Capital Investment and Determinants of Financial Constraints in Estonia

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May 05, 2009

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Unlike previous empirical work concerning 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 the financially constrained or in the financially unconstrained regime. By using new panel data for Estonian companies during 1993 through 2002 we find that: (i) investment behavior is characterized by two distinct regimes; (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) the actual probabilities of operating in the financially constrained regime are quite high and essentially stable during the whole period under consideration; (iv) ownership structure affects investment beyond its indirect effects through financial constraints.

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JEL Classification: C33, D21, D92, E22, G32, J54, P21.

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Abstract:

Unlike previous empirical work concerning 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 the financially constrained or in the financially unconstrained regime. By using new panel data for Estonian companies during 1993 through 2002 we find that: (i) investment behavior is characterized by two distinct regimes; (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) the actual probabilities of operating in the financially constrained regime are quite high and essentially stable during the whole period under consideration; (iv) ownership structure affects investment beyond its indirect effects through financial constraints.

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1. Introduction

It has long been accepted that access to capital is an important determinant of rates of investment. While an empirical literature has begun to emerge that investigates issues surrounding liquidity constraints in firms' investment decisions, the 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 2002, we respond to some of these deficiencies.

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 do 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 these hypotheses empirical research usually follows a strategy in which, initially, a standard investment demand model (e.g., accelerator or 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 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, while either insignificant or of significantly lower sensitivity for financially unconstrained firms.

Yet this empirical strategy has its problems[i]. 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, 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.

Our paper makes several important contributions. First, it accounts for the effect of governance structures in investment decisions through their role in mitigating or exacerbating

informational asymmetries and agency costs. To our knowledge no prior study addresses this issue in the same manner. Second, by using data from one of the most advanced transition economies, it assesses the differential effect and long-run viability of various ownership forms. This is an important issue in light of the continuing debate in transition literature on the efficiency of various ownership forms resulting from the extensive privatization process. Third, by calculating probabilities of firms' operating in the financially constrained regime it provides evidence of the pervasiveness of financial constraints across groups of firms and their persistence over time. Fourth, it provides evidence on differences in the propensity to invest by ownership structure. Finally, it stresses the role of planned creation of financial slack as a means to finance future investment, which is not clearly accounted for in standard accelerator models of investment. Our findings confirm the role of financial slack and relate to previous literature for both advanced and transition economies ((e.g. Kim, Mauer and Sherman (1998); Fazzari, Hubbard and Petersen (2000); Calvo and Coricelli (1994)).

The data used in this study possess certain advantages compared to data used by most other researchers, especially those working on transition. First, our surveys allow us to define a broader range of ownership groups than are usually found in transition studies where, if ownership data are available, classifications are usually restricted to state, foreign and domestic private firms. When authors are able to identify insider owners, they can seldom distinguish between employees, managers or former insiders. Second, the use of different waves of ownership data allows us to capture dynamics that one cannot do when shorter data series are used. Exceptions in the literature are the studies of Lizal and Svejnar (1998, 2002), who define a broad range of ownership structures and use data that cover long enough time span that allows them to capture appropriate dynamics. 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. These features of our data may make our findings of interest to both researchers on transition as well, more generally, to students of corporate governance.

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

2. The Estimating Framework

2.1 The Model

Mygind (2000) examines the development of financial system infrastructure in Estonia during transition. While companies' access to capital through bank loans became easier, he argues the stock market played only a marginal role as a source of capital. He also argues that, as enterprises engaged in deeper post-privatization restructuring, higher demand for funds, accompanied by still relatively limited bank involvement in financing the private sector, resulted in heavier reliance on internal finance and severe credit rationing for specific groups of firms.

We test this conjecture by using a switching regression model (Maddala, 1986, Maddala and Nelson, 1994). The usefulness of this approach is determined by the model's ability to identify significant differences in the data that allow efficient clustering of firms into groups. The model also allows for the simultaneous determination of differences in investment behavior across firms and the likelihood of their belonging to a particular regime over time.

A firm is assumed to operate either in the financially unconstrained or in the financially constrained regime where this is determined by the switching function. That 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, investment equations are given by the following:

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

$$\text{if} \qquad Z_{i,t} \cdot \alpha + \varepsilon_{i,t} \geq 0 \quad (2)$$

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

$$\text{if} \qquad Z_{i,t} \cdot \alpha + \varepsilon_{i,t} < 0 \quad (4)$$

where 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 error terms that are supposed to be correlated across equations, but not over time. Equations (1) and (3) are structural investment equations, while (2) and (4) constitute the switching function that will be estimated simultaneously with the investment equations.

To close the model we assume that the sample separation is unknown-- the observed values of investment are not known beforehand, but come from the process given by equation (1) or equation (3). Then the model specified becomes an endogenous switching regression model with sample separation unknown[ii]. Once the equations are simultaneously estimated, the respective probabilities of the firm being in either regime are calculated.

2.2 Empirical Specifications

For estimation purposes we assume the investment equation corresponds to a neoclassical (accelerator) model of investment demand, e.g. Jorgenson (1963). Although these models are

derived under restrictive assumptions, they perform well empirically and are widely used[iii]. The basic neoclassical model assumes that the supply of investment funds is perfectly elastic and thus financial constraints do not affect investment. To account for possible imperfect substitutability of internal and external finance, profit or cash flow variables are usually included in empirical specifications. However, it is unclear whether the coefficients of these variables reflect more imperfect substitutability of internal and external finance, information on future profitability of the firm or the presence of Jensen's (1986) "free cash flow". To partially overcome this problem, interaction terms between cash flow and variables measuring the severity of agency costs are often introduced, where the difference in estimated coefficients is interpreted as differences in access to external finance. Alternatively, under the assumption that a non-zero cash flow coefficient for unconstrained firms captures 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. Thus the equation to be estimated is:

$$\left(\frac{I_t}{K_{t-1}}\right) = \alpha + \sum_{s=1}^{S} \beta_s \cdot \frac{Y_{i,t-s}}{K_{i,t-1}} + \sum_{s=1}^{S} \gamma_s \cdot \frac{CF_{i,t-s}}{K_{i,t-1}} + \lambda \cdot D_{i,t} + \xi \cdot M_{i,t} + \varepsilon_{i,t} \qquad (5)$$

where I, K, Y and CF denote investment, capital, output, and cash flow respectively, s is the number of lags, D is a vector of industry and time dummies that capture effects common to all firms, while M is the inverse Mill's ratio. The latter is included because, for some firms, data are missing. By estimating a Heckman-type probit model, we calculate the probability that the firm is included in the sample, on the basis of investment, profit, industry affiliation and firm type.

As well as cash flow, the estimated equation includes two measures of financial slack -- (i) the sum of cash, short-term receivables and short-term securities; and (ii) revenue obtained from the sale of non-current tangible assets. While the accelerator framework does not

incorporate any intertemporal optimization, the existence of capital market imperfections, which could potentially lead to costly future financing decisions, provide a rationale for this. The idea that firms need to accumulate liquid assets to finance future investment opportunities with internal funds dates back to Myers and Majluf (1984).This preference for accumulation is reflected in Myers (1984) "pecking order" theory of financing. A number of studies[iv] examine the demand for liquid assets from a cost-benefit perspective and provide evidence that access to external capital is a fundamental determinant of the level of liquid assets.

Kaplan and Zingales (1997) argue that high levels of liquid assets are associated with a lack of financial constraints, given that investment will not be conditioned by the availability of finance. By contrast many, including Fazzari, Hubbard and Petersen (2000), argue that high levels of financial slack might be associated with financial constraints since large holdings of liquidity are accumulated by firms that expect to be constrained. For financially constrained firms this means that the coefficients for financial slack variables are expected to be positive, pointing to the inability of these firms to substitute between internal and external finance. But for financially unconstrained firms the comparable coefficients are not expected to be different from zero, indicating that they can freely switch between internal and external financing.

By voluntarily offloading unproductive assets firms can restructure and enhance efficiency (Hite, Owers and Rogers, 1987.) Then asset sales are uncorrelated with future investment opportunities and provide relief to financially constrained firms. But if voluntary asset sales are driven by considerations of the likelihood of future constraints, rather than restructuring, the assumption of no correlation between financial slack and future investment opportunities is violated. Lang, Poulsen and Stulz (1995) argue that firms selling assets perform poorly and/or have high leverage suggesting that asset sales provide funds when alternative

sources of finance are too expensive. Then the causality between asset sales and investment outlays is reversed, but is still expected to be positive for financially constrained firms.

Finally, ownership dummies are included to capture differences in investment behavior across firms for reasons unrelated to financial constraints. For example, employee owned firms might be expected to under-invest due to employee owners' attitudes to risk and differences in goals or the designation of property rights (Dow, 2003).

We assume the switching function is a function of two sets of variables: one determines the firm's financial status and the other measures the degree of information and agency problems. The former set includes balance sheet and income statement items, such as debt to capital ratio, interest payments to sales ratio and liquid financial assets to capital ratio. The latter set of variables includes the percentage of shares owned by the largest owner (a measure of ownership concentration), firm's age and firm size. 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 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, 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 time will depend on past performance and 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 either from a lack or exhaustion of collateralizable assets and, therefore, are highly likely to be operating in the financially constrained regime; similarly, firms having a high interest payment to sales ratio, are more likely to operate in that regime. By contrast, firms having a high ratio of liquid assets to

capital 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 on the ratios of debt to capital and interest payment to sales are expected to be positive, while the coefficient on liquid assets/capital is expected to be negative.

Yet, if firms enjoy easy access to capital or experience soft budget constraints the effect of financial variables on the probability of being financially constrained would at least be significantly reduced. Soft budget constraints include cheap capital provided to firms in the form of direct government subsidies and tax arrears, trade credits, and cheap loans from the banking sector. The strict budgetary and competition promoting policies adopted by successive Estonian governments have reduced the level of subsidies provided by direct budgetary policies to minimal levels (EBRD, 2000.) In addition, EBRD (1999) reports that in Estonia only about 9% of firms had tax arrears, the lowest percentage among transition economies. Concerning trade credit, it is difficult to gauge its importance from financial statement data. A high and increasing level of current payables might not reflect overdue payments but rather contractual arrangements or delivery lags. Further, if high levels of overdue trade credit are rolled over into long-term liabilities, this will translate into a high growth rate for such liabilities, which is not the case for firms in our sample. Schaffer (1998) argues that, at least in more advanced transition economies, firms have learned to apply hard budget constraints to each other. The final measure of soft budget constraints is easy access by distressed or loss-making firms to bank lending through special relations with financial institutions. To properly establish the extent of this channel, however, one needs to combine data from both firms and banks. While 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 loan has a low economic value to the bank itself. Unfortunately, banks are reluctant to disclose whether they invest in low economic value projects.

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 that are constructed to measure the probability of a firm being financially constrained. Assessing the relative importance of various channels is a difficult task, due in part to the lack of appropriate data. Nevertheless, given the theoretical importance of soft budget constraints, we use the available data to construct a dummy variable, which takes the value 1 if, at a given time, a firm has negative earnings before interest, taxes and depreciation and, at the same time, receives positive net financing, defined as an increase in short-term debt net of financing costs.

Concerning the second set of variables in the switching equation, the percentage of shares owned by the largest owner proxies the severity of agency problems, while the firm's age and size proxy the severity of informational asymmetries. The expected sign on the coefficient of the percentage of shares owned by the largest owner is theoretically ambiguous. If more concentrated ownership mitigates agency problems, this will lead to a lower probability of a firm 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. By including interaction terms of the percentage of shares owned by the largest owner with respective ownership dummies these conflicting hypotheses may be tested. The coefficients of these terms are expected to be negative when ownership is concentrated in the hands of outside owners and positive when ownership is concentrated in the hands of insiders. Furthermore, young firms are expected to be more prone to informational asymmetries than established firms, which have better possibilities of creating

long-term relationships with providers of capital than do newly established privatized firms. Consequently, the sign of the coefficient on a 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. In addition, small firms incur higher transaction costs when issuing both debt and equity and will face a higher risk of bankruptcy than large firms. Previous empirical work finds some support to this proposition, with Fazzari, Hubbard and Petersen (1988) and Hooks (2003) finding that financing constraints decrease with firm size. This means that the coefficient of firm's size is also expected to be negative. However, Letterie and Pfann (2007) do stress that the impact of firm size could be non-linear. In our empirical analysis we explicitly test for this.

3. Sample Description and Variable Definitions

Our data are annual firm-level observations for a sample of Estonian firms over the period 1993 through 2002. 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 surveys gather 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 industry. However, before merging this information to create an unbalanced panel data set for the data analysis, we recognize that, potentially, there are issues of measurement error in financial data during early transition that other researchers have noted (e.g. Filer and Hanousek, 2002). To address these issues, we use several criteria to examine our data.[v] The application of all these criteria results in our using in the data analysis a data set consisting of 4218 observations over the whole period 1993 through 2002. The list of variables and their definitions are given in Table 1.

Sample firms are classified into six ownership groups according to the dominant owner: domestic outsider, employee, former employee, foreign, manager and state. The ownership distribution over time reported in Table 2 shows that insider ownership, i.e. employee and manager, emerged as an important form of privatization. For example, in 1995 in more than 22% of cases, insiders or former insiders are dominant owners. Foreign owned companies comprise around 12% of the sample, with most of them being new companies established in the early 1990s, while domestic outsider owned firms comprise around 18% of cases. Finally, state owned firms account for around 48% of the sample, with 232 firms being 100% state owned while 30 firms are mostly in private hands but with the state still holding a dominant position. The size distribution of firms reveals that state owned firms are mostly large. By contrast, insider owned (i.e., employee, former employee and manager owned) and, surprisingly, foreign owned firms tend to be of small and medium size. Domestic outsider owned firms are both small and large.

Table 3 presents summary statistics of the most relevant variables used in the analysis. One observation emerging from the table is that investment levels are high relative to capital stock, with investment/capital ratio ranging from 0.17 in 1993 to 0.34 in 1995. We also see 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 the same magnitude in most years. The increase in debt after 1995 is consistent with the general increase of lending to the private sector during this period (Mygind, 2000). 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 early 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, 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, suggesting that they have been an important source of financing. 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 the decrease in employment.

Finally, to ascertain the importance of internal versus external financing in investment in fixed capital, we have data on the share of investment financed through internal funds or short or long-term debt by ownership group. Table 4 shows the evolution of the share of investment financed through internal funds and loans by ownership group. 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%. In no case is this share below 60%, which is in sharp contrast with the findings of Estrin and Jones (1998) who find that employee owned firms in their French sample fund up to 47% of their investment externally. Foreign owned firms receive most outside financing, with the highest share reaching 37% in 1994, followed by domestic outsider owned firms. This reliance on internal financing might result from owners' reluctance to use external financing due to fear of loss of control or it might reflect an inability to borrow externally.

4. Empirical Results

In this section we report and discuss the estimates of investment equations[vi] and switching function[vii] parameters. Due to the long time period under consideration we observe

entry of new firms and exit of existing firms from the sample. These decisions are potentially not random and we expect our findings to be sensitive to this phenomenon. As such, we performed the estimation using both unbalanced and balanced panels[viii], which provides evidence of the robustness of results, as well as of the direction and magnitude of the bias caused by entry and exit of firms over time.

In part 1 of Table 5 we report the results of estimating investment equations for firms operating in each regime. As a first step we test the existence of two distinct investment regimes using likelihood ratio tests. Under the restriction that the 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 χ^2 distribution. Yet, 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. The likelihood ratio test performed confirms that the data are better characterized by two separate regimes.[ix]

Given this evidence it is worthwhile exploring the differences in estimates across regimes. First, from the table we observe that 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 and internal funds to be a significant determinant of investment. For instance, Lizal and Svejnar (1998) find the sum of coefficients on output to be 0.027 and the sum of coefficients on

profit to be 0.019, while Lizal and Svejnar (2002) find those coefficients to be 0.010 and 0.019, respectively. In a study of firms from the three Baltic Republics, Lesnik and Sterken (1998) find that the coefficient on output to be at the range 0.007 to 0.04, while the coefficient on cash flow to be at the range 0.135 to 0.175. These results, however, correspond to estimates with pooled samples and as such are not directly comparable with our estimates. In a similar study to ours, Hu and Schiantarelli (1998) find the coefficients of sales and cash flow for firms in high-premium (constrained) regime to be 0.001 and 0.192, while for those in low-premium (unconstrained) regime to be 0.035 and 0.053 respectively. Overall, the results point to the importance of both production and internal funds as important determinants of firm's investment over the period of our study. In quantitative terms an one standard deviation increase in output (sales) would lead to an increase of 6.4% to 12.7% in investment, while an one standard deviation increase in cash flow would lead to an increase of 1.2% to 3.7% in investment.

Turning to differences in investment behavior across the two regimes, the coefficients of lagged cash flow variables are statistically significant at either the 5% or 1% levels. Further, as expected, the lagged cash flow coefficient is larger for financially constrained firms than for financially non-constrained firms, i.e., 0.021 versus 0.004. This supports the hypothesis that financially constrained firms are more sensitive to the availability of internal finance than are financially unconstrained firms. Moreover, this effect is economically as well as statistically significant. Specifically, a given increase in cash flow translates into an increase in investment that is five times larger for financially constrained firms (compared to unconstrained firms.) The positive and significant coefficient of lagged cash flow for financially unconstrained firms provides evidence that this variable might convey some information on future profitability or that

this sample is relatively unconstrained. The difference of the coefficient between constrained for unconstrained firms can be attributed to different sensitivities to the availability of internal funds.

The coefficient of twice lagged cash flow is positive and statistically significant only for firms operating in the financially constrained regime. This might be interpreted as evidence consistent with a cash smoothing or "buffer stock" liquidity hypothesis, i.e., given an inability to secure all desired financing when a profitable investment project is 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 coefficients of variables measuring financial slack, i.e., liquid assets and asset sales. The coefficients of lagged liquid assets and its twice lagged value are positive and significant for firms operating in both regimes, with those operating in the constrained regime displaying a higher sensitivity to the availability of liquid assets. This finding implies that all firms accumulate large holdings of liquidity to substitute for their inability to obtain external finance. However, the coefficients of the asset sales variables are statistically significant only for financially constrained firms, implying that asset sales provide additional funds for investment. 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 a 1% level, but they are larger in absolute value for unconstrained firms than for constrained firms. 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 are firms operating in the constrained regime.

Finally, the signs and significance of ownership dummies[x] reveal notable differences across the two regimes. The coefficients should be interpreted as the differential effect of a

particular ownership structure on investment over the control group of state ownership. Surprisingly, ownership structure does not seem to matter when firms operate in the financially unconstrained regime. On the contrary, ownership structure leads to differences in investment behavior only for firms that operate in the financially constrained regime. More specifically, investment in constrained firms increases with foreign ownership and decreases with employee and managerial ownership. In the latter case this phenomenon might reflect the preferences and goals of insider owners, who might prefer to divert resources in higher individual income rather than invest in the firm. Although, in principle, insiders, and especially non-managerial employees, own the shares individually there is empirical evidence (e.g., Kalmi, 2002) to show that there exist a strong degree of collective ownership. This fact makes our findings in line with those of Estrin and Jones (1998), who find that investment in employee owned firms decreases with the share of capital, which is collectively owned.

Next we test for the equality of individual coefficients in investment equations across the two regimes. More specifically, we test 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-statistics is 12.19 leading to decisive rejection of the null hypothesis. In the case of the coefficient of lagged sales the t-statistics is 7.81 again leading to rejection of the null hypothesis. Similar tests are performed for the other variables in the investment equations and in all cases we are able to reject the null of coefficients equality.

Turning to estimates of the switching equations, an important general conclusion that emerges is that both balance sheet, and information asymmetry and agency cost variables are important determinants of the likelihood of whether the firm is financially constrained or not. 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 1% significance level, indicating that the higher the ratio the lower the likelihood the firm will operate in the financially constrained regime. This is also an economically significant effect-- an increase of one standard deviation in the debt to capital ratio increases the probability of operating in the financially constrained regime by 8.4%. The corresponding figure for increases in interest payment to sales ratio is 5.3%, while for increases in liquidity to capital ratio is negative 4.7%, implying a decrease in the likelihood of operating in the financially constrained regime.

The coefficients of the variable that interacts the percentage of shares owned by the largest owner with the appropriate measure of ownership are mostly significant, indicating that ownership concentration is important in determining the regime in which a firm operates. For instance, the coefficients of the percentage of shares owned by the state and employees are positive and statistically significant, suggesting that higher ownership concentration in the hands of either the state or employees is associated with a higher probability of being financially constrained. In between these groups, when ownership is concentrated in the hands of employees the effect is almost twice as large as when ownership is concentrated in the hands of the state. Interestingly, there seems to be no significant effect of the likelihood of being financially constrained when ownership is concentrated in the hands of the domestic outsiders and foreigners, while ownership concentration in the hands of managers leads to a lower probability of being financially constrained.

The coefficients on firm size, firm age and the dummy for soft budget constraints, are each found to have the expected sign. These findings indicate that larger firms[xi], more

established firms and firms that have access to finance from sources other than the market are less likely to find themselves operating in the financially constrained regime. In a survey of the literature, Djankov and Murrell (2002) find a positive and significant effect of hardened budget constraints on enterprise restructuring, defined as sales growth, TFP or labor productivity. In light of these findings, our conclusions suggest that funds obtained as soft credits are possibly used in unproductive and inefficient way.

An advantage of using the switching regression approach is that it allows easy calculation of the probabilities that firms operate in one or the other regime. In Table 6 we report probabilities over time that firms, belonging to different ownership groups, operate in the financially constrained regime. Several important findings emerge from the table. First, the probabilities of being financially constrained are quite high and are 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 probabilities across ownership groups. Thus, 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, given their potentially higher creditworthiness. Yet, a lot of foreign owned firms seem to be financially constrained. This could be driven from the fact that 47% of foreign owned firms are small firms as well as that a lot of them are direct investments of foreign entities rather than subsidiaries of or joint ventures with foreign companies, i.e., they lack a direct and potentially unconstrained source of financing if financially distressed. Under these conditions, these firms are obliged to borrow in an underdeveloped capital market and compete for funds with other firm types in the economy. Further, and consistent with the results of the switching function, insider owned firms are found

to face higher probabilities of being financially constrained than are private 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. Within insider owned firms employee owned firms display consistently higher probabilities of being financially constrained. Finally, state owned firms face persistently large probabilities of being financially constrained over the whole period under consideration, with only employee owned firms displaying larger such probabilities. This result might seem surprising in light of the expectation that state owned firms might be subject to soft budget constraints. However, it perhaps means that, throughout the period, these firms were required to borrow in the capital market, where they had to face the competition of private firms. The strict monetary and budgetary policies of Estonian governments that led to direct budget subsidies of only about 1% of GDP per year provide support to this conjecture (EBRD, 1999).

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 2002. Our using 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 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 additional 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 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.

Our findings confirm the existence of two separate investment regimes for financially constrained and unconstrained firms. To explain the investment behavior of firms we augment the basic accelerator/neoclassical model of investment 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 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 or access to finance and the difference in coefficients between financially constrained and unconstrained firms captures differing sensitivity to access to finance. Subsequently, we focus on the difference of cash flow coefficients between financially constrained and unconstrained firms as 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. These findings support the claim that firms accumulate funds in response to existing or future financing constraints and are consistent with findings from both advanced (e.g. Kim, Mauer and Sherman (1998); Fazzari, Hubbard and Petersen (2000)) and transition economies (e.g. Calvo and Coricelli (1994)).

With respect to the likelihood of firms being financially constrained or not, 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 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 firm's 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 higher probability of being financially constrained and display 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 investments adds further weight to the appropriateness of this approach.

Table 1. Variable Definitions

Variable	Definition
Investment	The sum, in real terms, 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, in real terms, of non-current tangible assets, 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. We have excluded all firms with fewer than 10 employees.
Labor Cost	The sum, in real terms, of wages 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 in real terms.
Profit	Net profit per year in real terms. This is profit left after all taxes are paid.
Cash Flow	The sum, in real terms, of depreciation allowances and net profit.
Debt	The sum, in real terms, of short-term loans.
Current Liabilities	The sum, in real terms, of short-term loans and payables to suppliers and or customers.
Total Liabilities	The sum, in real terms, of short and long-term loans and other short and long-term liabilities.
Liquid Assets	The average per year of the sum, real terms, of cash, short-term receivables and short-term securities.
Financial Cost	The net, in real terms, of financial income accrued and financial cost incurred during a given year.
Asset Sale	Revenue, in real terms, 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 classified according to dominant ownership whereby a dominant owner holds the largest share of the voting stock.
Ownership Share	The share owned by the respective ownership group.
Debt to Capital	The ratio of debt to capital.
Interest Coverage to Sales	The ratio of interest expenses to net sales.
Liquid Assets to Capital	The ratio of liquid assets to capital.
Firm Age	The number of years the firm has been operated as a private entity.
Size	The logarithm of the average number of employees.
Soft Budget Constraint	A dummy variable that takes the value of 1 if the firm has negative EBITD and receives positive net financing defined as an increase in short-term debt net of financing costs.
Largest Share	The percentage of shares owned by the largest owner group

Table 2. Ownership Distribution Over Time According to Dominant Owner[1]

Year / **Ownership Group**	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Total
Domestic Outsiders	81	94	97	110	95	90	119	118	104	104	1012
Employee	48	54	47	41	27	26	29	24	19	19	334
Former Employees	0	0	11	14	19	15	16	13	3	3	94
Foreign	42	60	63	68	67	59	72	79	72	72	654
Managers	45	53	65	76	81	71	84	87	77	77	716
State	228	181	262	204	172	123	6	19	15	15	1,225
No Answer	54	56		1	19	18	31	4			183
Total	498	498	545	514	480	402	357	344	290	290	4218

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

Table 3. Means and Standard Deviations in Parentheses of Principal Variables Over Time

Year / **Variables**[1]	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Obs.[2]
Investment	2150 (12363)	2245 (18844)	3371 (22029)	3007 (17249)	2634 (15504)	3407 (14019)	4547 (19549)	4238 (16378)	4489 (15483)	4742 (15218)	4207
Capital	12250 (51023)	9740 (48137)	9771 (45305)	10329 (47218)	10411 (47756)	11200 (49623)	16816 (43022)	18217 (39576)	18934 (40332)	19881 (49653)	4218
Sales	21773 (63301)	21502 (61562)	30377 (93119)	24269 (69179)	27573 (77562)	27989 (63535)	32816 (88789)	35127 (74392)	36193 (76483)	36774 (75217)	4218
Employment[3]	196 (414)	166 (340)	164 (388)	161 (393)	157 (276)	137 (282)	124 (228)	138 (209)	129 (221)	126 (217)	4218
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)	28.19 (17.22)	29.09 (17.67)	31.28 (18.89)	4218
Cash Flow	805 (7530)	649 (8801)	1103 (10008)	658 (12607)	1678 (14428)	1994 (18195)	2932 (17328)	3429 (15692)	3689 (15219)	3712 (15771)	4218
Debt	867 (2692)	891 (4112)	1389 (3974)	1701 (4007)	1717 (3664)	2276 (3885)	2962 (4127)	2748 (4389)	2659 (4228)	2792 (4291)	4218
Current Payables	5516 (23301)	4848 (21130)	3804 (11895)	4334 (12503)	4363 (10672)	4605 (12843)	5445 (15750)	5538 (16327)	5729 (17482)	5792 (17795)	4218
Long-Term Liabilities	2595 (14961)	2702 (19652)	3143 (12450)	3433 (12048)	3820 (13874)	4469 (12052)	6863 (16384)	7019 (17119)	7321 (17673)	7448 (18437)	4218

[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 4. Share of Investment Financed Through Internal Funds and Loans Over Time According to Dominant Owner[1]

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
PART A	**Share Financed Through Internal Funds**									
Domestic Outsider	0.94	0.85	0.95	0.88	0.94	0.94	0.99	0.93	0.95	0.92
Employee	0.73	0.60	0.98	0.97	0.94	0.92	1.00	0.97	0.97	0.96
Former Employee			1.00	1.00	1.00	0.91	0.92	0.91	0.89	0.92
Foreign	0.76	0.63	0.91	0.94	0.84	0.88	0.86	0.81	0.78	0.73
Manager	0.90	0.82	0.93	0.92	0.95	0.96	0.96	0.90	0.84	0.88
State	0.89	0.86	0.94	0.94	0.96	0.96	1.00	0.93	0.96	0.91
PART B	**Share Financed Through Loans**									
Domestic Outsider	0.06	0.15	0.05	0.11	0.06	0.03	0.01	0.02	0.06	0.05
Employee	0.16	0.31	0.02	0.03	0.06	0.08	0.00	0.00	0.01	0.01
Former Employee			0.00	0.00	0.00	0.09	0.08	0.02	0.00	0.00
Foreign	0.06	0.22	0.02	0.00	0.07	0.04	0.08	0.10	0.10	0.12
Manager	0.00	0.10	0.07	0.04	0.02	0.03	0.01	0.04	0.09	0.11
State	0.05	0.04	0.03	0.04	0.02	0.04	0.00	0.02	0.02	0.01

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

Table 5. Coefficient Estimates for Two-Component Investment Regression and Switching Equation Using the Unbalanced Panel 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 Liquid Assets	Twice Lagged Liquid Assets
Constrained Regime	0.016* (4.54)	0.012* (21.32)	0.021* (5.29)	0.019** (1.91)	0.022** (2.19)	0.022** (1.79)
	Lagged Asset Sales	Twice Lagged Asset Sales	Domestic Outsider	Foreign	Manager	Employee
	0.036** (2.16)	0.028** (2.01)	0.016** (1.85)	0.023* (8.17)	-0.005 (-0.74)	-0.011* (-7.31)
N/Constrained Regime	Lagged Sales	Twice Lagged Sales	Lagged Cash Flow	Twice Lagged Cash Flow	Lagged Liquid Assets	Twice Lagged Liquid Assets
	0.056* (11.39)	0.009** (2.09)	0.004*** (1.47)	0.014 (1.13)	0.008** (1.89)	0.010** (1.95)
	Lagged Asset Sales	Twice Lagged Asset Sales	Domestic Outsider	Foreign	Manager	Employee
	0.029 (0.19)	0.011 (0.88)	0.009 (0.19)	0.012 (1.22)	0.001 (0.71)	-0.008 (-0.38)
Part 2						
Switching Equation[3]	Debt-to-Capital Ratio	Liquidity-to-Capital Ratio	Int. Coverage – to – Sales Ratio	Size	Age	SBC
Coefficient Estimates	0.028* (6.18)	-0.004* (-3.19)	0.077** (2.18)	-0.019* (-8.48)	-0.036*** (-1.59)	-0.017*** (-1.52)
	Largest Share*State	Largest Share * Domestic Out.	Largest Share*Foreign	Largest Share*Manager	Largest Share*Employee	
	0.027* (14.31)	0.074 (1.13)	0.012 (1.09)	-0.006* (-24.19)	0.028** (2.17)	

[1] * - significant at 1% confidence level, ** - significant at 5% confidence level, *** - significant at 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 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 6. The Average Probability of Being in the Financially Constrained Regime Over Time and Across Ownership Groups[1]

Ownership Group / Year	State	Foreign	Domestic	Manager	Employee
1995	0.52	0.32	0.42	0.47	0.54
1996	0.52	0.31	0.42	0.49	0.50
1997	0.52	0.29	0.42	0.49	0.52
1998	0.57	0.30	0.43	0.48	0.53
1999	0.56	0.33	0.46	0.49	0.57
2000	0.52	0.29	0.41	0.50	0.58
2001	0.54	0.28	0.41	0.48	0.58
2002	0.52	0.28	0.40	0.47	0.58

[1] The table reports average probabilities over time that each firm type operates in the financially constrained regime. The probabilities are obtained from the switching components of the switching regression framework.

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Endnotes

[i] First, the performance of investment demand models, even after being augmented with financial variables, is often not satisfactory in that they leave a large part of investment variation unexplained. Second, as Zeldes (1989) stresses, the use of structural models, especially in short panels, might fail to detect financial constraints when their tightness is almost constant over time. Further, there is some evidence of poor forecasting performance and parameter instability over time when estimating such equations as evidenced by Chirinko (1988), Hayashi and Inoue (1991), Oliner, Rudebusch and Sichel (1995), and Oliner, Rudebuch and Sichel (1996). Third, reliance on internal finance might not reflect financial constraints but rather behavior resulting from managers' and/or insider owners' preferences, such as aversion to outside control, and/or the use of an objective function other than maximization of dividends or even be due to Jensen's (1986) "free cash flow" hypothesis. Empirically it is difficult to disentangle these effects because they involve unobservables and, unsurprisingly, the available evidence, reviewed in Schiantarelli (1996), is mixed.

[ii] Hu and Schiantarelli (1998) estimate a similar model with unknown sample separation for a sample of U.S. manufacturing firms. On the other hand, Nabi (1989) estimates an endogenous switching regression model with known sample separation for a sample of Pakistani firms using information on firm's access to formal or informal credit markets to separate the sample. Finally, a similar approach is adopted 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. In the second step, he estimates investment equations separately for each sub-sample. The index constructed to partition the sample is assumed to be a function of firm liquidity, leverage, profitability and growth.

[iii] Studies that employ the neoclassical/accelerator model of investment demand include Jorgenson and Siebert (1968), Jorgenson (1971), Anderson and Kegels (1997), Lizal and Svejnar (1998, 2002), Budina et al. (2000) and Bratkowski et al. (2000).

[iv] An incomplete list would include Huberman (1984), Martin and Morgan (1988), Opler et. Al (1999) and Pinkowitz and Williamson (2001).

[v] The criteria are: (i) The firm's capital at the beginning and the end of the period should be positive; (ii) Investment should be non-negative; (iii) Investment should be smaller than end of period capital stock; (iv) Sales should be

positive; (v) The average employment per year should be positive and equal or greater than 10 ; (vi) Labor cost in a given year should be positive ; (vii) Ownership shares should add up to 100.

[vi] We estimated different versions of 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 here are for the best performing model. In this model, the investment equation includes lagged sales, twice lagged sales, lagged cash flow, twice lagged cash flow, lagged liquid assets, twice lagged liquid assets, lagged asset sales, and twice lagged asset sales, all normalized with lagged capital stock, along with ownership, time and industry dummies as explanatory variables.

[vii] In unreported regressions we estimated the model using a restricted version of the switching function, which included only financial variables. The findings based on these estimates are essentially unaltered from those reported in Tables 5. These unreported regressions are available from the authors upon request.

[viii] In the paper we discuss only the results obtained from the large (unbalanced) panel. As a robustness check we estimated all the specifications using the balanced sub-sample, which did not include all firms for which we did not have observations every year. The results obtained from the balanced panel are similar in sign and significance with those from the unbalanced panel and, consequently, we decided not to report them. These results are available from the authors upon request.

[ix] The critical values of χ^2 distribution at 5% significance level with 46 degrees of freedom is 61.66 . The value of likelihood ratio test is 209.12.

[x] In unreported regressions we extended the model by including the interactions of ownership variables with variables proxying for availability of internal finance. When estimated we find that the interaction coefficients are mostly insignificant and the significant ones have the right sign. The sign and significance of other coefficients is unaltered. These results are available from authors upon request.

[xi] We estimated specifications with the size and its squared included as right hand side variables. The coefficient of the squared parameter was insignificant and we decided not to report the estimates in the paper. The estimates are available from the author upon request.