efficiency of the banking system. Overall, Estonia scores quite high in the index of banking system reforms, with only Hungary scoring higher. Yet, as Berglof and Bolton (2002) argue, banks in transition economies are more involved in financing the government rather than the private system. Estonia is not an exception in this respect, although the share of credit to the private sector[52] has steadily increased over time, reaching almost 26% of GDP in 2000. In sum, the banking system in Estonia is consolidated, well regulated, increasingly foreign-owned, increasingly active in financing private activity as expressed by the credit extended to the private sector as a percentage of GDP, and relatively efficient as expressed by the percentage of bad loans to total loans.

Except for banks, other non-bank financial institutions such as investment funds, pension funds and insurance companies are important sources of capital for the private sector. In Estonia, however, these institutions started to develop late and are closely related to major banks. By the end of 1997, 19 investment funds and 8 life insurance and 14 non-life insurance companies existed. Nevertheless, as pointed out by Berengaut et al. (1998), they have rarely participated as strategic investors during the privatization process or been active in the stock market.

Another potential source of both debt and equity capital for the private sector is capital markets. A Securities Market Act was adopted in Estonia as early as 1993. However, only by the end of 1994 did shares start to be traded over-the-counter at a computerized depository. The Tallin Stock Exchange (TSE) did not start operating until May 1996, using a continuous

[51] The increased state share for 1998 is due to the re-nationalization of a bank that became insolvent during 1998. In 2000 this bank was sold to a Finnish financial group bringing the state's share in the banking sector back to zero.
[52] The data regard credit extended to households as well as enterprises.

trading, market-making system. The initial market capitalization was 16.7% of GDP. As reported in Table 1, this market capitalization increased in 1997 to almost 25% of GDP but decreased again in 1998, due to the fall in share prices following the Russian crisis of 1998, before bouncing back again starting from 1999. By 2000, only 23 companies were listed in the TSE with total market capitalization at 35% of GDP.[53] The stock market, however, is small and not sectorally diversified.[54] Attempts are also made to integrate the Estonian market with other capital markets in the region by building exchange alliances. In January 2000, all three Baltic Republic, i.e., Estonian, Latvian and Lithuanian, stock exchanges started trading a pan-Baltic list of shares that included five Estonian firms. Also, the Estonian stock exchange is a member of NOREX, an alliance of Nordic and Baltic stock exchanges.

In summary, the financial system infrastructure in Estonia makes it possible that companies gain access to capital through bank loans, while non-bank financial institutions and the stock market play only a marginal role as sources of capital. However, as enterprises engage in deeper post-privatization restructuring, high demand for funds, accompanied by limited bank involvement in financing the private sector, is likely to result in a heavy reliance on internal finance and severe credit rationing for specific groups of firms.[55]

This conjecture is tested using annual firm-level observations of a sample of Estonian firms over the period 1993 through 1999. The sample is created through a combination of data obtained from surveys and from standard firm financial statements reported to the Estonian Statistical Office. The aim of surveys is to obtain information on ownership configurations, which is not available in standard financial statements. The firms included in the survey scheme are selected as a stratified random sample based on size and industrial affiliation. The survey information is then augmented with financial information from balance sheet and income statements, such as current and fixed assets, current and long-term liabilities, equity, sales, expenditures, wages and salaries, inventories, gross and net profits, R&D expenditures, expenditures on capital goods, investment, etc. The merging of all this information creates an unbalanced panel data set with missing observations to be used in the analysis. The first step

[53] The small nature of the market becomes clear by one example: the flotation of Estonian Telecom in February 1999 increased market capitalization by 50%.
[54] This includes both the Tallin Stock Exchange and the over-the-counter market.
[55] Another source of external funds is foreign direct investment (FDI). In the long run, it is expected that firms that receive FDI will become less financially constrained than those that do not receive FDI. Given its very favorable investment climate, Estonia has been very successful in attracting large inflows of FDI, as documented by the last row of Table 1. The sharp increase in FDI in 1998 is caused by entry in the Estonian market of two large Swedish banks.

in the analysis is a check against errors and inconsistencies generated in the data collecting and reporting process. Examples of such errors are firms reporting zero labor force or capital or sales, or reporting ownership shares whose sum is lower or higher than 100. Consequently, prior to using the data set, checks are performed using the following seven criteria:

- The firm's capital at the beginning and the end of the period should be positive.
- Investment should be non-negative.
- Investment should be smaller than the end-of-period capital stock.
- Sales should be positive.
- The average employment per year should be positive and equal to or greater than 10.
- Labor cost in a given year should be positive.
- Ownership shares should add up to 100.

The application of all these criteria led to a drop of about 21 percent of observations, leaving the number of observations at 3833 over the whole period 1993 through 1999. More specifically, applying the first criteria led to 36 firms being dropped in 1993, 35 in 1994, 40 in 1995, 28 in 1996, 45 in 1997, 13 in 1998 and 60 in 1999. Furthermore, 121 observations were the deleted due to negative investment,[56] 335 due to having employment less than 10,[57] 12 due to zero labor cost, 16 due to zero net sales and 6 due to having investment larger than capital at the end of the period. Finally, an additional 315 observations, belonging to firms in real estate, education, health and public administration industrial branches, were dropped from the analysis. The final sample then includes a total of 3294 observations broken down as follows: 498 observations in 1993, 498 in 1994, 545 in 1995, 514 in 1996, 480 in 1997, 402 in 1998 and 357 in 1999. The list of variables to be used in the analysis and their respective definitions are given in Table 2.

Table 3 provides information on the distribution at a given point in time and evolution over time of the number of firms that fall in a given ownership group, while Table 4 provides information on the joint distribution of firms by ownership and size groups. Focusing first on

[56] Negative investment or dis-investment is the outcome of the strategic restructuring of a firm that leads to downsizing or the elimination of unproductive assets. While the processes and determinants of dis-investment are of interest in themselves, they are not the focus of this study and as such the respective observations, about 3% of the sample, are dropped from the analysis.

[57] A firm is dropped from the analysis if it shows as having employment of less than 10 in any given year. For instance, if a firm has 8 employees in 1995 but more than 10 in all other years it is dropped from the sample in all years.

Table 3, it is apparent that in early years insider ownership emerged as an important form of privatization. For example, in 1995 in more than 22% of cases, insiders, i.e., employees and managers, or former insiders were dominant owners. Determining whether this was the outcome of the privatization process or of the entrepreneurial spirit that leads insiders to establish their own companies requires data on the origin of the firms. From the respondents' replies a lot of firms show up as being new. Yet, this might partly be due to the fact that insiders establish an independent company that takes over the assets of a former state owned enterprise. In this case it would be a mistake to classify the firm as new. Unfortunately, the data do not allow discriminating between these cases. Foreign owned companies comprise around 12% of the sample, with most of them being new companies established as joint ventures in the early 1990s, while domestic outsider owned firms comprise around 18% of the sample. Finally, state owned firms comprise around 48% of the sample, with 232 firms being 100% in state ownership and 30 firms being mostly in private hands but with the state still holding the dominant position.[58] It would be interesting to compare this ownership distribution with the economy-wide distribution prevailing in Estonia in 1995. This is, unfortunately, not possible because official data from statistical yearbooks do not provide a detailed classification of ownership shares held by different owners as defined above. Furthermore, although the official data distinguish among state, foreign and private firms, it is not clear which definition is used to classify firms in a given group. For example, the Estonia Statistical Yearbook (1995) states that, by the second half of 1995, 87% of enterprises in Estonia were private. It is highly likely that even enterprises with a small involvement of private capital are classified as private, leading to a potential overstatement of the true degree of private ownership. Inspecting Table 4, we see that state owned firms tend mostly to be large, insider owned, i.e., employee, former employee and manager owned, and, surprisingly, foreign owned firms tend to be small or medium, while domestic outsider owned firms tend to be small or large.

After presenting the sample composition and ownership dynamics, we turn now to the variables of interest. Table 5 presents the summary statistics of the most relevant variables used in the analysis. The general facts that emerge from this table are that investment levels are high relative to capital stock, with the investment/capital ratio ranging from 0.17 in 1993

[58] If the focus of the analysis had been simply the effect of private ownership versus state ownership these firms would have been classified as private. As the identity of private owners, however, matters in explaining differences in observed behavior, these firms end up being classified as state-owned.

to 0.34 in 1995, that average employment decreases while real wage increases over time, that cash flow is positive, that short-term debt increases over time and that cash flow and short-term debt are approximately of the same magnitude in all years but 1996. The increase in debt after 1995 is consistent with the general increase of lending to the private sector during this period as reported in Table 1. This serves as an indication that Estonian firms enjoy access to capital and might not be as liquidity constrained as one could expect at this stage of transition. Furthermore, up to 1997, the sum of cash flow and short-term debt is less than investment suggesting that firms might have had access to other sources of capital such as short-term trade credit and/or long-term debt. This conjecture is supported by the last two rows of the table that show current payables and long-term liabilities, which include long-term loans as well as any other long-term debt a firm accumulates. The rate of growth of long-term liabilities is not high, except for the last year, suggesting that long-term liabilities do not constitute an important source of capital over the stated period. Current payables, however, are quite high and higher than investment over the whole period. Another important feature of Estonian firms during this period is that, on average, they have become more capital intensive as demonstrated by the increase in capital and decrease in employment.

Finally, an attempt is made to ascertain the importance of internal versus external financing in investment in fixed capital by focusing on the share of investment financed through internal funds or short- or long-term debt. The information on the sources of financing investment is available for a small sub-sample of firms.[59] In Tables 6.1 and 6.2 the evolution of the share of investment financed through internal funds and loans[60] over time for each ownership group is presented. It is apparent that, for all ownership groups, a very high share of investment is financed through internal funds. In several cases, notably for employee owned, former employee owned and state owned firms, in some years this share is as high as 100%. Foreign owned firms are the ones that receive the most from outside financing,[61] with the highest share reaching 37% in 1994, followed by domestic outsider owned firms. This reliance on internal financing might be the result of two forces. First, it might result from owners'

[59] Financial statements contain some information on sources of financing investment in fixed capital. This information, however, is missing for most of the firms in our sample. With the non-missing information a sub-sample of 862 firm observations over time is constructed.

[60] The data for loans include both short-term and long-term loans.

[61] In several cases the sum of respective shares from both tables belonging to a given ownership group does not sum up to 1. This means that other sources, except for internal funds and loans, have been used to finance investment. These sources are classified as private sources and might consist either of an owner's own financing that does not go to increase the owner's share in the company or of financing coming from other non-financial institutions.

reluctance to use external financing due to fear of loss of control. Second, it might result from the inability to borrow externally.[62]

The data we use in this study possess certain advantages compared to data used by most other studies, which make this study relevant to the transition literature in particular and corporate governance literature in general. First, the use of surveys allows us to define a broad spectrum of ownership groups. In most studies in the literature the authors divide the firms in their samples into state, foreign and domestic private firms. Even when authors are able to identify insider owners, they do not distinguish between employees, managers or former insiders. Second, the use of different waves of ownership data allows us to capture dynamics that are not possible to capture when shorter data series are used.[63] Finally, the combination of ownership with economic and financial data allows us to better measure the effect of unobserved firm characteristics, such as, for instance, the existence and degree of soft budget constraints, on firm behavior.

3. The Switching Regression Model

A switching regression model[64] is based on the existence of a switching function that determines whether a firm operates in one of several potential regimes. The appropriateness of using this model is determined by the arguments outlined in the introductory section, as well as by the model's ability to identify significant differences in the data at hand that allow for the efficient clustering of firms into groups. A further advantage of the model is that it allows for the simultaneous determination of differences in investment behavior across firms and the likelihood of them belonging to a particular regime over time.

In the current set-up, at any given point in time, the firm is assumed to be in either the financially constrained or financially unconstrained regime. Firms in the financially constrained regime face a higher sensitivity to the availability of internal finance than those in

[62] As shown in Table 1, the share of credit extended to the private sector to GDP, although increasing over time, has been low. This phenomenon, associated with high demand for funds at the beginning of transition, leads us to conjecture the presence of fierce competition in the credit market that could have resulted in credit rationing for a subset of firms.

[63] Only the data used by Lizal and Svejnar (1998, 2002) cover a long enough time span to allow the capture of appropriate dynamics.

[64] A good summary of switching regression models, their applications and problems in their estimation can be found in Maddala (1986) and Maddala and Nelson (1994).

the financially unconstrained regime. But, while the number of regimes is known, the particular regime a firm belongs to is determined by the switching function, which in itself depends on those variables that theoretically determine the wedge between internal and external finance, severity of information and agency problems and time-varying firm characteristics. Assume that for every firm operating in one of the financial regimes mentioned above, at any given point in time, investment equations are given by the following expressions:

$$\left(\frac{I_t}{K_{t-1}}\right)^{FC} = X_{i,t} \cdot \beta_1 + \varepsilon_{1i,t} \tag{1}$$

$$\text{if} \qquad Z_{i,t} \cdot \alpha + \varepsilon_{i,t} \geq 0 \ \text{ and} \tag{2}$$

$$\left(\frac{I_t}{K_{t-1}}\right)^{FU} = X_{i,t} \cdot \beta_2 + \varepsilon_{2i,t} \tag{3}$$

$$\text{if} \qquad Z_{i,t} \cdot \alpha + \varepsilon_{i,t} < 0 \,. \tag{4}$$

In the above equations i denotes firms, t denotes time, $X_{i,t}$ and $Z_{i,t}$ are vectors of explanatory variables that might possibly overlap, β_1, β_2 and α are vectors of parameters to be estimated, while $\varepsilon_{1i,t}$, $\varepsilon_{2i,t}$ and $\varepsilon_{i,t}$ are respective residuals that are supposed to be correlated across equations, but not over time. Equations (1) and (3) are structural investment equations, while equations (2) and (4) constitute the switching functions that, together with the investment equations, will be estimated simultaneously. Given that switching functions determine a firm's financial status, it is clear from the set-up that a change in financial status, represented by a change in the unobserved threshold value of $Z_{i,t} \cdot \alpha + \varepsilon_{i,t}$, will result in changes in investment behavior. The residuals from the system are assumed to be jointly normally distributed with mean vector zero and variance-covariance matrix as follows:

$$\Sigma = \begin{pmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{1\varepsilon} \\ \sigma_{21} & \sigma_2^2 & \sigma_{2\varepsilon} \\ \sigma_{\varepsilon 1} & \sigma_{\varepsilon 2} & \sigma_{\varepsilon}^2 \end{pmatrix}. \tag{5}$$

Depending on the assumptions on elements of the variance-covariance matrix (5), two different switching regression models result. So, if $\sigma_{1\varepsilon}$ and $\sigma_{2\varepsilon}$ are assumed to be zero, then this gives rise to exogenous switching models, while if $\sigma_{1\varepsilon}$ and $\sigma_{2\varepsilon}$ are assumed to be non-zero, then this gives rise to endogenous switching models. As argued in the introduction, because variables that determine a firm's financial status are correlated with investment, in this paper we assume an endogenous switching function. A further assumption that needs to be made to close the model is whether the sample separation is known or not, i.e., whether the observed values of investment are known beforehand to come from the process given by equation (1) or from the one given by equation (3). Here it is assumed that this is not known and the model specified then becomes an endogenous switching regression model with sample separation unknown.[65] As a final remark on the structure of the variance-covariance matrix, due to the structure of equations (2) and (4), σ_{ε}^2 cannot be identified, so it is usually assumed to be equal to unity.

Under such circumstances, when the regime the firm operates in is not observed ex ante, the probabilities of the firm, at a given point in time, operating in one regime or the other, depending on the value of the switching function, can be calculated as follows:

$$\text{Prob}\left(\left(\frac{I_t}{K_{t-1}}\right) = \left(\frac{I_t}{K_{t-1}}\right)^{FU}\right) = \text{Prob}\left(Z_{i,t}\cdot\alpha + \varepsilon_{i,t} < 0\right) = \text{Prob}\left(\varepsilon_{1i,t} < -Z_{i,t}\cdot\alpha\right) =$$

$$= \Phi\left(-Z_{i,t}\cdot\alpha\right) \text{ and} \tag{6}$$

[65] Hu and Schiantarelli (1998) estimate a similar model with unknown sample separation for a sample of U.S. manufacturing firms. Nabi (1989) estimates an endogenous switching regression model with known sample separation for a sample of Pakistani firms using information on firms' access to formal or informal credit markets to separate the sample. Other approaches that employ the switching regression model strategy are the studies of the effect of liquidity constraints on consumption and the studies of wage determination in labor markets. Finally, a similar approach is the one by Cleary (1999), who employs a two-step procedure: in the first step he uses discriminant analysis to partition the sample into financially constrained, partially financially constrained and not financially constrained firms and then, in the second step, estimates investment equations separately for each sub-sample. The index constructed to partition the sample is assumed to be function of firm liquidity, leverage, profitability and growth.

$$\text{Prob}\left(\left(\frac{I_t}{K_{t-1}}\right) = \left(\frac{I_t}{K_{t-1}}\right)^{FC}\right) = \text{Prob}\left(Z_{i,t}\cdot\alpha + \varepsilon_{i,t} \geq 0\right) = \text{Prob}\left(\varepsilon_{1i,t} \geq -Z_{i,t}\cdot\alpha\right) =$$

$$= \Phi\left(1 - Z_{i,t}\cdot\alpha\right), \tag{7}$$

where $\Phi(\cdot)$ denotes normal cumulative distribution functions. Then for every observation the probability density function of $I_{i,t}$ is a weighted average of conditional density functions, with weights equal to the probabilities in equations (6) and (7), as follows:

$$L_{i,t} = \phi\left(\varepsilon_{1i,t}\middle|\varepsilon_{i,t} \geq -Z_{i,t}\cdot\alpha\right)\cdot\Phi\left(1 - Z_{i,t}\cdot\alpha\right) + \phi\left(\varepsilon_{2i,t}\middle|\varepsilon_{i,t} < -Z_{i,t}\cdot\alpha\right)\cdot\Phi\left(-Z_{i,t}\alpha\right), \tag{8}$$

where $\phi(\cdot)$ is normal density function. Aggregating across all observations over all time periods the log-likelihood function is defined as follows:

$$L = \sum_{i=1}^{N}\sum_{t=1}^{T}\log(L_{i,t}), \tag{9}$$

or differently,[66]

$$L = \sum_{i=1}^{N}\sum_{t=1}^{T}\log\left(\Phi\left(\frac{-Z_{1,t}\cdot\alpha - \frac{\sigma_{1\varepsilon}}{\sigma_1^2}\cdot\varepsilon_{1i,t}}{\sqrt{1-\frac{\sigma_{1\varepsilon}^2}{\sigma_1^2}}}\right)\cdot\phi\left(\varepsilon_{1i,t},\sigma_1^2\right) + \left(1-\Phi\left(\frac{-Z_{1,t}\cdot\alpha - \frac{\sigma_{2\varepsilon}}{\sigma_2^2}\cdot\varepsilon_{2i,t}}{\sqrt{1-\frac{\sigma_{2\varepsilon}^2}{\sigma_2^2}}}\right)\cdot\phi\left(\varepsilon_{2i,t},\sigma_2^2\right)\right)\right).$$

The parameters of the investment equations and the switching function are then estimated by maximizing the log-likelihood function through maximum likelihood techniques. In this analysis the results are obtained by maximizing the likelihood function (9) using the EM algorithm available in STATA 8. Once equations are estimated, the respective probabilities of the firm being in either regime are calculated. However, before discussing the specification of investment and switching equations used in the estimation, some problems in estimating models such as this using the EM algorithm are worth mentioning. First, standard error estimates are only approximate and, in general, might be biased downwards. During

[66] See Hu and Schianatarelli (1998) for details.

estimation the iterative method to obtain bootstrapped standard errors is used. Second, because the likelihood function is not globally concave, the choice is between several local maxima. The selected maximum is the one that maximizes the likelihood function obtained from different starting values of the classification criteria.[67]

In estimating the above model, functional forms for both the investment and switching equations need to be specified. Here we assume that the investment equation corresponds to the one derived from neoclassical/accelerator models of investment demand as, for example, in Koyck (1954) and Jorgenson (1963). Although these models are derived under restrictive assumptions, they perform well empirically and are among the most widely used in both the western and transition literature.[68] In its basic form the neoclassical/accelerator model can be expressed as follows:[69]

$$\left(\frac{I_t}{K_{t-1}}\right) = \alpha + \sum_{s=1}^{S} \beta_s \cdot \frac{Y_{i,t-s}}{K_{i,t-1}} + \varepsilon_{i,t}\,, \tag{10}$$

where I, K and Y denote gross investment, capital and output (sales) respectively, while s stands for the number of lags to be included. This equation is derived under the assumption of a perfectly elastic supply of investment funds and, consequently, does not allow for financial constraints to affect investment. Usually, in the literature, profit or cash flow variables are included in specification (10) to account for the possibility of the imperfect substitutability of internal and external finance. However, it is not clear whether the coefficients of these variables reflect a more imperfect substitutability of internal and external finance, the information on the future profitability of the firm or the presence of "free cash flow" introduced by Jensen (1986). One way to partially overcome this problem is to introduce interaction terms between cash flow and variables designed to measure the severity of agency costs. The difference in estimates of the coefficients of these variables will then be interpreted as differences in access to external finance. Nevertheless, as mentioned above, care should be shown not to increase the numbers of parameters to be estimated too much due to the loss in degrees of freedom. Due to this problem and under the assumption that a non-zero cash flow

[67] A more detailed discussion of these issues is provided in Wedel and Kamakura (2000), pages 84-91.
[68] Studies that employ the neoclassical/accelerator model of investment demand are, for example, Jorgenson and Siebert (1968), Jorgenson (1971), Anderson and Kegels (1997), Lizal and Svejnar (1998, 2002), Budina et al. (2000) and Bratkowski et al. (2000).
[69] In the Appendix we show how equation (10) can be obtained from both accelerator and neoclassical models.

coefficient for unconstrained firms captures the future profitability, the difference in size between cash flow coefficients of constrained and unconstrained firms can be interpreted as capturing the reliance on internal finance. Incorporating then cash flow into equation (10) gives the estimating investment equation as follows:

$$\left(\frac{I_t}{K_{t-1}}\right) = \alpha + \sum_{s=1}^{S} \beta_s \cdot \frac{Y_{i,t-s}}{K_{i,t-1}} + \sum_{s=1}^{S} \gamma_s \cdot \frac{CF_{i,t-s}}{K_{i,t-1}} + \lambda \cdot D_{i,t} + \xi \cdot M_{i,t} + \varepsilon_{i,t}, \quad (11)$$

where D is a vector of industry and time dummies that capture the effects common to all firms, with λ being the respective vector of coefficients, while M is the inverse Mill's ratio or the probability that the firm is included in the sample. The latter is included because, for some of the firms during some years investment data are missing, so that, by running a Heckman-type probit model, the probability that the firm is included in the sample, on the basis of investment, profit, industry affiliation and firm type, is calculated. In the econometric analysis alternative measures of internal funds are employed, which are discussed in detail in Section 4.

In terms of the switching function, given by equations (2) and (4), it is assumed to be a function of two sets of variables: those that determine a firm's financial status and those that measure the degree of information and agency problems. The former set of variables includes balance sheet and income statement items, such as debt-to-capital ratio, interest expenses and liquid financial assets to capital ratio. The latter set of variables includes the percentage of shares owned by the largest owner as a measure of ownership concentration, firm age and firm size.[70] Time and industry dummies complete the set of explanatory variables of the switching function. The straightforward interpretation of the coefficients of these dummies is that they represent the effects of general macroeconomic conditions[71] on the probability of a firm being financially constrained. As these conditions are the same for all the firms in the economy or in an industry, then their sum constitutes the threshold over which a firm will be classified as financially constrained based on its own characteristics. Given that being financially constrained at any given moment in time will depend on past performance and

[70] A discussion of variable measurement is carried out in Section 4.
[71] An example would be a banking crisis or economy wide productivity shock, which affect similarly all firms in the economy.

results, all variables in the switching function other than time and industry dummies enter in the first lag.

Firms having a high debt-to-capital ratio are expected to be suffering from a lack of collateralizable assets and are, therefore, highly likely to be operating in the financially constrained regime. Similarly, firms having high interest payment to sales ratio, i.e. firms that have a heavy burden in servicing the existing debt, are more likely to operate in the financially constrained regime. On the other hand, firms having high liquid assets to capital ratio have plenty of resources at their disposal and, consequently, would face a low probability of being financially constrained. This means that, in the switching function specification, the coefficients of debt to capital ratio and interest payment to sales ratio are expected to be positive, while the coefficient of liquid assets to capital ratio is expected to be negative.

The effect of financial variables on the probability of being financially constrained, however, would be insignificant or significantly reduced if firms enjoy easy access to capital or experience soft budget constraints. The original notion of soft budget constraints, as introduced by Kornai (1980), regarded the action of a paternalistic state, which was not willing to accept the social consequences of closing down loss-making firms and, consequently, intervened by bailing them out unconditionally. Nowadays, however, this notion is broader and includes not only cheap capital provided to firms in the form of direct government subsidies, but also in the form of tax arrears[72] and trade credits, i.e., delayed payments to suppliers and cheap loans from the banking sector. As discussed in the previous section, strict budgetary- and competition-promoting policies by successive Estonian governments have reduced the level of direct budgetary policies to minimal levels. So, for example, the EBRD Transition Report (2000) states that budgetary subsidies in Estonia have been under 1% of GDP for the period 1995 through 2000, except for 1995 when their level reached 1.9% of GDP. As such, direct budgetary subsidies do not constitute an important source of finance for Estonian firms. Under such circumstances, tax arrears might provide a significant means through which the state extends its support to distressed firms. In fact, Schaffer (1998) stresses that tax arrears appear to be the main route through which budget constraints are softened in transition economies. Detailed data on tax arrears are,

[72] Tax arrears are those taxes that should have been paid but are not. Examples of such taxes are corporate and social security taxes.

unfortunately, unavailable from standard financial statements. There is, however, some information that corroborates the existence and pervasiveness of tax arrears in Estonia. For example, the EBRD Transition Report (2000) stresses that the efficiency of the collection of social security tax at the enterprise level in Estonia was 85.6% in 1998 and 76.2% in 1999. Furthermore, the EBRD Transition Report (1999) presents the results of a firm-level survey carried out in several transition countries. Among other things, firms were asked about the level of tax arrears, if they had any. The results show that although Estonia is the country with the lowest percentage of firms reporting to have tax arrears among advanced transition economies, this problem is present, with around 9% of firms reporting to have unpaid taxes.

Another potential source of cheap capital is overdue trade credit to suppliers. As in the case of tax arrears, it is not possible to gauge the importance of trade credit simply from financial statement data. In the previous section it was shown that current payables are high and increasing over time across all categories of firms. These, however, might not be overdue payments but reflect contractual arrangements or delivery lags. In fact, it is highly possible that most of current payables do not constitute overdue trade credit. Furthermore, if the high levels of overdue trade credit are rolled over to long-term liabilities, they will translate into a high growth rate of long-term liabilities over time. As seen in the previous section, this growth rate is low for almost the whole period. Schaffer (1998) argues that, at least in more advanced transition economies, firms have learned to apply hard budget constraints to each other. An exception in this respect would be public utility companies, which, forced by the state, would continue to provide services to firms even though they have not paid. Again, quantifying the extent of this phenomenon is not possible from accounting data.

A final measure of soft budget constraints is easy access on the part of distressed or loss-making firms to bank lending through special relations with banks and/or other financial institutions. In order to properly establish the pervasiveness of this channel of soft budget constraints one needs to combine data from both firms and banks. It is tempting to interpret positive net financing from a loss-making firm as evidence of soft budget constraints. This would be the case only if the stated loan has a low economic value to the bank itself. Unfortunately, data on whether banks invest in low economic value projects are not available, as banks would be reluctant to disclose such information. Two speculative conclusions, however, could be drawn from the data in Tables 6.1 and 6.2, i.e. the share of investment financed through loans over time. First, if firms in Estonia had widespread easy access to

bank loans we would expect the share of investment financed through bank loans to be higher. Second, if certain firms would enjoy special relations with banks we would expect the share of investment financed through bank loans be either stable or increasing over time. From the table it is clear that only state owned firms have this share more or less stable over time, albeit small in magnitude. These facts indicate that although access to cheap credit might be present in Estonia, it is neither widespread not persistent over time.

Overall, the presence of soft budget constraints would mitigate the severity of financial constraints and, if not accounted for, would provide biased estimates of financial variables on the probability of being financially constrained. From the potential channels of soft budget constraints direct budgetary subsidies are going to be the least important. The relative importance of the other three channels is difficult to evaluate due to the lack of appropriate data, as is the case with tax arrears, or the noise contained in the available data, as in the case with trade credit and bank loans. Nevertheless, given the data in hand, a measure of soft budget constraints is constructed and included in the set of variables that determine the probability of being financially constrained. The measure is constructed as a dummy variable that takes the value 1 if a firm, at a given point in time, has negative earnings before interest, taxes and depreciation (EBITD) and, at the same time, receives positive net financing defined as an increase in short-term debt net of financing costs.

Other than not being able to account for all channels of soft budget constraints, this measure has two further pitfalls. First, it might fail to capture firms with a genuine soft budget constraint, which is defined as the situation under which a firm's behavior is conditional to its own expectation and financing institution commitment that some financing will be provided in the future. This means that a firm with negative earnings and zero net financing in a given period is still experiencing a soft budget constraint if it expects to receive financing in the future. As this measure of soft budget constraint involves unobservables, it will always fail to capture the true degree of the soft budget constraint. Second, our measure of soft budget constraint might classify as firms that experience soft budget constraints those firms that in fact do not. For example, it could well be the case that young or newly established firms might be loss-making during the first years of their existence until they gain market share and establish relations with financial institutions. In the meantime, they might be receiving outside financing in response to their long-term growth potential. Both these problems generate biases in the real number of firms that experience soft budget constraints, but in different directions.

While the former understates the real number of firms that experience soft budget constraints, the latter overstates it. The true direction and degree of the bias however is unknown beforehand.

This lengthy discussion of the soft budget constraint phenomenon has pointed to its importance in affecting any firm's investment policies, as well as to the challenges a researcher faces in trying to measure its effect on firm behavior. These challenges are clearly reflected in our measure of soft budget constraints defined above. These caveats should then be kept in mind while interpreting the results in the next section.

With respect to the second set of variables that enter the switching equation, the percentage of shares owned by the largest owner is used as a proxy for the severity of agency problems, while the firm's age and size are used as proxy for the severity of informational asymmetries. The sign of the coefficient of the percentage of shares owned by the largest owner is ambiguous. A more concentrated ownership is supposed to mitigate agency problems and so lead to lower probability of being financially constrained. However, if shares are concentrated in the hands of managers and/or employees, insider-outsider conflicts of interests will arise and this might lead to a higher probability of being financially constrained. A way to solve this conflict is to include interaction terms of the percentage of shares owned by the largest owner with respective ownership dummies. The coefficients of these terms are expected to be negative when ownership is concentrated in the hands of outside owners, while they are expected to be positive when ownership is concentrated in the hands of insiders. Furthermore, young firms are expected to be more prone to informational asymmetries than established ones, which have the possibility to create long-term relationships with providers of capital. Consequently, the sign of the coefficient of firm's age is expected to be negative. Finally, small firms could face a higher premium on external finance due to the higher cost of collecting information on them. In addition, small firms incur higher transaction costs of issuing both debt and equity financing and face higher risk of bankruptcy than large firms. This means that the coefficient of firm size is also expected to be negative.

4. Econometric Results and Discussion

In this section we present and discuss the econometric results of estimating different versions of the switching regression model. Before proceeding with the results, however, a note on the

estimating procedure is necessary. As discussed above the sample separation into potentially constrained and non-constrained firms is endogenous and not known beforehand. Yet, in order to carry out the estimation an initial guess is needed to partition the sample. This is not a trivial undertaking, since a good measure of financial constraints would need data on demand for and supply of funds, which are unobservable. For example, in deciding whether a firm that receives zero outside financing over a given period is financially constrained or not, we have to determine whether this was the result of no demand for such financing or of unsatisfied demand. Similarly, in deciding whether a firm that receives positive outside financing over a given period of time is financially constrained or not, we have to determine whether the firm received all the financing it needed or whether it had excess demand. Consequently, some proxy of demand for external financing is needed to be able to construct a measure of liquidity constraints. In this paper a firm is classified as financially constrained if at a given moment in time the firm fulfills all of the following conditions:

- It experiences positive sales growth. This measure is used as a proxy of positive demand for financing due to positive growth prospects.[73]
- It has non-positive internal funds, defined as the sum of cash flow and liquid assets. Given the positive demand for financing in the first criteria the lack of internal funds is assumed to lead to a positive demand for external financing. Then, these two criteria taken together point to some demand for external financing.
- It does not receive net outside financing or receives less net outside financing than sales growth, i.e. the change in debt from the previous period is smaller in absolute value than sales growth. This criterion means that the firm is credit rationed in the credit market and is not able to satisfy its demand for external financing.

Applying all these criteria to the sample, 452 firm observations, or 13.8% of the whole sample, are classified as being financially constrained. This small number of financially constrained firms is influenced by the fact that in our sample most of firms report both positive sales growth and net financing over two consecutive periods. This, however, as mentioned above, does not mean that they received all the external financing they demanded.

[73] It should be noted that this is an imperfect measure of the demand for financing. Positive sales growth might be the result of other factors, such as the use of excessive capacity or idiosyncratic productivity improvements, which do not require extra capital investment.

As a result, this number of financially constrained firms must be considered as the lower bound of the total number of financially constrained firms in the sample.

In broad terms, the estimates obtained are classified into two groups: those obtained by using a restricted version of the switching regression and those obtained by using an extended version of the switching regression. Within each group, however, we estimate different versions of the investment equations by experimenting with the number of lags of all variables included in the specifications. Standard model selection criteria, such as individual coefficients' significance, the adjusted R^2, Akaike Information Criteria and Schwartz Information Criteria, are then used to discriminate among models. The results presented below are obtained by using the best performing model. In this model, the investment equation includes lagged sales, twice lagged sales, lagged cash flow, twice lagged cash flow, lagged financial slack and twice lagged financial slack, all normalized with lagged capital stock, along with time and industry dummies, as right hand side variables.

The cash flow variable included in the specification is defined as the sum of depreciation expenses and net profit. Different specifications were also estimated using the two alternative definitions of value added[74] instead of cash flow in investment equations. The results were substantially similar across specifications, with coefficient estimates obtained using the cash flow measure being statistically significant more often than those obtained using the value added measures. For this reason we have kept the specification with cash flow as the main one in the subsequent analysis. Given that the main aim of the analysis is to compare the investment-cash flow sensitivities between constrained and unconstrained firms, a short discussion is needed on the expected signs, magnitudes and significance of cash flow coefficients. A positive and statistically significant coefficient of cash flow for firms operating in the financially constrained regime would mean that these firms are sensitive to the availability of internal finance and, consequently, credit rationed with respect to external finance. Furthermore, it is customary in the empirical studies of advanced market economies that a statistically insignificant coefficient of cash flow for firms operating in the financially unconstrained regime is interpreted as a sign that these firms are indifferent in choosing between internal and external finance and hence are unconstrained financially. Yet, another

[74] According to the first definition value added is the sum of depreciation allowances, net profit, labor cost and expenditures for social tax and health insurance. The second definition includes all these variables as well as financial costs.

argument made, for instance, by Kaplan and Zingales (1997), states that cash flow may also convey information about future profitability other than the degree of financial constraints. In this case the coefficient of investment cash flow sensitivity would be positive and statistically significant even for the financially unconstrained firms, but the absolute value of this coefficient would be lower than that for the financially constrained firms. In the transition context, we expect cash flow to be an important conveyor of information on a firm's future profitability. Consequently, we expect cash flow coefficients to be different from zero even for the unconstrained firms.

In addition to cash flow, the investment equations include a measure of financial slack, defined as the sum of cash, short-term receivables, short-term securities and revenue obtained from the sale of non-current tangible assets. Differently from cash flow, this variable measures only the availability of internal funds and will, consequently, provide further evidence on the existence of credit rationing. The assumption here is that measures of financial slack as defined above are not likely to be positively correlated with a firm's future opportunities. This assumption might be violated, however, when voluntary asset sale is determined by the lack of future growth opportunities rather than restructuring considerations. If this is the case then the coefficient of financial slack would be biased against finding a liquidity effect. Kaplan and Zingales (1997) argue that high levels of financial slack are associated with the lack of financial constraints, given that investment will not be conditioned by the availability of finance. On the other hand, Fazzari, Hubbard and Petersen (1996) and Kim, Mauer and Sherman (1998) argue that high levels of financial slack might be associated with financial constraints given that it is those firms that expect to be constrained that accumulate large holdings of liquidity. These arguments mean that for financially constrained firms the coefficient of financial slack variables is expected to be positive and statistically significant, pointing to the inability of these firms to substitute between internal and external finance, while for financially unconstrained firms the coefficient of financial slack variables is expected to be not different from zero, indicating that they can freely switch between internal and external financing.

In part 1 of Tables 7 and 8 we report the results from estimating investment equations for firms operating in each regime using the restricted version of the switching (classification) equation, which includes only the balance sheet variables, i.e., debt to capital ratio, liquidity, defined as the sum of cash, short-term assets and revenue from sale of non-current assets, to

capital ratio and interest expenses to sales ratio, along with time and industry dummies. Except for the time and industry dummies, all other variables in the switching equation are included in the first lag, causing the first year of observations to be lost in estimation. Table 7 presents estimates when the whole (unbalanced) sample is used, while Table 8 presents estimates when only the balanced sub-sample is used, i.e., the sample that includes observations for those firms that are present in the sample over the whole period. Comparing the coefficient estimates across the balanced and unbalanced samples provides evidence of the robustness of results, as well as of the direction and magnitude of the bias caused by the entry and exit of firms over time.

As seen from Table 7 and Table 8 the coefficient estimates of output (sales) and measures of internal funds across both regimes are mostly statistically significant and of the expected sign, indicating strong support for the neoclassical/accelerator model. These results are in line with those obtained from other studies in both advanced market economies and transition economies, which have used neoclassical/accelerator models of investment behavior and found output to be positively correlated with and a significant determinant of investment. Turning to differences in investment behavior across the two regimes, from Table 7 we see that the coefficients of lagged cash flow are significant at the 5% and 10% significance levels. Furthermore, as expected, the lagged cash flow coefficient is larger for financially constrained firms than for financially unconstrained firms, i.e., 0.009 versus 0.001. This result means that both firm types are sensitive to the availability of internal finance, with the financially constrained firms being more sensitive to the availability of internal finance than financially unconstrained firms. As discussed above, the positive and significant coefficient of lagged cash flow for financially unconstrained firms provides evidence that this variable conveys some information on future profitability. Then, the difference of this coefficient between constrained and unconstrained firms is attributed to different sensitivities to the availability of internal funds.

In addition, the coefficient of twice lagged cash flow is positive and statistically significant only for firms operating in a financially constrained regime. This could be interpreted as evidence of the cash smoothing or "buffer stock" liquidity hypothesis, i.e., the fact that, given their inability to secure the desired level of financing when a profitable investment project will be undertaken, financially constrained firms accumulate internal funds over time and use them to finance these projects. Further evidence of different sensitivities to the availability of

internal funds across firms operating in the two regimes is given by the coefficient of the lagged financial slack variable and its twice lagged value. These coefficients are positive and significant at the 1% significance level only for financially constrained firms, implying that these firms accumulate large holdings of liquidity to substitute for their inability to obtain external finance. In contrast, respective coefficients for financially unconstrained firms are positive but insignificant, suggesting that these firms could easily substitute between internal and external finance. Finally, support for the hypothesis of different investment behavior across groups is provided by the coefficient estimates of sales and its lagged value. All coefficients are positive and statistically significant at the 1% and 10% significance levels, but they are larger in absolute value for unconstrained firms than for constrained firms. As argued above, this is consistent with the hypothesis that unconstrained firms are able to react more to the prospect of future growth opportunities, summarized by the sales variable, than firms operating in the constrained regime.

The results obtained from the balanced panel, as seen in Table 8, are essentially the same as those obtained from the unbalanced panel in terms of sign and significance, implying that results are robust and not affected by the entry and exit of firms over time. The coefficient of the lagged cash flow variable is still larger for financially constrained firms (0.021 versus 0.003), which also have positive and significant coefficients of financial slack variables. However, in terms of coefficient magnitude there are large differences between the two panels. Given that most of the coefficients obtained from the balanced panel are smaller in absolute value than those obtained form the unbalanced panel, it is tempting to conclude that the entry and exit of firms over time causes an upward bias in coefficient estimates. Yet, coefficients of lagged cash flow across both regimes, as well as the coefficient of lagged sales for unconstrained firms, are larger in the balanced panel than in the unbalanced panel.

The existence of two distinct regimes could be more formally tested using appropriate likelihood ratio tests. Testing, however, is not straightforward. The reason is that, in such models, under the restriction that coefficients of the two investment equations are equal, the parameters of the switching equation are not identified, which makes it difficult to calculate degrees of freedom. In addition, the likelihood ratio test statistic might not be asymptotically distributed as a χ^2 distribution. However, Goldfeld and Quandt (1976) have suggested that the likelihood ratio test can be performed using a χ^2 distribution with degrees of freedom

equal to the sum of the number of constraints and the number of unidentified parameters. In the above models the number of degrees of freedom is 36 when the unbalanced panel is used and 35 when the balanced panel is used. The difference in the degrees of freedom results from the inclusion of the inverse Mill's ratio in the investment specification when the unbalanced panel is used. The critical values of the χ^2 distribution at the 5% significance level with 36 and 35 degrees of freedom are 50.71 and 49.52, respectively. The respective values of the likelihood ratio tests are 872.147 for the unbalanced panel and 763.54 for the balanced panel. These values lead to decisive rejections of the null hypothesis of a single regime.

Having concluded that two distinct regimes characterize the data better than a single one, another type of test that could be performed is on the equality of individual coefficients in investment equations across the two regimes. More specifically, we test, for instance, whether the coefficient of lagged cash flow is equal for firms operating in the financially constrained regime and those operating in the financially unconstrained regime. The t-statistic of the test for the unbalanced panel is 13.54, while for the balanced panel it is 19.82, leading in both cases to a decisive rejection of the null hypothesis. In the case of the coefficient of lagged sales, the respective t-statistics are 7.33 for the unbalanced panel and 12.48 for the balanced panel, again leading to a rejection, at high levels of significance, of the null hypothesis. Similar tests are performed for the other variables in the investment equations. Only in the case of twice lagged cash flow for the balanced panel are we not able to reject the null hypothesis that coefficients are equal across regimes.

The identification of separate investment regimes is further supported by the estimates of the switching (classification) function reported in part 2 of Tables 7 and 8. The coefficients of debt to capital and interest payment to sales ratios are positive, although not always significant, indicating that, as expected, higher values of these ratios make a firm more likely to operate in the financially constrained regime. Furthermore, the coefficient of liquidity to capital ratio is negative and significant at the 1% significance level, indicating that the higher the ratio the lower the likelihood the firm will operate in the financially constrained regime.

Overall, these results point to the existence of separate regimes in the investment behavior of financially constrained and unconstrained firms, with financially constrained firms displaying a higher sensitivity to the availability of internal funds, while financially unconstrained firms

being more responsive to future growth opportunities. In addition, the likelihood of being financially constrained or not is significantly dependent on a firm's balance sheet position.

As stressed in the previous section, the effect of financial variables on the probability of being financially constrained would be significantly reduced if firms would enjoy easy access to capital in the form of special relations to financial institutions and/or preferential treatment from the state and suppliers. In order to account for this possibility, as well as for the effect of informational asymmetries and agency costs on access to capital, we allow for a more general specification of the switching equation. More specifically, other than the balance sheet variables, we have included in the specification the percentage of shares owned by the largest owner, its interaction with respective ownership dummies, firm size, firm age and a dummy denoting whether the firm is subject to soft budget constraints or not. Firm size is measured by the logarithm of the average number of employees, while firm age is measured by the number of years the firm has been operating in private hands.[75] The interpretation of this coefficient is the marginal change in the probability of operating in the constrained regime from operating one more year under private ownership. The construction of the soft budget constraints indicator was explained in detail in the previous section. The results from estimating the two-component investment equations using the extended version of the switching equation for both the unbalanced and the balanced panel are reported in part 1 and part 2 of Tables 9 and 10.

Focusing first on the switching equations estimates, an important general conclusion that emerges from these tables is that information asymmetry and agency cost variables are important determinants of the likelihood whether the firm is financially constrained or not. As expected, the coefficient of the percentage of shares owned by the largest owner, which corresponds to the effect of ownership being concentrated in the hands of the state, as well as most of the interaction terms are significant, indicating that some ownership concentration is important in determining the regime in which a firm operates. The signs of the coefficients, however, are inconsistent across panels. For instance, in the unbalanced panel estimates the coefficients of the percentage of shares owned by the state and employees are positive and significant, suggesting that higher ownership concentration in the hands of either the state or

[75] Given that most of the firms in our sample are former state owned firms, it would have made no sense to define firm age by the absolute number of years the firm has been in operation, since most firms had been operating for many years before transition started. At that time, however, the investment needs of these firms and the allocation of resources were determined by central planners.

employees is associated with a higher probability of being financially constrained. In between these groups, when ownership is concentrated in the hands of the state, the effect is twice as large as when ownership is concentrated in the hands of employees. Interestingly, there seems to be no significant effect on the likelihood of being financially constrained when ownership is concentrated in the hands of the other types of owners. A completely different picture emerges when the balanced panel is taken into account. In this case, ownership concentration in the hands of the state or employees continues to be detrimental to the probability of being financially constrained. The effect of ownership concentration in the hands of other owners, however, is different. Concentration of shares in the hands of managers also increases the probability of the firm being financially constrained, while the reverse is true when ownership is concentrated in the hands of outsiders, i.e. domestic outsider and foreign owners. Contrary to expectations, however, the negative effect of the concentration of ownership in the hands of employees is smaller than that of the concentration of ownership in the hands of managers and the state.

Turning to the coefficients of firm size, firm age and the dummy for soft budget constraints, it is seen that they have the expected sign, although the firm age coefficient is insignificant for the unbalanced sample, indicating that bigger firms, more established firms and those that have access to finance from sources other than the market are less likely to find themselves operating in the financially constrained regime. In an alternative specification, we also included in the switching regression the interaction terms of firm size and firm age with debt to capital ratio, liquidity to capital ratio and interest coverage to sales ratio to test whether balance sheet status is more important for firms that are subject to more severe asymmetric information problems. None of the interaction effects were, however, significant and, as such, they are not reported here. Finally, the effect of individual balance sheet variables is similar in sign and significance across both panels, with only the coefficient of the interest coverage to sales ratio being insignificant for the balanced panel.

The results of investment equations reported in part 1 of Tables 9 and 10 are consistent with those obtained earlier. That is, firms operating in a financially constrained regime display higher sensitivities to the availability of internal funds, expressed as a higher coefficient of lagged cash flow and significant coefficients of financial slack variables. Furthermore, firms operating in the unconstrained regime are more responsive to future growth opportunities. These results are robust to the sample used and do not seem to display any systematic bias,

i.e., the change in the magnitude of coefficients when estimation is performed using different samples is not unidirectional.

An advantage of using the switching regression approach is that it allows us to calculate the probabilities that firms will operate in one or the other regime. In Table 11 and Table 12 we report the probabilities that firms belonging to different ownership groups operate in the financially constrained regime for the unbalanced and balanced panel, respectively. Several important facts emerge from these tables. First, the probabilities of being financially constrained are quite high and seem to be rather stable over time. Second, consistent with the finding that the identity of owners matters with respect to access to finance, there are substantial differences in the probabilities across ownership groups. Third, firms under foreign ownership face the lowest probability of being financially constrained. This is consistent with the argument that foreign owners either have access to alternative capital markets or manage to crowd out domestic demand for capital. Discriminating between these hypotheses, however, requires data on the sources of finance, which we do not possess. Finally, consistent with the results of the extended switching function, insider owned firms face a higher probability of being financially constrained than private outsider owned firms. This is especially the case for the balanced panel where both manager and employee owned firms face a higher probability of being financially constrained than foreign and domestic outsider owned firms. In order to check the statistical significance of these differences we perform mean difference tests, not reported here, for each pair of ownership groups for every year. In no case are we able to accept the null that insider and private outsider owned firms have equal probabilities of being financially constrained.

5. Conclusions

In this paper we analyze the investment behavior and the determinants of financial constraints for a panel of Estonian companies during 1993 through 1999. The use of a switching regression framework when sample separation is unknown and endogenous represents the first application of this approach when studying investment behavior in a transition economy. The major benefit of using this approach is that it eliminates the bias generated from misclassification when a single classification criterion is used to partition the sample. Furthermore, our findings provide further evidence on the performance of the accelerator/neoclassical model of investment behavior, as well as fresh evidence for

hypotheses concerning the impact of a firm's ownership structure and the degree of informational asymmetries and agency costs on the determination of investment. Finally, our approach allows us to calculate the probabilities that firms with different ownership structures will operate in the financially constrained regime at a particular time, and to analyze changes in these probabilities as transition proceeds.

In the model, firms are assumed to be operating in either the financially constrained or unconstrained regime. The regime in which a firm operates at a given time is not known beforehand, and is endogenously determined by a selection equation. This is modeled to be a function of three key balance sheet variables (the debt to capital ratio, the interest coverage to sales ratio and the liquidity to capital ratio), as well as three variables that proxy the degree of asymmetric information and agency problems (the percentage of shares owned by the largest owner, firm age and firm size.) In addition, our approach allows us to take account of the fact that the effect of these variables on the probability of a firm operating in the constrained regime would be strongly moderated if firms would enjoy easy access to capital in the form of soft loans, overdue payments to suppliers, tax arrears and/or straightforward budgetary subsidies.

Our findings confirm the existence of two separate investment regimes for financially constrained and unconstrained firms. Furthermore, to explain the investment behavior of firms our preferred specification is not the basic accelerator/neoclassical model of investment, but rather such a model that is augmented with financial variables to approximate financing constraints. The results confirm the hypothesis that financially constrained firms are sensitive to the availability of internal finance, while financially non-constrained firms are more responsive to future growth opportunities. The sign and magnitude of these results are often consistent with the existing findings in the literature, both for advanced market as well as transition economies. Yet, our interpretation of certain coefficients is sometimes different. For example, we have allowed the coefficients on cash flow variables to capture future profit prospects besides access to finance. Under this assumption a significant coefficient of cash flow for the financially unconstrained firms captures investment sensitivity to future prospects and the difference in coefficients between financially constrained and unconstrained firms captures sensitivity to access to finance. Then, we focus on the difference of cash flow coefficients between financially constrained and unconstrained firms as an indicator of financing constraints. The importance of internal funds in investment decisions for financially constrained firms is further corroborated by the significance of variables that measure financial slack, included to measure only the availability of internal finance. These findings

support the claim of Calvo and Coricelli (1994) that investment behavior of firms in transition economies is consistent with a financing hierarchy theory.

With respect to the likelihood of firms being financially constrained or not, our findings point to the importance of the firm's balance sheet position, as well as to variables that proxy the severity of information asymmetry and agency costs. In general, our results indicate that firms with a weak balance sheet position and those facing more severe asymmetric information and agency costs problems are more likely to operate in the financially constrained regime. More specifically, a higher ratio of debt to capital, a bigger ratio of interest coverage to sales, and a lower liquidity to capital ratio increase the probability of a firm being financially constrained. This probability is also higher for newly privatized and smaller firms, as well as for those in which ownership is concentrated in the hands of insiders and the state. We also find that the existence of soft budget constraints lowers the probability of a firm being financially constrained. When the actual probabilities of operating in the financially constrained regime are calculated, it is found that they are quite high and basically stable during the whole period. Overall, the analysis has shown the importance of different capital market imperfections in firms' investment decisions.

The conclusions point to the importance of ownership configurations for both investment behavior and the likelihood of facing financial constraints. As expected firms whose ownership structures are dominated by insiders face a higher probability of being financially constrained and display a higher sensitivity to availability of internal finance. Moreover, ownership structure affects investment beyond its indirect effects through financial constraints, reflecting factors such as owners' preferences and goals in allocating the funds. Allowing us to distinguish between these differential effects of ownership structures on investment adds further weight to the appropriateness of this approach.

Table 1. Financial Institution Indicators[a]

Indicators	1993	1994	1995	1996	1997	1998	1999	2000
Number of Banks Operating in Estonia	21	22	18	15	12	6	7	7
Number of Foreign-Owned Banks	1	1	4	3	3	2	2	4
Share of Bank Assets Owned by the State	25.7	28.1	9.7	6.6	0.0	7.8	7.9	0.0
Non-performing Loans (as % of Total Loans)	n.a.	3.5	2.4	2.0	2.1	4.0	2.9	1.5
Credit to Private Sector (as % of GDP)	11.1	13.4	14.7	19.2	26.4	25.2	25.9	25.9
Stock Market Capitalization (as % of GDP)	n.a.	n.a.	n.a.	16.7	24.7	9.4	36.6	35.2
Net Foreign Direct Investment (in millions of USD)	156	212	199	111	130	574	222	324

[a] The source of the data is the EBRD Transition Report 2001.

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Table 2. Variable Definitions

Variable	Definition
Investment	The sum of investments in reconstruction, expansion and acquisition of buildings, in constructions of new buildings and other business related projects, in buying new machinery, equipment and means of transportation and in buying and improving land.
Capital	The book value of non-current tangible assets. It is calculated as the average of the value of these assets at the beginning and at the end of the year.
Employment	The average number of employees per year. The study has excluded all firms with fewer than 10 employees.
Labor Cost	The sum of wage and salaries in a given year.
Average Wage	The ratio of labor cost to average employment in a given year.
Sales	Net sales per year as stated in firm's income statement.
Profit	Net profit per year as stated in firm's income statement. This is profit left after all taxes are paid.
Cash Flow	The sum of depreciation allowances and net profit.
Value Added	Two definitions of value added are adopted. The first is the sum of depreciation allowances, net profit, labor cost and expenditures for social tax and health insurance. The second includes all these variables as well as financial costs.
Debt	The sum of short-term loans.
Current Liabilities	The sum of short-term loans and payables to suppliers and or customers.
Total Liabilities	The sum of short and long-term loans and other short and long-term liabilities.
Short-Term Assets	The sum of cash, short-term receivables and short-term securities.
Financial Cost	The net of financial income accrued and financial cost incurred during a given year.
Extra Revenue	Revenue obtained from sale of non-current tangible assets over a given period.
Industry Groups	7 broad industry groups were defined as follows: 1. Agriculture and fishing. 2. Mining, food products, textile and leather. 3. Wood products, paper products, coke, petroleum, chemicals, rubber, plastic, non-metallic, basic metals and machinery and equipment production. 4. Electrical, optical and transport equipment production. 5. Energy and construction. 6. Wholesale and retail trade. 7. Transport.
Size Groups	Firms are divided into three size groups according to their average employment. The first group includes firms with 49 or fewer employees, the second includes the firms with more than 49 employees and fewer than 101, and the third group includes firms with more than 101 employees.
Ownership Groups	6 ownership groups are defined as follows: state, foreign, institutional domestic outsiders, former employees, incumbent employees and managers.
Ownership Categories	Ownership categories are defined according to dominant ownership as follows: A firm is considered to be dominantly owned by the owner who holds the largest share.
Ownership Share	The share owned by the respective ownership group.

Table 3. Ownership Distribution over Time according to Dominant Owner[1]

Year / Ownership Group	1993	1994	1995	1996	1997	1998	1999	Total
Domestic Outsiders	81	94	97	110	95	90	119	686
Employees	48	54	47	41	27	26	29	272
Former Employees	0	0	11	14	19	15	16	75
Foreign	42	60	63	68	67	59	72	431
Managers	45	53	65	76	81	71	84	475
State	228	181	262	204	172	123	6	1,176
No Answer	54	56		1	19	18	31	179
Total	498	498	545	514	480	402	357	3294

[1]A firm is considered to be dominantly owned by the owner who holds the largest share.

Table 4. Number of Firms by Ownership Group and Size according to Dominant Owner[1]

Firm Size / Ownership Form	Small Firms	Medium Firms	Large Firms	Total
Domestic Outsiders	254	141	291	686
Employee	132	55	85	272
Former Employees	41	16	18	75
Foreign	209	109	113	431
Manager	276	128	71	475
State	400	252	524	1176
No Answer	90	40	49	179
Total	1402	741	1151	3294

[1] A firm is considered to be dominantly owned by the owner who holds the largest share.

Table 5. Means and Standard Deviations of Principal Variables over Time

Year / **Variables**[1]	1993	1994	1995	1996	1997	1998	1999	Obs.[2]
Investment	2150 (12363)	2245 (18844)	3371 (22029)	3007 (17249)	2634 (15504)	3407 (14019)	4547 (19549)	3283
Capital	12250 (51023)	9740 (48137)	9771 (45305)	10329 (47218)	10411 (47756)	11200 (49623)	16816 (43022)	3294
Sales	21773 (63301)	21502 (61562)	30377 (93119)	24269 (69179)	27573 (77562)	27989 (63535)	32816 (88789)	3294
Employment[3]	196 (414)	166 (340)	164 (388)	161 (393)	157 (276)	137 (282)	124 (228)	3294
Real Wage[4]	14.42 (17.11)	16.46 (10.91)	13.31 (7.73)	21.04 (30.59)	21.92 (17.28)	22.96 (14.63)	28.37 (18.33)	3294
Cash Flow	805 (7530)	649 (8801)	1103 (10008)	658 (12607)	1678 (14428)	1994 (18195)	2932 (17328)	3294
Debt	867 (2692)	891 (4112)	1389 (3974)	1701 (4007)	1717 (3664)	2276 (3885)	2962 (4127)	3294
Current Payables	5516 (23301)	4848 (21130)	3804 (11895)	4334 (12503)	4363 (10672)	4605 (12843)	5445 (15750)	3294
Long-Term Liabilities	2595 (14961)	2702 (19652)	3143 (12450)	3433 (12048)	3820 (13874)	4469 (12052)	6863 (16384)	3294

[1]All the variables except employment are expressed in thousands of Estonian kroons in 1993 prices.
[2]This number is the sum over the whole sample with non-missing values for the respective variable.
[3]Average number of employees in a given year.
[4]Real average wage per employee.

Table 6.1 Share of Investment Financed Through Internal Funds over Time according to Dominant Owner[1]

Year / Ownership Group	1993	1994	1995	1996	1997	1998	1999
Domestic Outsider	0.94	0.85	0.95	0.88	0.94	0.94	0.99
Employee	0.73	0.60	0.98	0.97	0.94	0.92	1.00
Former Employee			1.00	1.00	1.00	0.91	0.92
Foreign	0.76	0.63	0.91	0.94	0.84	0.88	0.86
Manager	0.90	0.82	0.93	0.92	0.95	0.96	0.96
State	0.89	0.86	0.94	0.94	0.96	0.96	1.00

[1] A firm is considered to be dominantly owned by the owner who holds the largest share.

Table 6.2 Share of Investment Financed Through Loans over Time according to Dominant Owner[1]

Year / Ownership Group	1993	1994	1995	1996	1997	1998	1999
Domestic Outsider	0.06	0.15	0.05	0.11	0.06	0.03	0.01
Employee	0.16	0.31	0.02	0.03	0.06	0.08	0.00
Former Employee			0.00	0.00	0.00	0.09	0.08
Foreign	0.06	0.22	0.02	0.00	0.07	0.04	0.08
Manager	0.00	0.10	0.07	0.04	0.02	0.03	0.01
State	0.05	0.04	0.03	0.04	0.02	0.04	0.00

[1] A firm is considered to be dominantly owned by the owner who holds the largest share.

Table 7. Coefficient Estimates for Two-Component Investment Regression and Switching Equation Using the Unbalanced Sample and the Restricted Version of the Switching Equation[1]

Unbalanced Panel						
Part 1						
Investment Equation[2]	Lagged Sales	Twice Lagged Sales	Lagged Cash Flow	Twice Lagged Cash Flow	Lagged Financial Slack	Twice Lagged Financial Slack
Constrained Regime	0,053*** (1,32)	0,013* (21,06)	0,009** (2,22)	0,016*** (1,55)	0,079* (19,46)	0,062* (8,37)
Unconstrained Regime	0,124* (18,39)	0,058* (9,19)	0,001** (1,69)	0,0012 (0,72)	0,021 (1,14)	0,00001 (0,09)
Part 2						
Switching Equation[3]	Debt-to-Capital Ratio	Liquidity-to-Capital Ratio	Int. Coverage-to-Sales Ratio			
Coefficient Estimates	0,092** (2,08)	-0,0033* (-9,36)	0,0012 (0,79)			

[1] * - significant at the 1% confidence level, ** - significant at the 5% confidence level, *** - significant at the 10% confidence level. Numbers in parentheses are *t*-statistics of coefficient estimates.

[2] The dependent variable is investment in fixed capital divided by lagged capital stock. The right hand side variables presented are also divided by lagged capital stock. Each estimated investment equation also includes a constant, time and industry dummies as well as the inverse of Mill's ratio to account for selection bias.

[3] The dependent variable is an indicator taking a value of 1 for firms classified as financially constrained and 0 for those classified as not financially constrained. The right hand side variables, other than time and industry dummies, enter in first lags.

Table 8. Coefficient Estimates for Two-Component Investment Regression and Switching Equation Using the Balanced Sample and the Restricted Version of the Switching Equation[1]

Balanced Panel						
Part 1						
Investment Equation[2]	Lagged Sales	Twice Lagged Sales	Lagged Cash Flow	Twice Lagged Cash Flow	Lagged Financial Slack	Twice Lagged Financial Slack
Constrained Regime	0,041** (2,12)	0,004*** (1,91)	0,021* (6,14)	0,012* (4,29)	0,032* (12,57)	0,047* (21,22)
Unconstrained Regime	0,147* (11,97)	0,049* (7,26)	0,003*** (1,34)	0,009 (0,09)	0,007 (0,29)	0,006 (1,19)
Part 2						
Switching Equation[3]	Debt-to-Capital Ratio	Liquidity-to-Capital Ratio	Int. Coverage-to-Sales Ratio			
Coefficient Estimates	0,054 (1,26)	-0,0031* (-12,36)	0,076* (9,71)			

[1] * - significant at the 1% confidence level, ** - significant at the 5% confidence level, *** - significant at the 10% confidence level. Numbers in parentheses are *t*-statistics of coefficient estimates.

[2] The dependent variable is investment in fixed capital divided by lagged capital stock. The right hand side variables presented are also divided by lagged capital stock. Each estimated investment equation also includes a constant and time and industry dummies.

[3] The dependent variable is an indicator taking a value of 1 for firms classified as financially constrained and 0 for those classified as not financially constrained. The right hand side variables, other than time and industry dummies, enter in first lags.

Table 9. Coefficient Estimates for Two-Component Investment Regression and Switching Equation Using the Unbalanced Sample and the Extended Version of the Switching Equation[1]

Unbalanced Panel						
Part 1						
Investment Equation[2]	Lagged Sales	Twice Lagged Sales	Lagged Cash Flow	Twice Lagged Cash Flow	Lagged Financial Slack	Twice Lagged Financial Slack
Constrained Regime	0,012* (19,12)	0,010* (15,06)	0,015* (12,98)	0,012** (1,79)	0,051* (7,74)	0,012** (2,12)
Unconstrained Regime	0,097* (7,42)	0,059*** (1,29)	0,004** (2,19)	0,001 (0,98)	0,01 (0,21)	0,0005 (1,23)
Part 2						
Switching Equation[3]	Debt-to-Capital Ratio	Liquidity-to-Capital Ratio	Int. Coverage-to-Sales Ratio	Size	Age	SBC
Coefficient Estimates	0,019* (9,87)	-0,003* (-4,42)	0,087*** (1,87)	-0,039* (-12,47)	-0,103 (1,42)	-0,029** (-2,53)
	Largest Share	Largest Share*Dom	Largest Share*For	Largest Share*Man	Largest Share*Emp	Largest Share*ForEmp
Coefficient Estimates cont'	0,025* (3,88)	0,057 (0,45)	0,032 (0,98)	-0,029 (-1,25)	0,012* (13,25)	0.001 (0,39)

[1] * - significant at the 1% confidence level, ** - the significant at 5% confidence level, *** - significant at the 10% confidence level. Numbers in parentheses are *t*-statistics of coefficient estimates.

[2] The dependent variable is investment in fixed capital divided by lagged capital stock. The right hand side variables presented are also divided by lagged capital stock. Each estimated investment equation also includes a constant, time and industry dummies as well as the inverse of Mill's ratio to account for selection bias.

[3] The dependent variable is an indicator taking a value of 1 for firms classified as financially constrained and 0 for those classified as not financially constrained. The right hand side variables, other than time and industry dummies, enter in first lags.

Table 10. Coefficient Estimates for Two-Component Investment Regression and Switching Equation Using the Balanced Sample and the Extended Version of the Switching Equation[1]

Balanced Panel						
Part 1						
Investment Equation	Lagged Sales	Twice Lagged Sales	Lagged Cash Flow	Twice Lagged Cash Flow	Lagged Financial Slack	Twice Lagged Financial Slack
Constrained Regime	0,018** (1,87)	0,003* (10,94)	0,021* (9,08)	0,015** (2,02)	0,038* (11,35)	0,027* (5,23)
Unconstrained Regime	0,092* (5,48)	0,009 (1,19)	0,002*** (1,41)	0,013 (0,79)	0,013 (1,19)	0,0019 (0,99)
Part 2						
Switching Equation[3]	Debt-to-Capital Ratio	Liquidity-to-Capital Ratio	Int. Coverage-to-Sales Ratio	Size	Age	SBC
Coefficient Estimates	0,035* (7,42)	-0,012* (-6,26)	0,013 (0,97)	-0,105* (-4,23)	-0,058* (7,46)	-0,136* (-5,27)
	Largest Share	Largest Share*Dom	Largest Share*For	Largest Share*Man	Largest Share*Emp	Largest Share*ForEmp
Coefficient Estimates cont'	0,082* (7,84)	-0,008* (-4,72)	-0,021* (3,38)	0,083* (12,07)	0,073* (9,83)	0.0007 (1,07)

[1] * - significant at the 1% confidence level, ** - significant at the 5% confidence level, *** - significant at the 10% confidence level. Numbers in parentheses are *t*-statistics of coefficient estimates.

[2] The dependent variable is investment in fixed capital divided by lagged capital stock. The right hand side variables presented are also divided by lagged capital stock. Each estimated investment equation also includes a constant and time and industry dummies.

[3] The dependent variable is an indicator taking a value of 1 for firms classified as financially constrained and 0 for those classified as not financially constrained. The right hand side variables, other than time and industry dummies, enter in first lags.

Table 11. The Average Probability of Being in the Financially Constrained Regime over Time and across Ownership Groups for the Unbalanced Sample

Ownership Group Year	State	Foreign	Domestic	Manager	Employee
1995	0,592	0,378	0,487	0,436	0,587
1996	0,512	0,334	0,453	0,477	0,563
1997	0,535	0,321	0,458	0,448	0,572
1998	0,561	0,319	0,478	0,459	0,559
1999	0,589	0,401	0,526	0,497	0,577

Table 12. The Average Probability of Being in the Financially Constrained Regime over Time and across Ownership Groups for the Balanced Sample

Ownership Group Year	State	Foreign	Domestic	Manager	Employee
1995	0,537	0,328	0,438	0,498	0,542
1996	0,518	0,309	0,429	0,504	0,505
1997	0,526	0,298	0,431	0,510	0,512
1998	0,545	0,310	0,459	0,487	0,539
1999	0,558	0,346	0,477	0,500	0,572

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APPENDIX

In this appendix we present the derivation of equation (10) in the text from both the accelerator and neoclassical models. Starting with the flexible accelerator model, as developed by Chenery (1952) and Koyck (1954), it is assumed that each period the firm closes a proportion of the gap between the desired capital stock and actual capital stock as follows:

$$K_t - K_{t-1} = \lambda \cdot \left(K_t^* - K_{t-1}\right), \tag{1}$$

where K_t^* denotes the desired capital stock at time t. As the desired capital stock is unobserved it is assumed to be a function of output as follows:

$$K_t^* = \beta \cdot Y_t . \tag{2}$$

Substituting the desired capital stock equation into the capital accumulation equation and re-arranging the following is obtained:

$$K_t = \lambda \cdot \beta \cdot Y_t + \left(1 - \lambda\right) \cdot K_{t-1} . \tag{3}$$

Substituting equation (3) into the capital accumulation constraint $K_t = \left(1 - \delta\right) \cdot K_{t-1} + I_t$ and re-arranging the terms the following expression for gross investments results:

$$I_t = \lambda \cdot \beta \cdot Y_t + \left(\delta - \lambda\right) \cdot K_{t-1} . \tag{4}$$

Dividing both sides of equation (4) by K_{t-1} and assuming that the adjustment process follows a distributed lag pattern with lags declining over time the final investment equation is obtained:

$$\frac{I_t}{K_{t-1}} = \alpha + \sum_{s=1}^{N} \lambda \cdot \beta \cdot \frac{Y_{t-s}}{K_{t-1}} + \varepsilon_t \ . \tag{5}$$

A similar equation as (5) is obtained from a neoclassical model of investment demand as developed by Jorgensson (1963). In this set-up firms maximize a profit function subject to a neoclassical production function. They determine the desired level of capital by equating the marginal product of capital with its user cost. Assuming a Cobb-Douglas technology of the form $Y_t = K_t^{\eta} \cdot L_t^{1-\eta}$, the first order condition with respect to capital after re-arrangement becomes:

$$\eta \cdot \frac{Y_t}{K_t} = \frac{c_t}{p_t}, \tag{6}$$

where c_t is the user cost of capital and p_t is the output price. From equation (6) the desired level of capital is then derived as:

$$K_t^* = \eta \cdot \frac{p_t}{c_t} \cdot Y_t . \tag{7}$$

The movement of capital towards its desired level again is assumed to happen through a rational distributed lag function. This will give rise to the following investment equation:

$$\frac{I_t}{K_{t-1}} = \gamma + \sum_{s=1}^{N} \eta \cdot \frac{p_t}{c_t} \cdot \frac{Y_{t-s}}{K_{t-1}} + \varepsilon_t . \tag{8}$$

Both equations (5) and (8) can be embedded in a single equation like equation (10) in the text.

Ownership Structures and Capital Constraints: An Empirical Investigation of the Credit Rationing Hypothesis in Privately Held Firms Using the Error Correction Specification

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Abstract

Economic theory argues at length that limited access to capital is one of the main obstacles to insider owned firm creation. As insider owners, especially non-managerial employees, are generally not wealthy they would rely on external financing in securing the needed capital. However, a combination of the structure of property rights, asymmetric information and moral hazard result in a higher cost of capital and, consequently, credit rationing for these firms. In this paper, new and rich panel data for a large and representative sample of privately held Estonian firms are used to estimate the sensitivity of access to capital to differing ownership structures. The System GMM estimates confirm the importance of financial factors in determining investment rates and suggest that firms owned by insiders, especially non-managerial employees, are more prone to be liquidity constrained than are others.

Keywords: Corporate Investment, Corporate Governance, Adjustment Costs, Liquidity Constraints, Error Correction, System GMM.
JEL Classification: C33, D21, D92, E22, G32, J54, P34.

1. Introduction

Economic theory argues at length that a firm's ownership structure is an important determinant of its access to finance and cost of capital. Notably, it is believed that limited access to capital is one of the main obstacles to insider owned firm creation, as stressed for instance by Dreze (1993), Putterman (1993), Bowles and Gintis (1996) and Dow (2003), and, as such, it is hypothesized that these firms would arise in industries where capital requirements per worker would be low. The argument goes that, as insider owners, especially non-managerial employees, are generally not wealthy they would rely on external financing in securing the needed capital. However, a combination of the structure of property rights, asymmetric information and moral hazard result in a higher cost of capital and, consequently, credit rationing for these firms. The outcome of this phenomenon is that investment rates across firms of differing ownership structures would be differently affected by the availability of internal finance.

In this paper, the credit rationing hypothesis is investigated in an error correction model framework using new and rich panel data for a large and representative sample of privately held Estonian firms. The paper is organized as follows: in the next section the model to be empirically estimated is outlined and the estimation strategy discussed, in Section 3 the sample used in the estimation is described and summary statistics of key variables are presented, in Section 4 estimation results are reported and discussed and in the last section conclusions are drawn and some policy recommendations are outlined.

2. Error Correction Model Specification

One increasingly common approach in analyzing the determinants of investment rates is the estimation of structural investment equations in the presence of symmetric, quadratic adjustment costs. The empirical performance of this approach, however, has not been highly satisfactory. Estimates obtained from such studies have produced implausible values for structural parameters and too-high adjustment cost parameters. Furthermore, the over-identifying restrictions used to test for model mis-specification have frequently been rejected. Given that the assumption of symmetric, quadratic adjustment costs is made more out of analytical convenience rather than empirical justification, it is the first one to come under

scrutiny. The first step in correcting for the mis-specification of the adjustment costs function has been to keep the symmetric and convex assumptions but relax its quadratic form in favor of a more general specification in the form of a power series, as, for instance, in the work of Whited (1998) and Chatelain and Teurlai (2001). This approach, however, has resulted in only minor improvements in parameter estimates and model specification. Consequently, an even more general adjustment costs function that could accommodate possible non-convexities is required.

A potential problem with estimating adjustment costs functions is the aggregation across capital goods at the plant level. Due to indivisibility[76] and/or irreversibility, different capital goods have adjustment costs components that are not strictly convex at the level of investment. These elements are blurred when aggregated accounting data are used. However, more disaggregated data at the plant level show that investment is "lumpy" pointing towards the existence of a fixed cost component of the adjustment costs function that is independent of the level of investment. For example, Doms and Dunne (1998), using U.S. manufacturing data, document that in more than 50% of their sample there exists a year when capital stock increases by 35%, and that investment spikes are usually observed in consecutive years. Similar evidence is provided in the work of Anti Nilsen and Schiantarelli (2000) for a sample of Norwegian firms. The authors show that in their sample zero investment phenomena occur in 21% of total observations for machinery and equipment and in 61% for buildings.

Several authors have tried to assess the existence and importance of non-convex components in adjustments costs functions. In a version of the Q model of investment, Barnett and Sakellaris (1998) find a non-linear relationship between average Q and investment rate. Caballero, Engel and Haltiwanger (1995) show that the probability of investment is related to the size of the gap between actual and desired capital stock. Cooper, Haltiwanger and Power (1999) and Anti Nilsen and Schiantarelli (2000) estimate hazard functions to estimate the probability of high investment conditional on the length of time from the last incidence of high investment. In both studies, positive slopes of the hazard functions are found that are supportive of the non-convexities in the adjustment costs function.

[76] See Nickell (1978) for a detailed discussion of this issue.

Although the above-mentioned studies suggest the existence of non-convex components in the adjustment costs function, due to its complex nature it is difficult to analytically characterize the adjustment process. This, however, does not mean that the adjustment costs can be assumed away and static models can be used to evaluate investment equations. It rather means that other dynamic specifications that are not derived as optimal responses to a given adjustment costs function could be employed in the analysis.[77] The interpretation of such models, as pointed out by Bond and Van Reenen (1999), is that they are an empirical approximation of a complex process that generated the data. A flexible dynamic model of this type is an error correction model (ECM) that in its most general form, can be represented as follows:

$$\alpha(L)\cdot\Delta X_t = \beta(L)\cdot\Delta X_t^* + \lambda\left(X_{t-s}^* - X_{t-s-1}\right), \qquad (1)$$

where $\alpha(L)$ and $\beta(L)$ are polynomials in the lag operator whose lengths will be chosen empirically, X_t is the variable of interest and X_t^* is its desired level. This specification stipulates that the change in the variable of interest depends not only on its target level, but also on the distance from the target. Nickell (1985) demonstrates that, as the presence of adjustment costs generates partial adjustment, error correction models of the type expressed in equation (1) provide an optimal representation of economic agents' behavior in a dynamic environment. Error correction models have been extensively used in economic literature, at least since the work of Davidson et al. (1978). For the first time they were introduced in the investment literature by Bean (1981) in his study of manufacturing investment in the UK. Other studies that have used this approach are Cuthbertson and Gasparro (1995), Bond, Harhoff and Van Reenen (1999), Carruth, Dickerson and Henley (2000) and Bloom, Bond and Van Reenen (2001).

Although error correction models seem to be the optimal solution for the estimation of economic models with complex underlying adjustment costs, they are not without problems. The most serious of these is that these models compound the adjustment costs parameters with those of the expectations formation process, leading to the potential instability of coefficients, and therefore become subject to the Lucas (1976) critique. In addition, it is often difficult to interpret whether certain variables are important structural determinants of the

[77] A typology of linear dynamic equations can be found in Chapter 7 of Hendry (1995).

model or simply convey information about the future values of the fundamentals that determine the variables of interest. This problem, however, is a general specification problem and arises also in the context of structural models.[78]

As error correction models are empirical generalizations of static factor demand equations, the starting point of the analysis is the derivation of the optimal demand for capital goods. Assuming that the firm employs a Cobb-Douglas technology of the form $Y_t = K_t^{\eta} \cdot L_t^{1-\eta}$, the desired level of capital, after re-arranging the first order condition with respect to capital, is determined by the following expression:

$$K_{i,t} = \eta \cdot \frac{P_{i,t}}{C_{i,t}} \cdot Y_{i,t} . \tag{2}$$

In this equation the desired level of capital stock is a function of output $Y_{i,t}$, output price $P_{i,t}$, share of capital in input mix η and the user cost of capital $C_{i,t}$. Taking the logarithm of this expression and denoting the logarithm of a variable with lower case letters, the desired level of capital can be expressed as follows:

$$k_{i,t} = \alpha + y_{i,t} - c_{i,t} . \tag{3}$$

A similar expression is also obtained if a Constant Elasticity of Substitution (CES) production function is assumed instead of a Cobb-Douglas one. Caballero, Engel and Haltiwagner (1995) derive the desired level of capital stock in the presence of the CES production function as follows:

$$k_{i,t} = \alpha + y_{i,t} - \sigma \cdot c_{i,t} , \tag{4}$$

where σ is the elasticity of substitution between capital and labor. In the absence of barriers to immediate adjustment, the capital stock would be always equal to its desired level. This is not the case however, and consequently, the actual capital stock will be different from the desired capital stock. Acknowledging the existence and the complex nature of adjustment

[78] See also a discussion in Bond and Van Reenen (1999).

barriers, it is assumed that equation (3) or (4) can be expressed as a general autoregressive distributed-lag (ADL) model and then the data are used to determine the relevant dynamics. For example, assuming an ADL (1,1) model, equation (3) becomes

$$k_{i,t} = \alpha_0 + \alpha_1 \cdot k_{i,t-1} + \alpha_2 \cdot y_{i,t} + \alpha_3 \cdot y_{i,t-1} + \alpha_4 \cdot c_{i,t} + \alpha_5 \cdot c_{i,t-1} + \varepsilon_{i,t}\,. \qquad (5)$$

In the long-run the actual values of all variables will be equal to their target levels. Then, from equation (5), it is seen that the long-run elasticity of capital with respect to output is $(\alpha_2 + \alpha_3)/(1-\alpha_1)$, while the long-run elasticity of capital with respect to its user cost is $(\alpha_4 + \alpha_5)/(1-\alpha_1)$.

In order to express equation (5) as an equilibrium correction model similar to equation (1), we use the fact that long-run elasticities of capital with respect to output and its user cost will be equal to unity.[79] Then, denoting the numerator and denominator of long-run elasticity expressions as equal to λ, equation (5) can be re-parameterized as follows:

$$k_{i,t} = \alpha_0 + (1-\lambda)\cdot k_{i,t-1} + \alpha_2 \cdot y_{i,t} + (\lambda - \alpha_2)\cdot y_{i,t-1} + \alpha_4 \cdot c_{i,t} + (\lambda - \alpha_4)\cdot c_{i,t-1} + \varepsilon_{i,t}\,. \qquad (6)$$

After some algebraic manipulations the following expression is obtained:

$$\Delta k_{i,t} = \alpha_0 + \alpha_2 \cdot \Delta y_{i,t} + \alpha_4 \cdot \Delta c_{i,t} + (1-\alpha_1)\cdot c_{i,t-1} + (1-\alpha_1)\cdot (k_{i,t-1} - y_{i,t-1}) + \varepsilon_{i,t}\,. \qquad (7)$$

Due to lack of data on the user cost of capital goods and problems associated with trying to construct a measure of it aggregating across capital goods, it is assumed here that its effect could be captured by the inclusion of firm- and time-specific variables in regression. Then equation (7) becomes:

$$\Delta k_{i,t} = \alpha_0 + \alpha_2 \cdot \Delta y_{i,t} + (1-\alpha_1)\cdot (k_{i,t-1} - y_{i,t-1}) + \tau_t + \mu_i + \varepsilon_{i,t}\,. \qquad (8)$$

In the above equation, the variable denoting the difference between the previous period log of capital and the previous period log of output is the equilibrium correction mechanism that

[79] This restriction could be tested by including an additional term in *y* in equation (5) and testing its significance.

captures departures from long-run equilibrium. In order to be consistent with error correction behavior the coefficient in front of this variable is expected to be negative. This means that when capital stock is above its desired level, it will result in lower future investment, while the opposite will happen when capital stock is below its desired level. A further assumption on equation (8) is required in order to make it a specification in investment rates rather than change in capital stock. As in Bond and Van Reenen (1999), it is assumed that $\Delta k_{i,t} = \left(I_{i,t} / K_{i,t-1}\right) - \delta_i$ with δ_i being the firm-specific depreciation rate, and whose effect could be captured in the firm-specific effects variable μ_i. Then, substituting for $\Delta k_{i,t}$ in equation (8), the specification to be used in the regression analysis is obtained as follows:

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha_0 + \alpha_2 \cdot \Delta y_{i,t} + \left(1-\alpha_1\right) \cdot \left(k_{i,t-1} - y_{i,t-1}\right) + \tau_t + \mu_i + \varepsilon_{i,t}. \qquad (9)$$

Finally, in order to account for the possible effect of financial constraints on a firm's investment decision, equation (9) is augmented with current and lagged values of several financial variables such as the ratio of cash flow to capital stock, the ratio of debt to capital stock, ownership variables, etc.

Equation (9) is derived under the assumption that the complex underlying adjustment process of capital accumulation could be approximated by an ADL (1,1) model. This assumption, however, might be too restrictive, i.e., it is possible that the adjustment process spreads longer over time, causing further lags of output and user cost of capital to influence capital accumulation. Accounting for this possibility, it is also assumed the adjustment process could be approximated by an ADL (2,2) model, in which case equation (3) for capital stock becomes:

$$k_{i,t} = \alpha_o + \alpha_1 \cdot k_{i,t-1} + \alpha_2 \cdot k_{i,t-2} + \alpha_3 \cdot y_{i,t} + \alpha_4 \cdot y_{i,t-1} + \alpha_5 \cdot y_{i,t-2} + \alpha_7 \cdot c_{i,t} + \alpha_8 \cdot c_{i,t-1} + \\ + \alpha_9 \cdot c_{i,t-2} + \varepsilon_{i,t}, \qquad (10)$$

where the long-run elasticities of capital stock with respect to output and user cost are equal to $\left(\alpha_3 + \alpha_4 + \alpha_5\right) / \left(1 - \alpha_1 - \alpha_2\right)$ and $\left(\alpha_7 + \alpha_8 + \alpha_9\right) / \left(1 - \alpha_1 - \alpha_2\right)$, respectively. Re-parameterizing equation (10), under the restriction that long-run elasticities are equal to unity and under the

assumption that the effect of the user cost of capital could be captured by time- and firm-specific variables, the following error correction specification results:

$$\Delta k_{i,t} = \alpha_o + (\alpha_1 - 1)\cdot \Delta k_{i,t-1} + \alpha_3 \cdot \Delta y_{i,t} + (\alpha_3 + \alpha_4)\cdot \Delta y_{i,t-1} - (1 - \alpha_1 - \alpha_2)\cdot (k_{i,t-2} - y_{i,t-2}) + \\ + [(1 - \alpha_1 - \alpha_2) - (\alpha_3 + \alpha_4 + \alpha_6)]\cdot y_{i,t-2} + \mu_i + \tau_t + \varepsilon_{i,t}\,. \qquad (11)$$

In this specification the restriction that the long-run elasticity of capital stock with respect to output is unity could be tested through the simple test of the coefficient in front of the second lagged value of output being equal to zero. Again, making the simplification $\Delta k_{i,t} = (I_{i,t}/K_{i,t-1}) - \delta_i$, the error correction specification of this ADL (2,2) model becomes:

$$\frac{I_{i,t}}{K_{i,t-1}} = \beta_o + \beta_1 \cdot \frac{I_{i,t-1}}{K_{i,t-2}} + \beta_2 \cdot \Delta y_{i,t} + \beta_3 \cdot \Delta y_{i,t-1} - \beta_4 \cdot (k_{i,t-2} - y_{i,t-2}) + \beta_5 \cdot y_{i,t-2} + \mu_i + \tau_t + \varepsilon_{i,t}\,. \qquad (12)$$

Equations (9) and (12) form the basis of the empirical analysis to be presented in Section 4. The aim of the analysis is twofold. On the one hand, we will identify the model that best approximates the underlying adjustment process, i.e., we will determine the relevance of an ADL (1,1) or an ADL (2,2) specification. On the other hand, we will ascertain the extent of financial constraints or credit rationing on firms' investment decisions. Attention, however, should be paid to the interpretation of financial variable coefficients. It would be tempting to interpret a significant coefficient of, let's say, cash flow as indicator of financial constraints. This, however, might not be the case. In the presence of adjustment costs the desired level of capital stock will depend not only on output and the user cost of capital, as shown in equations (3) and (4) above, but also on expectations of future realizations of output and prices. If these expectations depend also on financial variables, then financial variables will be significant in explaining investment even in the absence of financial constraints. Bearing this in mind, the approach followed in the literature[80] and also applied in this paper, is the comparison of financial variable coefficients across different sub-samples of firms.

[80] The literature on the effects of financial constraints on a firm's investment policies, which originates with the work of Fazzari, Hubbard and Petersen (1988), is extensive. A good review of its merits and drawbacks is Stein (2001).

Before closing this section a few words on the choice of the estimating method are necessary. The estimation of dynamic panel data models is customarily done using standard Generalized Method of Moments (GMM) techniques. These techniques are based on first differencing transformation in order to eliminate firm-specific effects and on the use of lagged values of variables as instruments.[81] However, Blundell and Bond (1998) show that in autoregressive models with short time series observations, the standard first-differenced estimator is subject to large finite sample biases due to weak instruments for first differences. Following Arellano and Bover (1995), they propose a system GMM estimator that includes both equations in levels and first differences. The equations in first differences are the standard ones used to eliminate firm-specific effects with two or more period lagged values of the endogenous variables used as instruments. These equations are then combined with equations in levels where firm-specific effects are present. Allowing for the levels of all variables to be correlated with firm-specific effects makes it impossible to use any variable in levels as an instrument for these equations. Blundell and Bond show, however, that in ADL-type models the first differences of the series are uncorrelated with firm-specific effects when these series are stationary.[82] This makes possible the use of lagged differences as instruments in the levels equations. Combining both of these sets of orthogonality restrictions, the system GMM estimator achieves improvements in terms of efficiency and precision with respect to the first-differenced GMM estimator. Based on this discussion in this paper we use the system GMM approach to obtain parameter estimates.

3. Firm Level Data Description

The empirical work in the paper is based on a large unbalanced representative panel of privately held Estonian firms over the period 1993 through 1999. The sample is created through a combination of data obtained from surveys and from standard firm financial statements reported to the Estonian Statistical Office. The aim of surveys is to obtain information on ownership configurations which is not available in standard financial statements. The firms included in the survey scheme are selected as a stratified random sample based on size and industrial affiliation. The survey information is then augmented

[81] See for example the discussion in Arellano and Bond (1991).

[82] In a transition economy, the assumption of stationary series, especially in the early years of transition, is a strong one. If this assumption does not hold then the independence of first differences with firm-specific effects is violated and, as such, first differences cannot be used as valid instruments. In the empirical work, we test the validity of instruments and, consequently, the validity of the assumption of the independence of first differences and firm-specific effects.

with financial information from balance sheet and income statements, such as current and fixed assets, current and long-term liabilities, equity, sales, expenditures, wages and salaries, inventories, gross and net profit, R&D expenditure, expenditure on capital goods, investment, etc. The merging of all this information creates an unbalanced panel data set with missing observations to be used in the analysis. The first step in the analysis is a check against errors and inconsistencies generated in the data collecting and reporting process. Examples of such errors are firms reporting zero labor force or capital or sales, or reporting ownership shares whose sum is lower or higher than 100. Consequently, prior to using the data set, the check is performed using the following seven criteria:

- The firm's capital at the beginning and the end of the period should be positive.
- Investment should be non-negative.
- Investment should be smaller than end-of-period capital stock.
- Sales should be positive.
- The average employment per year should be positive and equal to or greater than 10.
- Labor cost in a given year should be positive.
- Ownership shares should add up to 100.

The application of these criteria led to a drop of about 21 percent of observations, leaving 3833 observations over 1993 through 1999. More specifically, applying the first criterion led to 36 firms being dropped in 1993, 35 in 1994, 40 in 1995, 28 in 1996, 45 in 1997, 13 in 1998 and 60 in 1999. Furthermore, 121 observations were the deleted due to negative investment,[83] 335 due to having employment less than 10,[84] 12 due to zero labor cost, 16 due to zero net sales and 6 due to having investment larger than capital at the end of the period. Finally, an additional 315 observations belonging to firms in real estate, education, health and public administration industrial branches, were dropped from the analysis. The final sample then includes a total of 3294 observations broken down as follows: 498 observations in 1993, 498 in 1994, 545 in 1995, 514 in 1996, 480 in 1997, 402 in 1998 and 357 in 1999. The list of variables to be used in the analysis and their respective definitions are given in Table 1.

[83] Negative investment or dis-investment is the outcome of the strategic restructuring of a firm that leads to downsizing or the elimination of unproductive assets. While processes and determinants of dis-investment are of interest in themselves, they are not the focus of this study and as such the respective observations, about 3% of the sample, are dropped from the analysis.

[84] A firm is dropped from the analysis if it shows having employment of less than 10 in any given year. For instance, if a firm has 8 employees in 1995 but more than 10 in all other years it is dropped from the sample in all years.

Throughout the paper, investment is defined as the sum of investments in reconstruction, the expansion and acquisition of buildings, the construction of new buildings and other business related projects, buying new machinery, equipment and means of transportation and buying and improving land.[85]

In order to account for the non-smoothness of investment rates across firms in Figure 1 we present the distribution of investment rates for the whole sample. As is clear from the figure the distribution is highly skewed to the left with a long right-hand tail. Interestingly, the number of observations for which investment is either zero or 1% of existing capital represents 14% of the total number of observations. From these firms, 10.3% refrain from making any investment at all, and 3.7% invest positive amounts but no more than 1% of existing capital stock. The existence of zero investment rates is consistent with the irreversibility or the fixed components of the adjustment cost hypothesis. Another interesting finding from the inspection of investment rates is that small investment rates are quite frequent. For instance, in approximately 21% of observations firms invest slightly more than zero and up to 0.08 of existing capital stock. Assuming a depreciation rate of 8%, this level of investment can easily be considered as replacement investment. One potential explanation for this phenomenon could be that the adjustment costs associated with replacement investment are small but increase substantially when firms engage in expansion investment. Alternatively, Anti Nilsen and Schiantarelli (2000) suggest that the incidence of small investment could be a result of the fact that time to build and the distribution of delivery dates characterizes many investment projects that span more than one calendar year.

Finally, we analyzed the incidence of zero and small investment across firms of different size, defined in Table 1. Curiously, almost 78% of zero investment observations belonged to small firms, with only 6% of observations belonging to large firms. On the other hand, small investment occurrences were more evenly distributed across size groups, with 35% belonging to small firms, 26% belonging to medium firms and 39% belonging to large firms. These findings provide support to the conjecture that fixed adjustment costs are more important to small firms than to large ones.

[85] It would have been preferable to separate the investment in machinery and equipment from those in building and land. This, however, was not possible due to data unavailability.

Another element of the non-smoothness of investment rates across firms is lumpiness or the fact that investment rates are not similar across years. That is, over time investment seems to be happening discontinuously. In order to account for this we calculate, only for those firms that are present in the sample over the whole period, the share that investment in one year represents of the total investments over the 7-year period. The results show that while for large firms investment is more or less evenly spread out over time, for small firms investment can be characterized as lumpy. For instance, for small firms investment in two consecutive periods accounts for almost 65% of the total 7-year period investment. The large number of firms with a small investment and the lumpiness of investment for small firms constitute evidence of non-linearities in investment that needs to be taken into account in empirical work.

Table 2 provides information on the distribution at a given point in time and the evolution over time of the number of firms that fall in a given ownership category using the dominant ownership classification as defined in Table 1. Focusing on the 1995 sample, in more than 22% of cases, insiders, i.e., employees and managers, or former insiders were dominant owners. This provides evidence of the importance of insider ownership during the early years of transition. Determining whether this is the outcome of the privatization process or of the entrepreneurial spirit that leads insiders to establish their own companies requires data on the origins of the firms. From the respondents' replies a lot of firms show up as being new. Yet, this might partly be due to the fact that insiders established a company that took over the assets of a former state-owned enterprise. In this case, it would be a mistake to classify the firm as new. Unfortunately, the data do not allow discriminating between these cases. Furthermore, it should be mentioned that the spread of insider ownership was not the outcome of a political process that resulted in widespread support for insider ownership. It arose mainly due to the lack of feasible alternatives and well-defined privatization policies at the time. Foreign-owned companies comprised around 12% of the sample, with most of them being new companies established as joint ventures in the early 1990s, while "real" domestic outsider owned firms comprise around 18% of the sample. Finally, state-owned firms comprised around 48% of the sample, with 232 firms being 100% in state ownership while 30 firms were mostly in private hands but with the state still holding the dominant position.[86] It

[86] If the focus of the analysis had been simply the effect of private ownership versus state ownership these firms would have been classified as private. As the identity of private owners, however, matters in explaining differences in observed behavior, these firms end up being classified as state owned.

would be interesting to compare this ownership distribution with the economy-wide one prevailing in Estonia in 1995. This is, unfortunately, not possible because official data from statistical yearbooks do not provide a detailed classification of ownership shares held by different owners as defined above. Furthermore, although the official data distinguish between state, foreign and private firms, it is not clear which definition is used to classify firms in a given group. For example, the Estonia Statistical Yearbook (1995) states that, by the second half of 1995, 87% of enterprises in Estonia were private. It is highly likely that even enterprises with a small involvement of private capital are classified as private, leading to a potential overstatement of the true degree of private ownership.

As a final step in data description, we turn now to the variables of interest. Table 3 presents the summary statistics of the most relevant variables used in the analysis. The general facts that emerge from this table are that investment levels are high relative to capital stock, with investment/capital ratio ranging from 0.17 in 1993 to 0.34 in 1995, that average employment decreases while real wage increases over time, that cash flow is positive, that short-term debt increases over time and that cash flow and short-term debt are approximately of the same magnitude in all years but 1996. The increase in debt after 1995 is consistent with the general increase of lending to the private sector during this period in Estonia. Furthermore, up to 1997, the sum of cash flow and short-term debt is less than investment suggesting that firms might have had access to other sources of capital such as short-term trade credit and/or long-term debt.

This conjecture is supported by the last two rows of the table that show current payables and long-term liabilities, which include long-term loans as well as any other long-term debt a firm accumulates. The rate of growth of long-term liabilities is not high, except for the last year, suggesting that long-term liabilities do not constitute an important source of capital over the stated period. Current payables, however, are quite high and higher than investment over the whole period. Another important feature of Estonian firms during this period is that, on average, they have become more capital intensive as demonstrated by the increase in capital and decrease in employment.

The high mean of investment rates, combined with the high percentage of firms investing low rates, suggest that some firms experience investment rates at the range 0.6 through 1. One explanation of such rates could be that new owners inject high rates of capital in newly

privatized firms during the first year(s) of privatization. This argument is supported by the fact that 90% of high investment rates are found in non-state-owned firms and that such rates are recorded within the first three years of privatization. Another explanation of the high investment rates could be that the initial capital stock is highly understated. In this case, investment rates are grossly overstated and the results will be biased.

4. Estimation Results

In this section we report and discuss the estimation results which are obtained by the use of the system GMM estimator for dynamic panel data recently available in Stata 8. This estimator is an extension of the more standard Arellano-Bond GMM estimator as already explained in Section 2 above. The estimation results are reported in Table 4 and Table 5. The list of instruments used in estimation is detailed in the respective table notes. Furthermore, in the tables the p-values of the Sargan-Hansen statistics used to test the overidentifying restrictions and the p-values of the second order autocorrelation test are reported. Finally, a measure of goodness of fit is reported, which is the squared correlation between the predicted investment rates with the actual ones. Windmeijer (1995) shows that, in the framework of the instrumental variable regression, this measure is equivalent to the standard R^2 in OLS regressions.

In Table 4 we report the estimation of ADL (1,1) and ADL (2,2) specifications with and without financial variables for the whole sample. More specifically, Model 1 and Model 2 correspond to ADL (1,1) specifications with and without financial variables, respectively, while Model 3 and Model 4 correspond to ADL (2,2) specifications with and without financial variables, respectively. An inspection of the coefficients of sales growth across all specifications shows that they are all of the expected sign, i.e., positive, and significant at conventional significance levels. This variable is used as a proxy for a firm's own future growth opportunities and coefficient estimates corroborate that firms respond to better opportunities by increasing investment. Of more interest in these models is the coefficient of the error correction term, which determines the direction and speed of adjustment. As expected, the coefficient is negative across all specifications, although not always significant. The negative sign found here is in line with other similar studies such as Bond, Harhoff and Van Reenen (1999) and Bloom, Bond and Van Reenen (2001). The magnitude of the coefficient is, however, lower in this study than in the others. For instance, Bloom, Bond and

Van Reenen (2001) find that the speed of adjustment of UK companies is almost twice as large as the speed of adjustment indicated by our estimates.

The importance of Table 4 lies in that it allows us to discriminate between the optimality of ADL (1,1) versus ADL (2,2) specifications as well as between a specification augmented with financial variables versus one non augmented one, i.e., one without financial variables. Focusing on the first issue an ADL (2,2) specification would be the preferred one if the coefficients of lagged sales growth, twice lagged sales and lagged investment to capital ratio are individually and jointly significant. From the individual coefficients only the coefficient of twice lagged sales is positive and significant in both the augmented and non-augmented specifications. However, we were not able to reject the hypothesis that these coefficients are jointly insignificant. The p-values of the respective Wald tests are 0.316 for the non-augmented specification and 0.295 for the augmented specification. Based on these tests we keep the ADL (1,1) specification as the preferred one. Turning then to the second issue we perform similar tests on the joint significance of financial variables. Namely, we test whether the coefficients of cash flow to capital ratio, lagged cash flow to capital ratio, debt to capital ratio and lagged debt to capital ratio are jointly significant. The p-value of the Wald test is 0.037, which means that at the 5% significance level we are able to reject the hypothesis that these coefficients are jointly insignificant. Then a specification augmented with financial variables is superior to one in which these variables are left out.

Finally, we perform a series of diagnostic tests on the preferred specification, i.e., the one denoted by Model 2 in Table 4. The tests are satisfactory in that they confirm the nonexistence of a second order serial correlation in first-differenced residuals and confirm the validity of the instrument set. Furthermore, the goodness of fit measure shows that the explanatory power of the model is about 22%, which is not very high but in line with what other authors have found. For instance, Bloom, Bond and Van Reenen (2001), who use the same measure of goodness of fit, find that it ranges between about 26% and 31% across their different specifications.

Having selected the ADL (1,1) augmented with financial variables as the preferred specification, we now turn to the examination of the sensitivity of investment rates to a firm's access to capital and of the degree to which this sensitivity varies with firm ownership structure. In this analysis there are two issues that need to be addressed beforehand, namely,

the endogeneity of ownership structures and the interpretation of the coefficients of financial variables. In investigating the investment rate-ownership structure causality two approaches could be adopted. In the first approach the whole sample is pooled together and dummy variables, which take the value of one if a firm belongs to a given ownership and zero otherwise, are introduced. These dummies are then included in the regression with one of them left out to serve as a control group. Furthermore, all dummies are interacted with all other variables in the regression allowing not only the intercepts but also slopes to differ across groups. The coefficients in front of the ownership dummies and the respective interacted variables will then be interpreted as the marginal effects of a given ownership structure over the control group's ownership structure. A major problem in estimating such specifications with ownership variables as right-hand side variables is the endogeneity of ownership, i.e., in equilibrium different owners will determine their optimal ownership share based on various firm characteristics, among which is a firm's investment needs. A potential solution to the problem is the use of instrumental variables, i.e., the endogenous variables in the model, the ownership dummies in our case, that are instrumented with a set of variables that are correlated with them but not with the error term. There are, however, two problems with this method.

The first problem has to do with the quality of the instruments, while the second has to do with the functional form adopted. In general, finding appropriate instruments for ownership dummies is difficult. The literature concerning the determinants of ownership structures is large and it has identified several factors influencing the choice of optimal ownership shares, such as firm size, productivity, profitability, capital intensity, financing requirements or firm quality. In principle, all these variables could serve as instruments for the endogenous ownership dummies. The application of the instrumental variable approach requires all these instruments to be uncorrelated with the unobserved variables. In investment equations, however, all factors mentioned will be correlated with unobserved firm-specific shocks to investment and, as such, will still be correlated with the error terms. Then, the use of such bad instruments, as Angrist and Krueger (2001) point out, will still lead to biased parameter estimates.

Instead of using the potential instruments to substitute for the endogenous ownership dummies in the regression, a two-step procedure could be adopted. At the beginning, first-stage predicted probabilities of a firm being under a given ownership structure are generated

through the estimation of a probit or logit regression, and then in the second stage, these predicted probabilities are included in the main regression instead of the ownership dummies. While this approach sounds appealing, it has a drawback in that the use of nonlinear first stage predicted values in the second stage equation will not generate consistent estimates unless the nonlinear model happens to be specified exactly right, leading otherwise to misspecification bias.[87] However, getting the functional form of ownership equations right is not trivial. As mentioned above, financing requirements are one of the determinants of optimal ownership shares. What matters, however, for a forward-looking firm are not only current financing requirements but also future requirements. Assume, for instance, that two similar firms are randomly allocated to managers. In the process of financing restructuring both firms will have to raise capital, but one might need more funds than the other. If the manager of this firm expects that his/her credit constraint will be binding in the future, then he/she might decide to issue equity that will subsequently dilute his/her ownership share. A fully specified model of ownership determinants will have to contain measures of such future financing requirements.

Given the problems with the instrumental variable approach, the second approach in analyzing the effect of ownership structures on investment rates consists of the division of the sample into several sub-samples according to the ownership groups defined and the estimation of the relevant specifications for every sub-sample separately. This approach is adopted here by dividing the sample into five sub-samples as follows: state owned, domestic outsider owned, foreign owned, manager owned and employee owned firms. As the number of observations for former employee owned firms does not allow an independent analysis of this group, these firms are included in the employee owned firms group. In the interpretation of results we then focus on the differences in respective coefficients across ownership groups, which provide unbiased estimates of the true differences.

The other major problem in estimating investment equations augmented with financial variables is the ambiguous interpretation of the coefficient of the variable included to measure access to internal finance, i.e., cash flow in our model. As already emphasized above the cash flow variable could be capturing not only access to internal finance but also expectations on future demand realizations and consequently future investment opportunities. However,

[87] For a more detailed discussion of this point as well as of the dangers of the instrumental variables approach to estimation see Angrist and Krueger (2001).

assuming that measures of cash flow are equally correlated with future opportunities across all firm types in a given industry, then the differences in these coefficients are unbiased indicators of the differences in financing constraints. Moreover, assuming that from our firm types foreign owned firms are not subject to liquidity constraints either because they have alternative sources of funding from their parent companies (in case they are subsidiaries of foreign based multinationals or joint ventures with these multinationals) or because their foreign owners enjoy access to global capital markets,[88] then for these firms the coefficient of cash flow will capture only the information on future demand conditions. In turn, we expect that positive differences between the cash flow coefficients of other firm types and that of foreign owned firms provide evidence of the existence and degree of liquidity constraints across firms.

The estimation results of the ADL (1,1) specification augmented with the financial variables are reported in Table 5 for each of the firm types. The coefficients of sales growth are positive and significant, except in the case of employee owned firms, meaning that firms respond to better future opportunities by increasing investment rates. The error correction terms are also of the expected sign, although not always significant. Their magnitude, however, differs substantially across groups with manager owned firms displaying the highest speed of adjustment, while employee owned ones display the lowest. Differently, employee owned firms are more than five times slower than manager owned firms to react to departures from the long-run equilibrium.

We then consider the coefficients of financial variables and compare them across ownership groups. The first observation is that the coefficients of lagged financial variables (both cash flow and debt) are insignificant across all groups and this makes their interpretation impossible. Foreign owned firms display a positive and significant coefficient of cash flow, but an insignificant coefficient on debt. The significant cash flow coefficient indicates that this variable conveys important information on future demand conditions, which make the firm a favorable investment prospect. To the extent that these conditions are similar across firms in one industry we would expect that the coefficients of cash flow for all other firm

[88] If none of these assumptions hold then foreign owned firms will be competing with other domestic owned firm types for domestic funds. In that case funds allocation will be decided by a bank's risk assessment of individual firms, and foreign owned firms could also be subject to liquidity constraints. We, however, expect that the assumptions above hold and foreign owned firms can be considered as operating as not financially constrained in any sense.

types are also positive and significant. In fact, this is not the case with only the cash flow coefficients of manager and employee owned firms being positive and significant, while the cash flow coefficients of domestic outsider and state owned firms are positive but insignificant. For manager and employee owned firms, though not only these firms, the cash flow coefficients are positive and significant but also larger in absolute value than that of foreign owned firms, indicating that these firm types experience credit rationing. The degree of credit rationing is larger for employee owned firms than for manager owned ones. Further evidence of credit rationing comes from the inspection of the coefficients of debt variables. A negative and significant coefficient means that firms have reached their debt ceiling and further borrowing becomes too costly. From the table it is seen that only employee owned firms display a significant debt coefficient, suggesting that these firms face credit rationing in the loan market.

Diagnostic tests performed provide information on the validity of specifications. In no case are we able to reject instrument validity, tested through the Sargan-Hansen test, and only in the case of domestic outsider owned firms we can not reject the presence of second order serial correlation in first-differenced residuals. Finally, goodness of fit measures range between about 18% in the case of state owned firms to about 26% in the case of foreign owned firms, which is in line with previous findings.

5. Conclusions and Policy Implications

In this paper we examined the impact of ownership structures on capital constraints for a sample of privately owned Estonian firms over the period 1993 through 1999. We argued that investment patterns at the firm level are characterized by non-convexities and lumpiness, which make the common estimation approaches, which apply continuous and convex adjustment costs, inappropriate. Accounting for these features, we set up the estimation in an error correction framework, which is interpreted as an empirical approximation of a complex dynamic adjustment process present in the data. Various tests are implemented to determine the correct specification. Among the conclusions of these tests is that the exclusion of financial variables from the basic error correction specification will lead to a mis-specified model.

The analysis is further complicated by the two-way relationship between ownership structures and financing needs. While customary, the use of instrumental variables to remove the bias caused by this causality is, in itself, prone to other biases. We proceed by first dividing the sample into sub-samples according to ownership classes and then analyzing the investment equations separately for each class.

The results are easily summarized. All firm types respond to better future opportunities by increasing their investment. The speed of adjustment towards the long-run equilibrium is different though, with manager owned firms having the highest, and employee owned firms the lowest, speed. This pattern could be related to the easiness of access to capital. Cash flow and debt coefficients confirm that the degree of capital constraints varies with firms' ownership structures. Compared to the base case of foreign owned firms, which are assumed not to be constrained in any sense in their access to capital, the manager owned and employee owned firms display significant credit rationing. Especially severe is credit rationing for employee owned firms in that it operates through both internal and external finance. These results show that these firms face a larger wedge between the cost of internal and external capital than other firm types. As such, given the non-convex and irreversible nature of investment they would be unwilling to undertake long-term projects and will, consequently, display a low speed of adjustment.

The slow speed of adjustment though could be explained by another phenomenon. In a related work, we analyzed the capital allocation decisions by estimating the returns to scale in a production function framework. The results of this analysis indicate that, on average, all firms in Estonia independently of their ownership structure operate, albeit to different degrees, with inefficient input combination, i.e., they are at the wrong point on their production function, and suggest that they might be over-investing. Moreover, the degree of over-investment is larger for employee owned firms. This finding is consistent with the agency conflicts hypothesis within the firms, i.e., from conflicts between owners and managers. Yet, there is one environmental factor related to the transition process in general which explains the findings above. It is the fact that most of the firms may have inherited capital from the pre-transition period that they do not need and for which there is no secondary market to dispose of the capital. To be able to conclude whether our results are driven from one or the other explanation, we need to control for the inheritance phenomenon.

A main implication of these conclusions is the role that public policy could play in ameliorating firms' access to capital in particular and developing capital markets in general. While straightforward, the provision of direct subsidies is likely to be counter-productive in that they could soften the recipient's budget constraints and exacerbate the inefficient allocation of capital. Although not conclusive, there exists evidence (Demirguc-Kunt and Maksimovic, 1996) that seems to corroborate that government subsidies to industry do not increase the proportion of firms that grow faster than predicted. In light of this issue a better way to inject new capital into indigenous firms could be through promotion of foreign investment at various levels.

Alternative policies need to focus on the development of capital markets and the financial sector, i.e., banking and non-banking institutions. Estonia's capital market, although growing, is small, and as such, its future will lie in alliances with other stock exchanges. The first step in this direction was the creation of the pan-Baltic stock exchange in early 2000 as well as the alliance between the Nordic and Baltic stock exchanges, NOREX. While there will be definite benefits to large listed Estonian firms, most of the firms in Estonia will not experience direct benefits from these developments. As such, the development of the banking system is of paramount importance. Until recently, banks were more focused on financing the government than the private sector. Here there is a scope to introduce legislation that will increase bank incentives to extend loans to private companies. Similar steps need to be taken to increase non-banking institution participation in financing the private sector, which until now has been marginal. A possible way would be to provide tax breaks to such institutions that would be contingent on the amount of loans they extend to private companies, especially to those encountering difficulties in raising finance.

Table 1. Variable Definitions

Variable	Definition
Investment	The sum of investments in reconstruction, expansion and acquisition of buildings, in constructions of new buildings and other business related projects, in buying new machinery, equipment and means of transportation and in buying and improving land.
Capital	The book value of non-current tangible assets. It is calculated as the average of the value of these assets at the beginning and at the end of the year.
Employment	The average number of employees per year. The study has excluded all firms with fewer than 10 employees.
Labor Cost	The sum of wage and salaries in a given year.
Average Wage	The ratio of labor cost to average employment in a given year.
Sales	Net sales per year as stated in firm's income statement.
Profit	Net profit per year as stated in firm's income statement. This is profit left after all taxes are paid.
Cash Flow	The sum of depreciation allowances and net profit.
Value Added	Two definitions of value added are adopted. The first is the sum of depreciation allowances, net profit, labor cost and expenditures for social tax and health insurance. The second includes all these variables as well as financial costs.
Debt	The sum of short-term loans.
Current Liabilities	The sum of short-term loans and payables to suppliers and or customers.
Total Liabilities	The sum of short and long-term loans and other short and long-term liabilities.
Short-Term Assets	The sum of cash, short-term receivables and short-term securities.
Financial Cost	The net of financial income accrued and financial cost incurred during a given year.
Extra Revenue	Revenue obtained from sale of non-current tangible assets over a given period.
Industry Groups	7 broad industry groups were defined as follows: 1. Agriculture and fishing. 2. Mining, food products, textile and leather. 3. Wood products, paper products, coke, petroleum, chemicals, rubber, plastic, non-metallic, basic metals and machinery and equipment production. 4. Electrical, optical and transport equipment production. 5. Energy and construction. 6. Wholesale and retail trade. 7. Transport.
Size Groups	Firms are divided into three size groups according to their average employment. The first group includes firms with 49 or fewer employees, the second includes the firms with more than 49 employees and fewer than 101, and the third group includes firms with more than 101 employees.
Ownership Groups	6 ownership groups are defined as follows: state, foreign, institutional domestic outsiders, former employees, incumbent employees and managers.
Ownership Categories	Ownership categories are defined according to dominant ownership as follows: A firm is considered to be dominantly owned by the owner who holds the largest share.
Ownership Share	The share owned by the respective ownership group.

Figure 1. Distribution of Investment Rates Across Firms

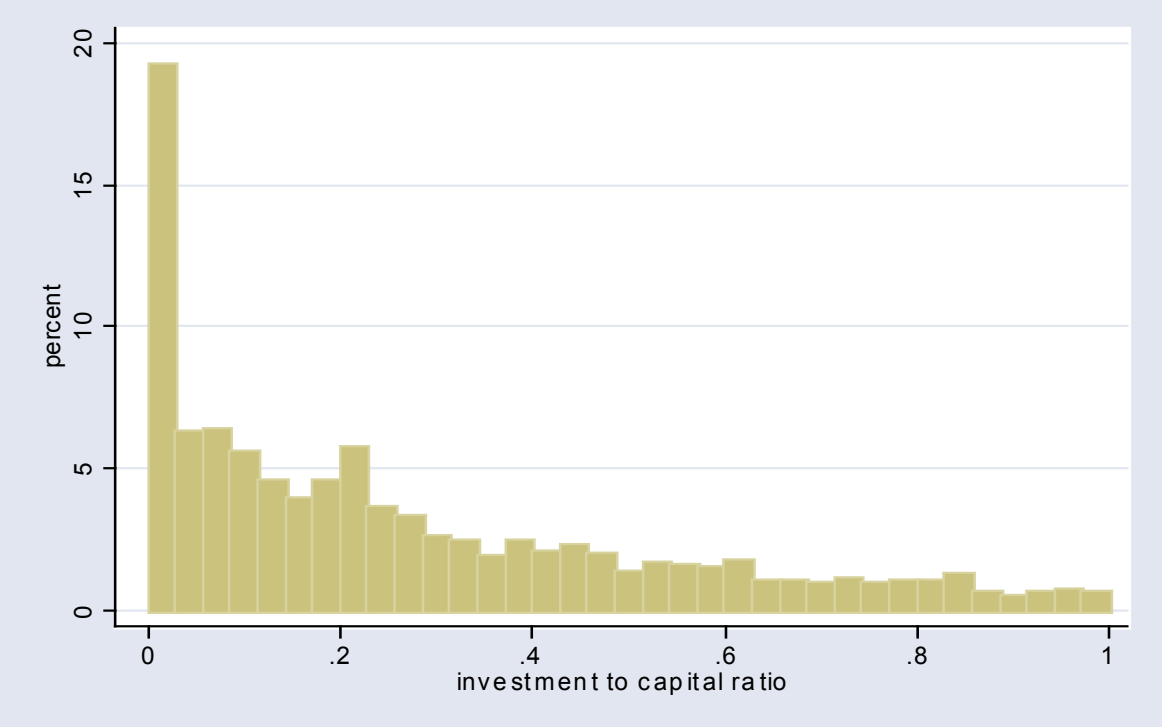

Table 2. Ownership Distribution over Time according to Dominant Owner[1]

Year / Ownership Group	1993	1994	1995	1996	1997	1998	1999	Total
Domestic Outsiders	81	94	97	110	95	90	119	686
Employee	48	54	47	41	27	26	29	272
Former Employees	0	0	11	14	19	15	16	75
Foreign	42	60	63	68	67	59	72	431
Manager	45	53	65	76	81	71	84	475
State	228	181	262	204	172	123	6	1,176
No Answer	54	56		1	19	18	31	179
Total	498	498	545	514	480	402	357	3294

[1]A firm is considered to be dominantly owned by the owner who holds the largest share.

Table 3. Means and Standard Deviations of Principal Variables over Time

Year / Variables[1]	1993	1994	1995	1996	1997	1998	1999	Obs.[2]
Investment	2150 (12363)	2245 (18844)	3371 (22029)	3007 (17249)	2634 (15504)	3407 (14019)	4547 (19549)	3283
Capital	12250 (51023)	9740 (48137)	9771 (45305)	10329 (47218)	10411 (47756)	11200 (49623)	16816 (43022)	3294
Sales	21773 (63301)	21502 (61562)	30377 (93119)	24269 (69179)	27573 (77562)	27989 (63535)	32816 (88789)	3294
Employment[3]	196 (414)	166 (340)	164 (388)	161 (393)	157 (276)	137 (282)	124 (228)	3294
Real Wage[4]	14.42 (17.11)	16.46 (10.91)	13.31 (7.73)	21.04 (30.59)	21.92 (17.28)	22.96 (14.63)	28.37 (18.33)	3294
Cash Flow	805 (7530)	649 (8801)	1103 (10008)	658 (12607)	1678 (14428)	1994 (18195)	2932 (17328)	3294
Debt	867 (2692)	891 (4112)	1389 (3974)	1701 (4007)	1717 (3664)	2276 (3885)	2962 (4127)	3294
Current Payables	5516 (23301)	4848 (21130)	3804 (11895)	4334 (12503)	4363 (10672)	4605 (12843)	5445 (15750)	3294
Long-Term Liabilities	2595 (14961)	2702 (19652)	3143 (12450)	3433 (12048)	3820 (13874)	4469 (12052)	6863 (16384)	3294

[1]All the variables except employment are expressed in thousands of Estonian kroons in 1993 prices.
[2]This number is the sum over the whole sample with non-missing values for the respective variable.
[3]Average number of employees in a given year.
[4]Real average wage per employee.

Table 4. System GMM Estimates of Investment Error Correction Specifications for the Whole Sample[a]

Model Parameters	Model 1	Model 2	Model 3	Model 4
Sales Growth	0.125* (0.009)	0.119** (0.017)	0.154*** (0.059)	0.143*** (0.077)
Error Correction Term	- 0.021 (- 0.168)	- 0.014 (- 0.107)	- 0.036** (- 0.073)	- 0.019** (- 0.055)
Lagged Sales Growth	-	-	0.031 (0.257)	0.047 (0.302)
Twice Lagged Sales	-	-	0.009*** (0.071)	0.011** (0.048)
Lagged Investment to Capital Ratio	-	-	- 0.006 (- 0.197)	- 0.014 (- 0.267)
Time and Industry Dummies	Yes	Yes	Yes	Yes
Firm Specific Effects	Yes	Yes	Yes	Yes
Size Dummies	Yes	Yes	Yes	Yes
Financial Variables	No	Yes	No	Yes
Sargan Statistic p-value	0.348	0.469	0.574	0.627
Second Order Autocorrelation Test p-value	0.078	0.123	0.039	0.112
Goodness of Fit	0.187	0.217	0.191	0.198

[a] Values in brackets denote respective p-values. Each model is estimated with time, industry and size dummies, whose estimates are not reported here. Model 1 and Model 2 correspond to ADL (1,1) specifications, while Model 3 and Model 4 correspond to ADL (2,2) specifications. Both specifications are estimated first without financial variables and then with financial variables, whose estimates are however not reported here. The reported estimates are the one-step coefficients with heteroscedasticity consistent standard errors. The instrument set for the ADL (1,1) specifications in the first-differenced equations includes the second or more lag of the following variables: investment to capital ratio, sales growth, error correction term, cash flow to capital ratio and debt to capital ratio. The instrument set for equations in levels includes the second or more lags of the growth of the above-mentioned variables. For ADL (2,2) specifications the instrument set includes the third or more lags of the variables as explained above as well as of lagged sales growth, twice lagged levels of sales and lagged investment to capital ratio. The instrument validity is tested using the Sargan-Hansen test of overidentifying restrictions. The goodness of fit measure is the correlation between the actual and predicted values of investment to capital ratio. Finally, all regressions include the inverse of Mill's Ratio to account for sample selection bias.
*, **, and *** denote significance at the 1%, 5% and 10% significance levels, respectively.

Table 5. System GMM Estimates of Investment Error Correction Specifications for Sub-Samples of Firms under Different Ownership Structures[a]

Model / **Parameters**	Foreign Owned	Domestic Outsider Owned	Manager Owned	Employee Owned	State Owned
Sales Growth	0.146** (0.029)	0.129*** (0.057)	0.104** (0.087)	0.097 (0.104)	0.089*** (0.092)
Error Correction Term	- 0.021*** (-0.076)	- 0.009 (-0.112)	- 0.036*** (-0.091)	- 0.007*** (-0.064)	- 0.007 (-0.156)
Cash Flow to Capital Ratio	0.026** (0.045)	0.029 (0.0105)	0.044*** (0.084)	0.072** (0.021)	0.069 (0.128)
Lagged Cash Flow to Capital Ratio	0.009 (0.137)	0.003 (0.256)	0.011 (0.183)	0.022 (0.111)	0.008 (0.194)
Debt to Capital Ratio	0.001 (0.348)	0.009 (0.301)	- 0.009 (-0.163)	- 0.012** (-0.039)	- 0.002 (-0.219)
Lagged Debt to Capital Ratio	0.00002 (0.569)	0.00001 (0.526)	0.0011 (0.443)	- 0.001 (- 0.239)	0.00001 (0.658)
Time and Industry Dummies	Yes	Yes	Yes	Yes	Yes
Firm Specific Effects	Yes	Yes	Yes	Yes	Yes
Size Dummies	Yes	Yes	Yes	Yes	Yes
Sargan Statistic p-value	0.487	0.398	0.478	0.532	0.617
Second Order Autocorrelation Test p-value	0.191	0.111	0.107	0.134	0.097
Goodness of Fit	0.258	0.221	0.195	0.208	0.175

[a] Values in brackets denote respective p-values. Each model is estimated with time, industry and size dummies, whose estimates are not reported here. The reported estimates are the one-step coefficients with heteroscedasticity consistent standard errors. The instrument set in the first-differenced equations includes the second or more lag of the following variables: investment to capital ratio, sales growth, error correction term, cash flow to capital ratio and debt to capital ratio. The instrument set for equations in levels includes the second or more lags of the growth of the above mentioned variables. The instrument validity is tested using the Sargan-Hansen test of overidentifying restrictions. The goodness of fit measure is the correlation between actual and predicted values of investment to capital ratio. Finally, all regressions include the inverse of Mill's Ratio to account for sample selection bias.

*, **, and *** denote significance at the 1%, 5% and 10% significance levels, respectively.

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