OWNERSHIP STRUCTURES AND CAPITAL ALLOCATION: EVIDENCE FROM ESTIMATING PRODUCTION FUNCTIONS UNDER ALTERNATIVE SPECIFICATIONS

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Abstract

New and rich panel data for a large and representative sample of firms are used to estimate the effect of ownership structures on capital allocation. This issue is examined in a production function framework under alternative specifications. Our estimates confirm differences in capital allocation across firm under different ownership structure. Furthermore, we find that: (i) most of Estonian firms operate at the wrong point on their production function (ii) insider owned firms suffer from under-investment, (iii) state and domestic outsider owned firms display over-investment (iv) there is evidence of widespread managerial discretion.

Keywords: Corporate Investment, Insider Ownership, Production Functions, Generalized Method of Moments

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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 *(see endnote 1)* firms' creation (Dreze (1993), Putterman (1993), Bowles and Gintis (1996) and Dow (2003)). In turn, 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 and market failures, such as asymmetric information and moral hazard result in 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 and, consequently, some firms might be operating in an under-capitalized position compared to firms under alternative governance structures.

In this paper, using new and rich panel data for a large and representative sample of Estonian firms, we investigate econometrically the effect of ownership structures on capital allocation. Fundamentally, we provide new empirical evidence on a topic that has attracted the attention of theoretical and applied economists, but for which there is little empirical evidence. The analysis performed relates to previous empirical work on the efficiency of capital allocation through estimation of returns to scale in a production function framework. This work is then extended by checking the robustness of results through the use of alternative forms of the production function, namely Cobb-Douglas, Constant Elasticity of Substitution and Translog production function. A further contribution of the paper is that it is among the first attempts that provide a comprehensive analysis of the efficiency of capital allocation across ownership groups. Finally, 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 literature on the efficiency of various ownership forms emanating from the extensive privatisation process in almost all transition economies.

In the next section we develop the hypotheses on the effect of ownership structures on capital allocation. This is followed by a discussion of the analytical framework and of the problems arising in estimation of production functions. In the fourth section the sample used in the analysis is described, while in the fifth the estimation results are reported and discussed. In the last section we conclude and discuss some implications of empirical findings.

2. Ownership Structure, Capital Allocation and Returns to Scale

Various theoretical arguments, emanating from advances in economics of information, have highlighted the impact of ownership structures in

determining access to finance, which, in turn, affects investment decisions and capital allocation. The outcome of this process is that firms under certain ownership structures are likely to operate as under-capitalized, while others as over-capitalized.

One group of firms likely to face higher likelihood of being more constrained than others in raising capital is insider owned firms. The literature on employee ownership stresses a host of factors such as member' wealth position, their time horizon, risk attitudes, goal structure and the structure of property rights *(see endnote 2)* 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 lead to 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 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 substantially higher than the market one. Overall, disincentives to invest internally and barriers to raise capital externally might lead to employee owned firms under-investing. The implication of under-investment is that these firms will be operating in the increasing returns to scale region of the production function.

A substantial part of insider ownership is in the form of managerial ownership. An initial increase in managerial ownership is considered beneficial because it better aligns the interests of managers and shareholders and, consequently, lowers managerial discretion. However, at high levels, managerial ownership *(see endnote 3)* is associated with entrenchment and divergence of interests between managers and shareholders. In addition, high managerial shareholding creates incentives to issue overvalued securities at the expense of outside financers. These factors might result in firms 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 behaviour on the part of managers has been an argument against managerial ownership. 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 market for corporate control. When outside career opportunities do not exists 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, manager's behaviour 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 (Djankov (1999)). On the contrary, MBOs serve as screening mechanisms that allow only highly qualified, growth oriented *(see endnote 4)* managers to become owners *(see endnote 5)*. 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' entrenchment, which in itself exacerbates informational asymmetries and leads to more expensive external finance and less investment.

In addition to under-investment, certain types of firms might be prone to over-investment. This would be the case in firms where the existence of insufficient monitoring mechanisms leads to high managerial discretion. As manager's interests might be driven by empire building and personal satisfaction rather than shareholder value maximization this will result in them engaging in unprofitable investment projects or in even projects with negative net present value, which might result in over-investment. The implication of over-investment is that these firms will be operating in the decreasing return to scale region of the production function. As over-investment depends then on managerial discretion, it is conjectured that firms with highly dispersed outside ownership, and, consequently, more managerial control, are more likely to experience over-investment. Yet, the existence of an outside core owner that owns more than 50% of the shares in the firm does, in principle, provide the necessary mechanism through which managerial discretion can be kept under control. Whether outside majority shareholding translates into managerial discipline will depend on how active these outsider majority shareholders are in their monitoring role, which in itself will depend on the identity of majority shareholders.

When majority shareholders are foreigners, who possess enough experience and resources to engage in effective monitoring, managerial discretion will be kept at minimal levels and, consequently, over-investment will not be an issue. When majority shareholders are domestic outsider investors the degree of effective monitoring will depend on the identity, number and size of investors. Depending on

the combination of these factors several scenarios might arise. On the one hand, if majority 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 majority ownership is concentrated in the hands of a large number of small investors, possibly individuals, then managers are more likely to enjoy substantial discretion in pursuing their objectives and arguments that lead to over-investment will apply. In between these two situations lie a host of other scenarios resulting in different degrees of managerial discretion that might or might not give rise to over-investment problem. Given that in the sample we have no data either on the identity or on the number and size of domestic outsider investors, we can not make ex ante predictions on whether firms dominated by domestic outsiders will display over-investment or not. Finally, when majority ownership is concentrated in the hands of the state *(see endnote 6)* managers will possess virtual control of the firm and enjoy high degrees of discretion in pursuing their interests. As such state owned firms would be likely to display over-investment. The implication of over-investment is that these firms will be operating in the decreasing returns to scale region of the production function.

A mitigating force to managerial discretion in non-insider dominated firms is the availability of external finance. In a transition economy like that of Estonia, although the availability of external finance has been increasing over time, it is still limited relative to GDP. This would result in fierce competition for external financing and in, probably, all domestic firms, independently of governance structure, experiencing some degree of financing constraints *(see endnote 7)*. This argument implies that, in the case of non-insider dominated firms, more specifically of state and domestic outsider dominated firms, whether they operate in the increasing or decreasing returns to scale region of the production function will depend on the net effect of managerial discretion, or the effectiveness of monitoring mechanisms, and access to external finance. Yet, even if these firms experience under-investment, its degree would be more limited than that of insider dominated firms.

3. The Analytical Framework

The analysis starts with the assumption that a specified relationship exists for every firm between output, expressed as firm sales, and inputs employed in production, of the following form: $V = F(K, L, A)$ where V denotes sales, K and L denote quantities of capital and labour used in production and A is an index of technical change. Estimating returns to scale requires the operationalization of this relationship. Depending on the assumptions of the properties of such functions, different functional forms have been proposed in the literature. Here the following alternative forms of the production function are adopted: Cobb-Douglas, Constant Elasticity of Substitution and Translog *(see endnote 8)*.

Although based on highly restrictive assumptions, the Cobb-Douglas production function, is the most frequently used in empirical studies. Its estimable version takes the following form:

$$\ln(V/L) = \ln A + r \cdot T + \alpha \cdot \ln(K/L) + (\alpha + \beta - 1) \cdot \ln L + u \quad (1)$$

where α and β are output elasticities with respect to inputs, r is the average rate of Hicks neutral technical change, T is a time index and u is a standard disturbance term. A positive and significant coefficient on $(\alpha + \beta - 1)$ will confirm the presence of increasing returns to scale while a negative and significant coefficient on $(\alpha + \beta - 1)$ will confirm the presence of decreasing returns to scale.

Although very convenient in estimation, this form of the production function has the disadvantage of being very restrictive in that it limits all partial elasticities of substitution be equal to one. This restriction is relaxed in the Constant Elasticity of Substitution function of Arrow et. al. (1961), that, as the name shows, limits partial elasticities of substitution to be constant and equal for any input pair, but not always equal to one. Its estimable version is the following:

$$\ln(V/L) = \ln A + r \cdot T + (\eta - 1) \cdot \ln L - \frac{\eta}{\rho} \cdot \ln\left[\delta + (1-\delta) \cdot \left(\frac{K}{L}\right)^{-\rho}\right] \quad (2)$$

where δ is the distribution parameter, ρ is the substitution parameter and η is the elasticity parameter. The linear estimation of equation (2) is, however, not possible unless the term in brackets is approximated by a linear function. Following Kmenta (1967), this term is approximated by a second order Taylor series expansion around the point $\rho = 0$. Then, the estimating equation becomes the following:

$$\ln\left(\frac{V}{L}\right) = \ln A + r \cdot T + (\eta - 1) \cdot \ln L + \eta \cdot (1-\delta) \ln\left(\frac{K}{L}\right) - \frac{1}{2} \cdot \rho \cdot \eta \cdot \delta \cdot (1-\delta) \cdot \left(\ln\left(\frac{K}{L}\right)\right)^2 + u \quad (3)$$

The test for increasing (decreasing) returns to scale then becomes a test for positive (negative) and significant coefficient of $(\eta - 1)$. Inspecting equations (1) and (3), it can also be seen that a significant coefficient on the last term in equation (3) points to the rejection of the Cobb-Douglas function. This means that, except for testing the returns to scale parameters, equation (3) serves to discriminate which of the two models fits the data better.

The development of both Cobb-Douglas and Constant Elasticity of Substitution functional forms rests heavily on the assumptions of homotheticity and

separability, which lead to elasticities of substitution being constant for any pair of inputs. Christensen et. al. (1973) propose a functional form that is independent of these assumptions and does not constraint elasticities of substitution in any way. For our general specification this functional form will be a translog second order approximation *(see endnote 9)* to the logarithm of V, as introduced, for instance, by Chan and Mountain (1983), as follows:

$$\ln V = a_1 + a_2 \cdot T + a_3 \cdot T^2 + a_4 \cdot (\ln K - \ln L) + a_5 \cdot \ln L + a_6 \cdot \left[(\ln K)^2 - \ln K \cdot \ln L\right] + a_7 \cdot \left[(\ln L)^2 - \ln K \cdot \ln L\right] + a_8 \cdot T \cdot (\ln K - \ln L) + u \quad (4)$$

If $a_5 = 1$ the production functions displays constant returns to scale, it $a_5 > 1$ it displays increasing returns to scale and if $a_5 < 1$ it displays decreasing returns to scale.

The parameters of interests in each equation are: a_4 in the Cobb-Douglas equation, a_3 in the Constant Elasticity of Substitution equation and a_5 in the Translog equation.

A central, well-known problem in estimation of production functions is simultaneity bias *(see endnote 10)*, leading to inconsistency of OLS estimates. Alternative estimation methods proposed in the literature are Instrumental Variables and Generalized Method of Moments (GMM) estimators. A recurring problem with the latter two estimators is that the available instruments for the first difference in inputs might be weak and possess little explanatory power. A robust estimation approach, which explicitly accounts for input endogeneity, is the one developed by Olley and Pakes (1996). This method uses an investment proxy to control for the correlation between input levels and the unobserved productivity shock. Levinsohn and Petrin (2003) extend this method by showing that the use of intermediate inputs also corrects for the endogeneity problem. Further, the use of intermediate inputs is superior to that of investment proxy in samples of firms reporting zero or negative investment.

A further source of bias in the estimation of scale parameters from a production function specification is the use of deflated sales instead of real output as the dependent variable. This approach implicitly assumes that all firms within the same industry charge the same price. Price dispersion, however, even in narrowly defined industries, in the presence of imperfect competition is a major source of firm heterogeneity. Klette and Grilichies (1996) show that there exist a systematic relationship between the price a firm charges and its inputs' growth. This relationship depends on idiosyncratic shocks to both factor prices and productivity, as well as demand shocks. The cost of not accounting for the effect of omitted output price variable is that the estimated scale elasticities would be a mixture of real scale elasticities and demand side elasticities and be, consequently, downward biased. Although instrumental variable approach would seem the appropriate way to solve this issue, it is not trivial finding instruments that are correlated with inputs or their growth, but not with the omitted output price. Klette and Griliches (1996) solve for the omitted output price variable by including total industry's output as independent variable in the production function specification *(see endnote 11)*.

4. Sample Description and Variable Definitions

The data used in this paper consist of 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, which gather information on ownership configurations, and from standard firm financial statements reported to the Estonian Statistical Office. The firms included in the survey scheme are selected as a stratified random sample based on size and industry. Before carrying out the analysis we address measurement error issues by adopting several criteria to examine consistency of our data *(see endnote 12)*. The application of all these criteria results in our using in the analysis a data set consisting of 3294 observations over the whole period 1993 through 1999.

Sample firms are classified into six ownership *(see endnote 13)* groups according to the dominant owner: domestic outsider, employee, former employee, foreign, manager and state. Table 1 presents the distribution of firms by ownership group over time. The data show 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. This provides evidence to 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 up as being new ones. Yet, this might partly come 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. 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.

Table 2 presents summary statistics of the most relevant variables used in the analysis. One observation emerging from both of these tables 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 for the unbalanced panels and from 0.17 in 1993 to 0.36 in 1995 for the balanced panel. 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 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 in the unbalanced panel, 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 especially during the early years of the transition. 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.

5. Empirical Results and Discussion

This section reports and discusses the results of estimating equations (1), (3) and (4). In estimation each equation is augmented with a vector X consisting of industry and time dummies designed to capture industry and economy wide specific effects common to all firms such as a banking crisis, shocks to exchange rate, demand shocks, industry idiosyncratic productivity shocks, etc. Furthermore, to correct for the correlation of inputs quantities and output price present in the deflated sales variable all the specifications are estimated with the total industry output included as a right hand side variable.

The hypothesis of significant differences in returns to scale parameter across firms with various governance structures could be tested in two ways. One way is to pool the whole sample together and introduce dummy variables that will take the value one if a given firm belongs to a given ownership group and zero otherwise. While accounting for the ownership effect on firm productivity, this approach imposes the restriction that all input elasticities are the same across ownership groups, with differences in performance captured only by differences in intercept terms. Relaxing this restriction, all dummies could be interacted with all other variables in the regression allowing not only the intercepts but also slopes to differ across groups. A disadvantage of this approach is that the number of parameters to be estimated increases substantially. For example, leaving the state owned firms as the control group, the Cobb-Douglas specification will have 20 more parameters to be estimated, i.e., five dummy variables denoting the other ownership groups and their respective interactions with T, $\ln(K/L)$ and $\ln L$. The test on returns to scale for a given ownership group would then be a test on the significance of the sum of two parameters, i.e., the coefficient a_4 and the coefficient in front of the interaction of the respective ownership variable with $\ln L$. With large enough samples, however, the estimates would still be unbiased and consistent and all tests performed would be valid.

In addition to the increase in the number of parameters to be estimated, this approach suffers from further problems. First, when data are pooled the variance of the residual is forced to be the same across groups. A more serious problem though 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 firm productivity. If unaccounted for this problem will lead to inconsistent estimates. The solution to such problems is the application of IV techniques where appropriate instruments are found that are highly correlated with the ownership dummies but not correlated with the error term *(see endnote 14)*. Finding such instruments, however, is not easy. The literature on determinants of ownership structures suggests that variables such as firm profitability, labor productivity, capital intensity, current and future financing requirements, firm size as well as industry specific variables, all appropriately lagged, would serve as instruments for ownership dummies. Yet, this procedure imposes heavy requirements on data and, given the discussion above on the endogeneity of inputs, identification problems might arise.

A solution to this issue would be to divide the sample into sub-samples of firms belonging to a given ownership group and then carry out the estimation for each group separately. In adopting this strategy, it is implicitly assumed that the ownership effect is constant across firms within each ownership group, i.e., that while there is between group variation in ownership effect, there is no within group variation. This might be a reasonable assumption in that owners of the same type are, on average, expected to behave similarly. However, even within each individual group there are differences in ownership structures across firms that might lead to differences in observed behavior. For instance, it is conjectured that the monitoring of management on the part of owners would be more effective the higher the share they own in the firm. This means that, managerial discretion would be more limited in a firm where dominating owners, other than the managers themselves, own, let us say, 80% of the shares than in a firm where dominating owners own just 35% of the shares.

Furthermore, the higher the share owned by employees the more pronounced the under-investment problem might be. The implication of these arguments is that, grouping firms into ownership clusters based only on owners' identity and not on the degree of concentration of ownership, i.e., percentage of shares held by the largest owner, overlooks important differences within each cluster and leads to imprecise inferences. Yet, we do not expect our results to be affected by the separating criteria we have used. The reason is that, 87% of firms in the sample have a clear majority owner. This pattern is similar across ownership groups, with the lowest share of firms having a clear majority owner being 75% for employee owned firms, while the largest being 99% for state owned firms. This makes it reasonable to assume that owners of the same type behave similarly and, in turn, within group ownership effect will be the same. Idiosyncratic ownership effects for an individual firm would then be captured by the inclusion in the specification of firm specific dummies. Under this assumption, separating the full sample into sub-samples and carrying out the analysis for each of them separately, solves the endogeneity of ownership issue and provides consistent estimates. Adopting this approach, for the purposes of the analysis the sample is divided into the following five sub-samples: state owned, foreign owned, domestic outsider owned, employee owned and manager owned firms *(see endnote 15)*.

GMM and Olley-Pakes (OP) regression estimates for the Cobb-Douglas, Constant Elasticity of Substitution and Translog production functions for each ownership group are reported in Table 4, Table 5 and Table 6, respectively *(see endnote 16)*. These methods allow to explicitly control for the potential endogeneity of inputs as well as to model sample selection, which is an important factor given the potential exit from the market of least efficient firms. The presence of increasing (decreasing) returns to scale is given by significantly positive (negative) coefficient a_4 in the Cobb-Douglas case, significantly positive (negative) coefficient a_3 in the Constant Elasticity of Substitution case and significantly greater (smaller) than unity coefficient a_5 in the Translog case.

Focusing on the differences across estimation methods, we see that GMM estimates are generally insignificant although the regression fit in terms of the partial R^2, which measures instrument relevance, is within the range of that found in other studies. Furthermore, instrument validity, tested through Hansen's J-statistic, is never rejected. However, as already noted, the insignificance of individual coefficient estimates could be driven by the fact that instruments are weak and their explanatory power is low. The OP results although producing the same general pattern of returns to scale, show more significant evidence of the presence of increasing or decreasing returns to scale.

Test results on the appropriate functional form for the production function are mixed. The significance of coefficient a_5 in the Constant Elasticity of Substitution regression leads to rejection of the Cobb-Douglas as the appropriate functional form for domestic outsider and state owned firms. For all other firm types the Cobb-Douglas specification is firmly accepted, When the Translog specification is then compared to both the Cobb-Douglas and the Constant Elasticity of Substitution using F tests, it emerges that it dominates the other two functional forms only for domestic outsider owned firms. For employee owned firms the Cobb-Douglas form outperforms the other two, while for the other groups there is no one single form that dominates the other two across all estimation methods used. These conclusions indicate that pooling all firms in one sample and carrying out the estimation adopting one functional form, appropriately chosen, would result in mis-specification bias.

The results, in general, provide support to our hypotheses. In the Cobb-Douglas and Constant Elasticity of Substitution case the coefficient of returns to scale is mostly positive and significant for employee and manager owned firms, pointing to increasing returns to scale, and mostly negative and significant across other ownership groups, pointing to decreasing returns to scale. The same pattern holds in the Translog case where the coefficient of returns to scale is significantly above unity for employee and manager owned firms, pointing to increasing returns to scale, and significantly below unity, for other ownership groups, pointing to decreasing returns to scale. Tests performed indicate that for domestic outsider and state owned firms the coefficient is significantly smaller than one, while for foreign owned firms it is not, suggesting that foreign owned firms operate at the constant returns to scale point of their production function.

Examining the results more closely we observe that coefficient signs are, generally, not affected by the functional form adopted. Their magnitude and significance, however, do, although differences in coefficients from one functional form to the other are not large. It would be desirable, however, to test whether this difference is significant or it is due to differences in other parameters. Yet, such tests cannot be performed through first estimating separate regressions and then comparing parameters across them, due to the fact that the covariance of the parameters to be compared cannot be estimated. One has to pool the data into a single regression where both coefficients appear, with dummy variables, and their interactions with all other variables in the regression, introduced to capture group specific coefficients. The estimation of a single regression is further complicated by two considerations. First, one has to account for the endogeneity of ownership

dummies. Second, estimating a single production function across groups of firms that have different functional forms might cause mis-specification bias. Nevertheless, bearing these points in mind when evaluating the test results, we proceed by pooling the data, estimating a single regression using all functional forms *(see endnote 17)* and then test for coefficient equality across ownership groups.

In general, the results of the tests are inconclusive, with the outcome depending on the functional form assumed and the estimation method applied. For instance, if returns to scale for manager and foreign owned firms are compared, the null of coefficient equality cannot be rejected when Constant Elasticity of Substitution and Translog production function parameters are estimated using GMM. However, returns to scale are significantly lower for manager owned firms when estimation is carried out using OP estimator. Similar conclusions are obtained when returns to scale parameters for foreign, manager, state and domestic outsider owned firms are compared to each other in pairs. Only, for employee owned firms are we able to show that they display significantly different returns to scale than all other groups across all functional forms and estimation methods.

Besides returns to scale parameters, an interesting fact that emerges from the tables is the high rates of growth of real output per annum across all ownership groups expressed by time trend coefficients α_2 in respective regressions. Curiously, none of the time trend coefficients is significant for the Translog production function. When the other two forms are adopted, we find that output growth rates range from 4,7% per annum for employee owned firm to 19,8% per annum for foreign owned firms. These estimates are large, even if one takes into account the high growth rates that Estonia's economy experienced over the period covered by this study. In fact, the average growth rate of real GDP in Estonia over the period 1995 through 1999 was around 4,7% per annum. Our results indicate average growth rates of about twice as large *(see endnote 18)*, suggesting that our sample consists mainly of above average performing firms.

Another finding emerging from the tables is that the industry output variable is mostly insignificant. In particular, the expectation that its inclusion will correct the bias in returns to scale coefficients and consistently produce larger estimates is not fulfilled *(see endnote 19)*. Sometimes returns to scale coefficients become larger, but sometimes they become smaller. The differences in absolute value across ownership groups are not small and the results are in line with those obtained before. Similarly, the estimates of the growth rates of real output confirm previous findings, with employee owned firms experiencing an average 4,8% growth per annum, while foreign owned firms experiencing an average 11,4% growth rate per annum.

The results of this analysis indicate that all firms in Estonia operate, albeit to a different degree, with inefficient input combination, i.e., they are at the wrong point on their production function. One potential explanation of this inefficiency is that it arises from conflicts with outside providers of capital or from preferences in capital allocation of various owners' types. Alternatively, the results could be driven from agency conflicts within the firms, i.e., from conflicts between owners and managers. If this were the case, the findings would be consistent with some theoretical predictions and empirical observations. First, foreign owners are more successful in disciplining management. Second, managers in domestic non-insider owned firms enjoy large degrees of discretion and they can pass the cost of their actions to other shareholders. Third, managers in employee owned firms enjoy high degrees of control and subsequently discretion. Yet, while agency conflicts might be present and play their role in inefficiencies in capital allocation, there is one environmental factor related to transition 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 that they cannot dispose of due to the lack of a secondary market. It could well be the case that one of the strings attached to privatisation contracts was that new owners, irrespective of their identity, were forced to buy the privatised entity as a whole instead of being able to cherrypick the best assets and renounce the unproductive ones. To be able to conclude whether our results are mostly driven from one or the other explanation, we would need to control for the inheritance phenomenon.

6. Conclusions

This paper has analysed the effect of ownership structures on capital allocation by estimating returns to scale in a production function framework. The robustness of results has been tested through the use of alternative functional forms of the production function, namely Cobb-Douglas, Constant Elasticity of Substitution and Translog production functions. The theoretical arguments explored led to testable hypotheses regarding the effects of ownership structures on the efficiency of capital allocation. More specifically, employee and manager owned firms might display under-investment due to extra premium on the price of external finance charged by providers of capital because of idiosyncratic informational asymmetries and agency costs. Furthermore, over-investment might arise in firms with imperfect monitoring mechanism that lead to high degrees of discretion on the part of managers. In both cases firms will operate with inefficient input mix or inefficient scale, but the direction of the inefficiency will be different. In the case of under-investment the firm will display increasing returns to scale, while in the case of

over-investment it will display decreasing returns to scale.

The estimation of returns to scale suffers from simultaneity bias and endogeneity problems, which, if unaccounted for, lead to inconsistent parameter estimates and imprecise inferences. Simultaneity bias arises when right-hand side variables are correlated with unobserved factors that are relegated in the error term. Different estimators are developed to correct for this bias depending on the assumptions on the nature of unobservables and the way their effect is transmitted to right-hand side variables. Furthermore, the choice of input quantities is correlated with output prices present in the left-hand side variable when deflated sales or value added is used instead of real output. Finally, in the estimation of production functions one has to control for the endogeneity of ownership, i.e., the fact that, in equilibrium, different owners will determine their optimal ownership share based on various firm characteristics, among which is firm productivity. Here all these issues are explicitly accounted for, first by separating the sample into five sub-samples according to ownership structure and then carrying out the estimation for each sub-sample by employing alternative estimation methods. Moreover, the inclusion of total industry output as right hand side variable controls for the unobserved output price.

The results of this analysis indicate that, on average, all firms in Estonia operate, albeit to a different degree, with inefficient input combination, i.e., they are at the wrong point on their production function. One potential explanation of this inefficiency is that, it does not arise from conflicts with outside providers of capital or from preferences in capital allocation, but from agency conflicts within the firms, i.e., from conflicts between owners and managers. Yet, while agency conflicts might be present and play their role in inefficiencies in capital allocation, there is one environmental factor related to 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 a secondary market to dispose of. To be able to conclude whether our results are driven from one or the other explanation, we need to control for the inheritance phenomenon.

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Notes

[1] Insider owned are those firms where the ultimate decision-making rights and residual claims rest with their worker members, where the decision-making and residual claimant group could consist of the whole firm's labor force or a small part of it. From this set of firms are excluded those where employees exercise influence in decision-making through unions or other collective bargaining agreements.

[2] 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 of the cases, employee owners are share owners, i.e., they own part of the firm on an individual basis and are able to trade shares in the capital markets. However, these firms still retain a strong degree of collective ownership by imposing limits on share trade. Evidence of this is provided by, for instance, Kalmi (2002) for Estonia. In a field survey of firms under insider ownership he 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.

[3] 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 high as 10%.

[4] In contrasts to standard managerial theories, the term growth-oriented in this context does mean empire-builder for personal satisfaction but rather people devoted to restructuring and reform.

[5] Financing of an MBO often requires external financing and only qualified managers might be able to raise external finance.

[6] As Shleifer and Vishny (1997) point out state ownership can be viewed as relation between a principal and two agents. The principal are the individuals (citizens), who are the ultimate owners of the firm. Being dispersed they have no ability and 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 have usually objectives quite different from those of the principals and they can easily collude to pursue their objectives at the expense of the principals.

[7] This argument will not apply to foreign firms, as they are expected to have access to sources of funds other than domestic capital markets.

[8] In what follows, in order to simplify the notation the firm index is suppressed, but it should be kept in mind that all variables refer to firm level ones.

[9] In empirical work the translog production function framework has been widely used to examine various issues, such as, for instance, input substitution, separability and aggregation, technical change, productivity growth and productive efficiency. However, in most of the studies, estimation is carried out using cost share equations derived under the assumptions of constant returns to scale and perfect competition in both input and output markets.

[10] The source of this bias is the unobserved firm characteristics that affect input choices. A more formal and detailed presentation of this issue, as well as a summary of studies that account for it, can be found in Griliches and Mairesse (1995).

[11] They specify the demand facing an individual firm as function of total demand faced by the industry and the market share of the firm. The omitted output price variable is then expressed as a function of observables, such as industry's and firm's output. Incorporating this relation in the production function specification leads to the addition of industry's output as a right-hand side variable with its coefficient being the inverse of firm's demand elasticity. Their empirical results show that the coefficient of the industry's output is highly significant and that its inclusion eliminates the downward bias in scale elasticities.

[12] 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.

[13] Ownership is defined as the right to residual returns, i.e., to what remains after the factors of production have been paid their contribution. In addition, some authors, as 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), whether formal or real control need to be taken into account. For example, Kalmi (2002) presents case study evidence that in employee owned firms there are the managers those who exercise real control. Measuring control, however, and, especially, distinguishing formal versus real control, would require data, for instance, on owners' board representation, on voting rules, shares classes and 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.

[14] Another solution would be the application of Maximum Likelihood Estimation. Yet, this approach is more sensitive to mis-specification and is more data intensive.

[15] With respect to former employee owned firms the total number of observations over the whole sample is small and, given that estimation methods are data intensive, it does not allow meaningful analysis. One approach to carry out the analysis is to group these firms together with employee owned firms. While it is difficult to imagine that former employee owned firms will behave similarly to real outsider owned firms, it might also be debatable whether they will display behavior similar to employee owned ones. An argument in support of this assumption is that, drawing from their previous experience as insiders

in the firm and potentially enjoying high degrees of coordination with their previous peers, i.e., current incumbents, former employees will actively participate in monitoring the management as well as be involved in important decision-making. If this argument does not hold, however, former employee owned firms will be closer to state owned firms where managers enjoy high degrees of discretion in following their objectives at the expense of outside shareholders. Tests were performed to determine whether former employee owned and employee owned firms could be pooled together. In no case were we able to reject the null hypothesis that coefficient vectors are the same across both groups. Subsequently, we pool these two groups together in the analysis.

[16] In unreported regressions depending on different assumptions on the degree of simultaneity bias and endogeneity of inputs, we also estimated specifications using OLS, Within in levels, OLS in first differences, Within in first differences. The findings based on these estimates are essentially unaltered from those reported in Tables 4, 5 and 6. These unreported regressions are available from the authors upon request.

[17] Ownership dummies are instrumented with the fitted values of a first-stage probit equation predicting the probability that a firm would be in a given ownership structure at a particular point in time as function of firm's profitability, productivity, capital intensity, labor quality, investment, all lagged one period, as well as firm size, industry and time specific effects. In estimation the variance of the residuals is not constrained to be the same across groups.

[18] We obtain the same results when the sample is pooled and a single equation is estimated. In this case the estimates of time trend parameter are the following: 0.092 for the Cobb Douglass, 0.084 for the Constant Elasticity of Substitution and 0.118 for the Translog production function. The latter coefficient is, however, insignificant.

[19] We estimated regressions, unreported here, excluding the industry output variable. The results were similar in terms of sign and significance, but there were substantial changes in magnitude.