# OWNERSHIP STRUCTURE, TEHNOLOGY TRANSFER AND FIRM PERFORMANCE

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**Abstract**

This paper contributes to the literature on corporate governance by providing evidence on the importance of owner identity on technology transfer from foreign firms. To this end we use a panel of Estonian firms for 1993-2002 and employ panel data techniques to avoid endogeneity and sample selection bias. We find that across different ownership groups only domestic outsiders benefit from spillovers of technology transfer. However, a large technology gap with foreign firms motivates all local firms to use their existing technology more efficiently and as such successfully cope with the increased open market competition. Furthermore, because of rent seeking and/or asset striping behavior insider owned firms, face financial constraints, and as such cannot invest in new technology as much as domestic outsider owned firms.

**Keywords:** executive compensation, corporate governance

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## 1. Introduction

The privatization process in transition economies resulted in the emergency of a variety of ownership structures. While the advantages of private ownership over the state one were easily established, the debate on which form of private ownership would lead to better restructuring outcomes and higher levels of performance was an on-going one. This debate gave rise to an extensive theoretical literature, which shows the advantages of certain ownership forms over the others, and empirical literature, which assesses the role of different ownership structures on enterprise performance. The latter literature consists of studies that compare the pre- and post-privatization firm performance as well as studies that compare the performance across firms with different ownership structures. A general insight emerging from this literature is that privatization improves firm performance with, in most cases, outsider owned firms performing better than the other domestic ownership forms (Djankov and Murrell, 2002).

Many transition economies welcomed foreign direct investments (FDIs) during their privatization process, believing that FDIs would bring in access to advanced technology, new capital and managerial expertise. It is a well-known fact that FDIs affect a local economy directly with advanced technology, increased employment, and exports, and indirectly with increased productivity of local firms through transfer of technology (Kokko, 1994; Blomstrom and Kokko, 2002). Externalities that result in improved firm productivity through technology transfer are known as technology or productivity spillovers, since the foreign investor cannot appropriate them fully (Kokko, 1994). They can improve local firms' productivity through demonstration-imitation effects and/or labor mobility or cause negative effects by crowding out local firms (Aitken and Harrison, 1999).

The purpose of this paper is to investigate the importance that firm ownership structure has on technology transfer between foreign and local firms and, consequently, on firm performance. To this end, we employ a sample of Estonian firms for the period 1993-2002, with detailed information on different firms' ownership structure. Our study is most unusual because, unlike most studies for transition economies, which estimate the impact of ownership structure on firm performance, we estimate the impact that technological transfer has on firm performance for different ownership structures. Consequently, we contribute to the literature on corporate governance by providing evidence on the importance of owner identity on technology transfer from foreign firms Most importantly, we also account for the technological gap between foreign and local firms, classified in employee, manager, outsider and state-owned firms, which is measured as the difference from the stochastic production frontier. Lastly, the panel nature of our data allows us to account for issues of unobserved firm heterogeneity, sample selection bias and endogeneity.

The structure of the paper is as follows. In section 2, we discuss the theoretical arguments and review the extant literature on the relation between ownership structure, firm performance and productivity

spillovers. In section 3, we describe the data and the privatization process in Estonia. In Section 4, we describe the estimation strategy and in section 5 we discus the results. Finally, in Section 6, we conclude.

## 2. Theoretical Considerations

The start of transition underscored the need for restructuring of state-owned enterprises, which, in turn, led to the necessity of bringing in non-state owners on the grounds of possessing the required expertise and having access to new capital. Yet, the identity of new owners was not a foregone conclusion and has long been debated by economists and policy makers (Boycko et. al., 1996; Grosfeld and Roland, 1997; Aghion and Blanchard, 1998). The discussion is often framed into insider versus outsider framework, although within each group there is heterogeneity of owners, which raises further considerations. Importantly, the advice and policy prescriptions offered to governments in the process of designing privatization policies hardly mentioned insider ownership, especially employee ownership, as a viable way of transformation of enterprises. Whenever mentioned, its negative effects were envisaged, while its positive effects overlooked. The pitfalls of insider ownership included insiders' risk averseness, their preferences for short-term income and labor hoarding, and their discrimination against non-insider shareholders (Lipton and Sachs, 1990; Blanchard et al., 1991; Boycko et al., 1996; Earle and Estrin, 1996). All these would result in insider-owned firms inability to obtain necessary financing and delayed restructuring (Aghion and Blanchard, 1998; Filatochev, Wright and Bleaney, 1999). An overall conclusion of this line of arguments seems to be that privatization to outsider owners is more likely to lead to desired restructuring and firm performance.

In between outsider owners, foreign owners were expected to restructure faster. These expectations stemmed from the fact that foreign owners would bring in new capital, technology, managerial expertise and competitive pressure. For instance, studies that have accounted for the endogeneity problem (the fact that often insiders selected the best performing firms) have been successful in finding a positive relationship between firm performance and outsider ownership, concluding that, privatization "works" only if the firm is controlled by outsiders. For instance, Smith et al. (1997) find that foreign ownership improves firm performance more than employee ownership. Similarly, Earle and Estrin (1997) find that, outside private owners and firms owned by investment funds in Russia have undertaken the deepest restructuring and were the best performing. In another study, Frydman et al., (1999) compare the performance of state and privatized firms in three transition economies Czech Republic, Hungary and Poland for the period 1990 through 1993. They conclude that privatization improves the performance of firms owned by outsiders.

Furthermore, Djankov and Murrell (2002), in a comprehensive literature review of the studies on the effects of privatization in transition economies, conclude that: in general privatization is inclined to improve firm performance; in most cases privatized firms perform better than state owned firms; concentrated ownership is beneficial for firm performance; and that Central and Eastern European countries experienced a larger positive impact of privatization than the CIS countries.

It is widely recognized that foreign direct investment (FDI) has played an important role in the process of restructuring by providing a vital source of investment for overcoming the situation of a collapsing state sector and a slowly growing private sector, and by contributing managerial skills, new technology, capital and competition (IMF et al. 1991, EBRD 1994, Meyer 2001). These contributions are expected to benefit domestic firms that come in contact with foreign-owned firms. More specifically, by welcoming foreign direct investments, developing and transition countries hoped to generate technology transfer to local firms, since foreign direct investment is associated with the existence of intangible assets owned by the parent firm (Kokko 1992, Blomstrom and Kokko 1996). The transfer of foreign technology to local firms may occur through various forms of spillovers, or externalities. Such spillovers are usually known as technology spillovers and occur when the activities of one firm lead to improvements in technology and, hence, in productivity of another firm and as such the first firm cannot capture all benefits created by its technology[i7]. Technology spillovers are measured by estimating production functions where the spillover effect is the coefficient in front of the share in employment, equity or sales of foreign firms in the industry (Görg and Strobl, 2001; Meyer and Sinani, 2008).

Accordingly, spillovers of technology transfer may materialize through four main channels: demonstration-imitation, training of domestic employees, competition and backward –forward linkages. Positive spillovers of technology transfer occur when the foreign firms after entering the market demonstrate their advanced technologies to domestic firms, which may afterwards adapt and imitate them (Kokko 1992), when they train domestic employees who may leave for the domestic firms or through backward forward linkages. Negative effects may arise when the increased competition from foreign firms, which can produce at lower marginal cost with their advanced technologies, drive market shares away from domestic firms. Especially in the short run, competition from foreign firms may crowd local firms out of the market (Aitken and Harrison 1999).

[7] Since technology spillovers lead to improvements in domestic firm's productivity they are also known as productivity spillovers.

However, it may also be the case that domestic firms use the existing technology more efficiently or invest in new technology in order to maintain their market shares (Blomstrom and Kokko 1998).

The empirical literature spillovers from technology transfer includes studies on transition, developing and developed economies. Yet this literature provides rather mixed results as some studies find that foreign presence has a positive impact on the productivity of domestic firms, while others find no evidence or a negative effect (Sinani and Meyer, 2004). The different results are mainly the outcome of using aggregate versus firm level data. Studies that use cross-section data do not control for firm specific effects and as such lead to an upward bias of the spillover coefficient (Görg and Strobl, 2001).

Local firms' ability to attract technology spillovers may also vary with the technology gap, namely the difference in technological levels between domestic and foreign firms. The larger the technological gap between foreign and local firms, the larger is the potential for productivity improvements (Findlay, 1978; Das, 1987). Relatively backward local firms may increase their productivity even by imperfect copying of production processes used by foreign firms. In particular, the technological gap hypothesis implies that the magnitude of spillovers may be larger for developing and transition economies than those in industrial countries.

In this paper we investigate the effect that firm ownership structure has on spillovers from technology transfer and consequently on firm performance. While the literature on spillovers from technology transfer distinguishes only between foreign and local firms, in this paper we are able to differentiate local firms into four ownership groups, namely, manager, employee, domestic outsider and state owned firms. Accordingly, we contribute to the literature on corporate governance by providing evidence on the importance of owner identity on technology transfer from foreign firms. Furthermore, in contrast to Sinani and Meyer (2004), we employ a more detailed ownership categorization, as well as account for the importance that technology gap has on the different owner potential to adopt the foreign technology.

## 3. Data and Variable Definitions

Our data consist of annual firm-level observations for Estonian firms for the period 1993-2002 and it contains detailed information on financial statements and ownership structure. The ownership data is obtained from ownership surveys reported at the Estonian statistical office. Firms included in the survey scheme were selected from a stratified random sample chosen to represent eighteen economic branches at a 3-digit Nace classification. Responses provide detailed information on the distribution of ownership across managers, employees, outsiders (separated into foreigners and domestic), and the state. The ownership data were then augmented with firm's economic and financial information from the balance sheet and income statements. Prior to using the data, a series of consistency checks were performed and inconsistent data is left out[8].

**Dependent Variable.** *Value added* is constructed as the sum of net profit, depreciation and labor cost. Labor cost is the sum of wages and salary, social security and interest costs. The dependent variable is expressed in thousands of kroons.

**Independent Variables**. *Ownership structure* is constructed by classifying firms into five categories: foreign owned, employee owned, manager owned, domestic outsider owned and state owned, using the percentage of shares held by the largest or dominant owner. Although frequently used in the literature (Earle, Estrin and Leshchenko, 1996; Frydman, Gray, Hessel and Rapaczynski, 1997; Jones, 1998; Jones and Mygind, 1999), this approach has been often criticized on the grounds that it does not take properly into account the presence of dispersed ownership and might, consequently, not lead to the optimal typology of ownership forms. This concern does not seem to be present in our data, which are characterized by highly concentrated ownership. For instance, in 95% of the cases the dominant owner is also the majority owner. Table 1 shows the evolution of dominant ownership over time.

**[Insert Table 1 here]**

The data provide evidence to the importance of insider ownership during the early years of transition, with substantial employee and managerial dominant ownership. However, a clear trend that emerges from the table is also the steady decline in employee ownership over time. Differently, managerial ownership shows a slight increase over time. In fact, unreported transition matrixes, show that over time firms owned by employees and former employees switch ownership to managers. The clear definition and division of ownership groups allows us to perform the empirical analysis separately for each and every group and as such we are able to derive the importance of owner's identity on technology transfer and firm performance.

*Competition* is proxied with the Herfindahl index, constructed at a three-digit Nace classification, as follows:

[8] We check for inconsistencies using different criteria. For instance, a firm's capital at the beginning and end of each year should be positive; sales should be positive; labor cost in a given year should be positive; average employment per year should be positive and equal or greater than 10; investment in new machines and equipment should be non-negative; and the ownership shares should add up to 100.

$$\text{Herfindahl}_j = \sum_i \left( \frac{Sale_i}{Sale_j} \right)^2 \quad \text{j-industry, i –firm} \quad (1)$$

Herfindahl index is a measure of concentration of firms in an industry, and as such it captures monopoly power. That is, if a firm in an industry has a large monopoly power, then competition in that industry is low. Competition is expected to improve firm performance by motivating domestic firms to use their existing technology more efficiently, or to upgrade it, thus reducing the technology gap with foreign firms. A negative coefficient of the competition variable suggests that when market concentration is high (i.e., competition is low) firm level productivity growth is low.

*Firm size* is measured as the logarithm of the average number of employees, at firm level. Firm size may reflect economies of scale, namely, large firms produce at lower average cost, hence have higher productivity.

*Investment in new technology* is measured as the ratio of expenditure on new machinery and equipment to net sales of the firm. Investment in new technology is needed for Estonian firms to compete and survive in the open market economy. This would furthermore contribute to higher firm productivity and to lower the technology gap with the foreign firms. However, not all firms have the same likelihood of access to funds for investment, with insider owned firms facing barriers to capital accumulation. The literature on employee ownership (Dow, 2003) stresses that, 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. This could lead to outside investors being reluctant to invest in employee owned firms or, when they do invest, the risk premium they charge is substantially higher than the market one. The literature on managerial ownership in a transition economy (Aghion and Blanchard, 1998; Filatochev, Wright and Bleaney, 1999) stresses the possibility of managerial entrenchment and subsequent rent seeking or asset stripping behavior. Under high uncertainty and infantile capital markets, informational asymmetries might lead to adverse selection problems in the market for corporate control (Earle and Estrin, 1996). These arguments imply that 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.

*Export intensity* is measured as the ratio of export sales to total firm's sales in a given year. Firms that produce for exporting markets are under the pressure of international competition and as such they will utilize their resources better. We expect these firms to perform better as well as to be better conduits of technology transfer.

*Spillovers from technology transfer* are proxied as the share of foreign firms employment in total industry employment[9]. A positive coefficient implies that positive spillover effects dominate over the negative effects. Hence a larger presence of foreign firms in the industry contributes to increasing the productivity of domestic firms through demonstration /imitation or labor mobility. Since spillovers are not instantaneous and take time to materialize we include them in the empirical analysis with a lag (Aitken and Harrison, 1999).

We also account for the *technology gap* between foreign and local firms, namely, manager, employee, domestic outsider or state owned firms.

An appropriate measure of technology gap should reflect the level of technology a firm uses in its production. However, constructing a measure of technology has proven to be very difficult especially when accounting data is the data source. The different measures of technology gap used in the existing literature have been constructed as the ratio of vale added or labor productivity of foreign to local firms or as the ratio of total factor productivity (Kokko, 1994; Sjoholm, 1999). The motivation for using labor productivity or value added to construct the gap is the argument that both measures reflect a firm's advanced technology, i.e., the higher the labor productivity, the more advanced the technology used in production. The problem with this argument is that high labor productivity does not necessarily imply advanced technology especially in labor-intensive sectors where technology need not be advanced. In such case, we would miss interpret a high value of labor productivity as reflecting advanced technology. On the other hand, total factor productivity reflects more then just technology, i.e., it also captures productivity shocks.

Differently, from the above measures of gap, we will construct a measure of technology gap based on firm level technical efficiency. A firm is considered to be technically efficient if it is able to produce maximum output with the given combination of inputs, i.e., if it operates on the production frontier. Deviations from the frontier due to excessive use of inputs make the firm technically inefficient. In understanding the advantage of using technical efficiency as measure for the gap, one has to know the difference in between being technically efficient and productive. When a firm is technically efficient it is operating on the production frontier, which is the maximum attainable output, and reflects the current state of technology. On the other hand, a firm may be productive but not necessarily operating on the

[9] We also use two alternative definitions of spillovers: the share in equity and the share in sales. The results, not reported here, are similar in sign and significance to those reported in Table 4.

production frontier. Differently, a firm can be technically efficient and still be able to increase productivity. Hence, technical efficiency reflects technology much closely than productivity. Nevertheless, this measure still does not necessarily reflect how advanced the technology used is. For instance, if the firm is using its inputs excessively it may be either because its technology is not advanced or because it is not correctly used.

The production frontier in this chapter is specified as in Battese and Coelli (1992):

$$\ln y_{it} = \ln f(x_{it};\, t,\, \beta) + v_{it} - u_{it},$$

$$where \quad u_{it} = u_i * [\exp(-\eta * (t-T))] \qquad (2)$$

$f(.)$ is a Translog production function.

$y_{it}$ -the logarithm of the production of i-th firm in the t-th time period.

$x_{it}$ -a vector of logarithmic transformations of inputs. That is, capital, labor and materials.

$u_{it}$ - are non-negative random variable accounting for technical inefficiency, assumed to be *i.i .d.* as truncations at zero of the $N(\mu, \sigma_u^2)$ and $\eta$ is a parameter to be estimated.

The parameterization of time effects allows for a time varying (in)efficiency model. This is a much more realistic assumption than the time invariant (in)efficiency. After all, as Coelli, Battese and Rao (1998) point out, one would expect that managers learn from their previous experience and this should be reflected in some persistent pattern of technical (in)efficiency scores. Furthermore, in order to distinguish between the technology of foreign and local firms we include in the specification of the production function a dummy for foreign firms[10].

After estimating firm level technical efficiencies $TE = \exp(-u_{it})$, the technology gap between local and foreign firms in each industry is constructed as follows:

$$Gap_{ijt} = \frac{mean\ TE^F_{jt}}{TE^D{}_{ijt}} \qquad (3)$$

i-the firm

D-domestic firm (whether the firm is manager, employee, domestic outsider or state owned)

F-foreign firm

j-industry and t-time

The measure of gap, as expressed in equation (3), compares local firms' technical efficiency with the average technical efficiency of foreign firms and is calculated for each domestic firm, despite the ownership form. Hence, it refers to firms rather than industries. Gap will take value one when a local firm's technical efficiency equals the average technical efficiency of foreign firms, will take a value greater than 1 when $mean\ TE^F_{jt} > TE^D{}_{ijt}$, and a value less than 1 when $mean\ TE^F_{jt} < TE^D{}_{ijt}$.

Finally, other control variables include industry and time fixed effects. Industry dummies control for industry-specific effects in firm performance. Such effects could arise, for instance, due to systematic differences in productivity levels across industries. Similarly, time fixed effects capture the impact of macroeconomic conditions common to all firms.

**[Insert Table 2 here]**

Table 2 reports the summary statistics of the most relevant variables used in the analysis. Several facts emerge from inspection of the data. First, value added has been steadily increasing over time, except for the early years. The average level of value added in real terms has almost doubled over the time period under consideration. Second, average employment has decreased, which is accompanied by increases in capital stock and subsequent increases in capital intensity. The increases in capital stock are not surprising given the high level of investment, which ranges from 17% to 36% of capital stock. Finally, as the last row of the table shows, Estonian firms have been internationally oriented since the beginning of transition as evidenced by the level of exports and the share of exports in net sales, which has been relatively high and stable over the whole period under consideration.

**[Insert Table 3 here]**

Table 3 compares foreign firms with domestic firms. Foreign firms outperform domestic firms by most criteria: in most industries they have on average higher capital intensity, labor productivity and higher technical efficiency. Although it may be expected that higher productivity is the result of economies of scale, in most industries foreign firms tend to be smaller than domestic ones (column 4). In contrast, domestic firms invest in new technology more than foreign firms in almost half of industries[11] (column 3) This is consistent with the technology gap hypothesis, namely, that domestic firms invest relatively more than foreign firms in order to increase their technological capabilities and their ability to benefit from foreign firms' advanced technology. Nevertheless, with respect to the technology gap, we find that, in almost all industries foreign firms have higher technical efficiency than local firms. However, this does not hold in the sectors of rubber and plastic and transportation, where the technology need not necessarily be advanced.

[10] Since the frontier is sensitive to outliers, they were dropped from the sample.

[11] As in most cases the ratio is less than one, i.e., the mean of investment in new machinery is higher for domestic firms.

## 4. Empirical Strategy

We measure the technology transfer from foreign to local firms by estimating a production function. Indeed, if such transfer of technology actually occurs we should observe productivity improvements in domestic firms. Hence, we estimate the following production function

$$Y_{igt} = F^{i,g}(K_{igt}^{\alpha}, L_{igt}^{\beta}, M_{igt}^{\gamma}, A_{igt}) \quad (4)$$

where $Y_{igt}$ is gross output for domestic firm *i* with ownership structure *g* (*g*= manager, employee, domestic outsider or state owned firm) at time *t*. K, L and M represent capital, labor and materials used in the production process, while A is the technology used in the production process. Furthermore, the production function is homogenous of degree *n* in inputs.

Taking the logarithm and time derivative of (4) we obtain

$$y_{igt} = c + \alpha k_{igt} + \beta l_{igt} + \gamma m_{igt} + \rho A_{igt} + \nu_{igt} \quad (5)$$

where all lower case letter variables indicate their logarithmic growth form, and their coefficients represent the elasticity of output with respect to capital, labor and materials.

The technology variable $A_{igt}$ is a function of firm and industry variables that affect a firm's technology. For instance, Felipe (1999), Haddad and Harrison (1993), Sjöholm (1999), Zukowska-Gagelman (2000), Kinoshita (2001), and Damijan and Knell (2005) consider $A_{ijt}$ as a function of firm characteristics such as managerial capabilities, organizational competence, R&D and increasing returns to scale, or industry characteristics such as inter-sector transfer of technology and competition.

$$A_{igt} = f(X_{igt})$$

Hence, we express $A_{igt}$ as a function of firm size, investment in new technology, export intensity, Herfindahl index, technology spillovers, technology gap as well as the interaction between spillovers and technology gap.

The final model we estimate is:

$$y_{igt} = c + \alpha k_{igt} + \beta l_{igt} + \gamma m_{igt} + \rho X_{igt} + \nu_{igt} \quad (6)$$

We estimate equation (6) with the Fixed Effects (FE) estimator. A Hausman test for the fixed versus random effects cannot reject the null hypothesis that the fixed effects are correlated with the error term and hence the FE model best represents the data[12]. The advantage of this method is that the FE model exploits the panel nature of the data to control for unobserved firm characteristics that are fix over time, namely fixed effects, as well as corrects for potential heteroskedasticity created form different firm and industry characteristics by using the data in group mean deviations. This procedure results in the White heteroskedasticity consistent estimator (Greene 2003).

Nevertheless, we also control for other estimation issues such as sample selection bias and endogeneity. Sample selection bias may arise from bankruptcy, merger, or firms choosing not to report. In such cases the dependent variable is not observed over the entire period in the data set. Not correcting for it leads to biased estimates, therefore, we apply a Heckman two-step procedure. In the first step, we calculate the probability that a firm is included in the sample based on firm's profit, labor productivity and industry affiliation. In the second step, the resulting inverse Mills ratio is included as a right hand side variable.

Endogeneity can arise when foreign firms invest in more productive industries, leading to a reverse causality from the left hand side variable to the technology spillover measure (Aitken and Harrison, 1999). Furthermore, domestic firms' decision to invest in new technology depends on past and current levels of output and profit, which in turn are affected by investment at firm level. To account for both sources of endogeneity, we employ lagged values of the respective variables as instruments, namely, investment in new technology, and technology spillovers.

Hence, our final analysis is based on the fixed effects model, which corrects for the estimation problems of the panel data, and includes the inverse Mills ratio from the Heckman two-step procedure, as well as the lagged values of technology spillovers and investment in new technology. Finally, equation (6) is estimated for each domestic firm ownership structure separately.

**[Insert Table 3 here]**

## 5. Results

Table 4, reports the results of estimating equation (6) for four domestic ownership structures, namely, managers, employee, domestic outsiders and state owned firms. The coefficients of inputs are positive and significant across all ownership groups, confirming that their use results in higher productivity growth.

Focusing on the results of firm and industry characteristics we find that the coefficient of spillovers from technology transfer is positive and significant only for domestic outsiders. Domestic outsider owned firms have the financial resources to upgrade their technology and/or to attract local employees away from foreign firms (Domadenik, Prasnikar and Svejnar, 2008). Therefore, they possess the absorptive capabilities to benefit from the technology of foreign firms, as reflected by a higher productivity growth of these firms compared to the other groups. Indeed, manager, employee and state owned firms do not benefit from spillovers. This is not surprising as insider owned firms are relatively small in size and face steeper financial constraints in

[12] The result of this test is presented in Table 4.

capital accumulation (Aghion and Blanchard, 1998; Meyendorf and Thankor, 2002; Dow, 2003). Hence we expect these firms to lack the ability to absorb and implement the advanced technologies of foreign firms. In contrast to insider owned firms, state owned firms suffer from labor hoarding, soft budget constraints, operate with outdate technology and are shielded from competition with foreign firms (Basu, Estrin and Svejnar, 2005). Consequently, they lack incentives to restructure and capabilities to comprehend and operationalize advanced technologies of foreign firms. Our results are thus in line with Djankov and Murrell (2002), who conclude that only outsider ownership improves firm performance.

According to technology gap hypothesis, the larger the technology gap, the more local firms have to benefit from foreign firms. Hence, we expect domestic firms across all ownership groups to have a positive and significant coefficient of the technology gap variable as well as of its interacted term with the spillover variable. Accordingly, we find that the coefficient of technology gap variable is positive and significant across all ownership groups. The implication is that a large technology gap with foreign firms motivates local firms to use their existing technology more efficiently and as such successfully survive the increased open market competition (Wang and Blomstrom, 1992), as demonstrated by the negative and significant coefficient of the competition variable. However, the coefficient of the interaction term of technology gap with the spillover variable is positive and significant only for the domestic outsider group, suggesting that for a given level of technology gap, only domestic outsiders have the absorptive capability to benefit from spillovers of technology transfer, which in return reduces the gap and increases firm productivity growth. For instance, domestic outsider owned firms may benefit from foreign firms through demonstration and imitation effects or by attracting trained local employees away from foreign firms. Furthermore, these firms also are more export oriented and invest more in new technology then other ownership groups. By investing more in new technology and being in contact with international competitors in foreign markets, domestic outsider owned firms can efficiently cope with foreign firms in the domestic markets. In contrast, because of rent seeking and/or asset striping behavior insider owned firms, have financial constraints, and as such cannot invest in new technology as much as domestic outsider owned firms.

Finally, while firm size matters for all ownership groups, the magnitude of its coefficients is smaller for manager, employee and state owned firms. Insider owned firms are typically small and labor intensive hence firm size contributes less to firm productivity growth. In contrast, state owned firms are larger in size, however, they suffer from labor hoarding and outdated technology, thus do not benefit form economies of scale either.

## 6. Conclusions

In this paper we have investigated the importance that firm ownership structure has on technology transfer between foreign and local firms and, firm performance. In the analysis, we employ a unique sample of Estonian firms over the period 1993 through 2002, which consists of detailed ownership and financial information. Our fixed effects estimates confirm the importance of ownership structures in realizing spillovers from technology transfer and closing technology gap with foreign firms. More specifically, only domestic outsider owned firms seem to be able to benefit from technology spillovers. This result is not surprising given the obstacles that insider owned firms face in capital accumulation. In addition, the results suggests that for a given level of technology gap, only domestic outsiders have the absorptive capability to benefit from spillovers of technology transfer, which in return reduces the gap and increases firm productivity growth.

Overall, our results suggest that identities of owners do matter in determining their ability to invest in new technology and be able to benefit from spillovers from foreign firms. These conclusions imply a role for public policy in increasing the level of investment by domestic firms by influencing the environment firms operate in through policy measures such as the provision of fiscal incentives, development of capital markets and financial system and improvements of access to capital. Of particular importance is the development of the banking sector and other non-banking institutions, such as investment funds, venture capital funds, mutual funds and credit unions. In Estonia the banking is mostly involved in financing the government than the private sector. Here there is scope to introduce legislation that will increase banks incentives to extend loans to private companies. Similar steps need to be taken to increase non-banking institutions participation in financing the private sector, which until now has been marginal. A possible way would be to provide tax breaks to such institutions that would be contingent to the amount of loans they extend to private companies, especially to those encountering difficulties in raising finance.

Other than improving domestic firms access to finance public policy must focus on improving domestic firms ability to learn from foreign investors. One possible way is to upgrade labor skills either through increased training or ability to attract qualified labor force from foreign competitors. In addition, promoting exports would increase transfer of knowledge and technology to local firms and subsequently lead to better performance.

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## Appendices

**Table 1. Ownership Distribution Over Time According to Dominant Owner**

| Year<br>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 | 58 | 55 | 46 | 41 | 45 | 37 | 22 | 22 | 428 |
| 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 | 1225 |
| Total | 444 | 442 | 545 | 513 | 461 | 384 | 326 | 340 | 290 | 290 | 4035 |

**Table 2. Means and Standard Deviations in Parentheses of Principal Variables Over Time**

| Year<br>Variables[1] | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | Obs.[2] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital | 12250<br>(51023) | 9740<br>(48137) | 9771<br>(45305) | 10329<br>(47218) | 10411<br>(47756) | 11200<br>(49623) | 16816<br>(43022) | 18217<br>(39576) | 18934<br>(40332) | 19881<br>(49653) | 4218 |
| Employment | 196<br>(414) | 166<br>(340) | 164<br>(388) | 161<br>(393) | 157<br>(276) | 137<br>(282) | 124<br>(228) | 138<br>(209) | 129<br>(221) | 126<br>(217) | 4218 |
| Materials | 7347<br>(12937) | 7748<br>(11885) | 7912<br>(12993) | 7948<br>(13278) | 8239<br>(12673) | 8349<br>(14218) | 8863<br>(15839) | 8756<br>(15451) | 8927<br>(15824) | 9218<br>(17034) | 4218 |
| Value Added | 5640<br>(20344) | 5122<br>(19764) | 5145<br>(21639) | 6236<br>(24276) | 7214<br>(26830) | 8009<br>(27349) | 9706<br>(29441) | 9738<br>(30295) | 9912<br>(30991) | 10156<br>(32847) | 4218 |
| Sales | 21773<br>(63301) | 21502<br>(61562) | 30377<br>(93119) | 24269<br>(69179) | 27573<br>(77562) | 27989<br>(63535) | 32816<br>(88789) | 35127<br>(74392) | 36193<br>(76483) | 36774<br>(75217) | 4218 |
| Investment | 2150<br>(12363) | 2245<br>(18844) | 3371<br>(22029) | 3007<br>(17249) | 2634<br>(15504) | 3407<br>(14019) | 4547<br>(19549) | 4238<br>(16378) | 4489<br>(15483) | 4742<br>(15218) | 4207 |
| Exports | 7456<br>(10674) | 8129<br>(11938) | 9784<br>(12189) | 8562<br>(11875) | 9783<br>(13721) | 9587<br>(13278) | 10219<br>(18564) | 10834<br>(15218) | 11298<br>(15832) | 11553<br>(16098) | 4218 |

**Table 3: A comparison of foreign firms relative to domestic firms.**

| | K/L (1) | Y/L (2) | Inv/Y (3) | Firm size (4) | Tech Gap (5) |
|---|---|---|---|---|---|
| Manufacturing | | | | | |
| food products | 2.61 | 2.19 | 2.09 | 1.03 | 1.20 |
| Textile products | 0.83 | 1.41 | 3.65 | 0.68 | 1.07 |
| leather products | 2.44 | 2.54 | 1.13 | 1.70 | 1.40 |
| Wood products | 1.13 | 2.72 | 0.78 | 0.55 | 1.23 |
| pulp & paper | 2.34 | 2.23 | 2.34 | 1.65 | 1.10 |
| chemical products | 4.23 | 2.71 | 0.74 | 0.12 | 1.32 |
| rubber and plastic products | 3.47 | 0.56 | 0.42 | 0.48 | 0.77 |
| other non-metallic products | 3.31 | 2.84 | 0.84 | 1.54 | 1.06 |
| basic metal products | 1.81 | 1.49 | 0.42 | 0.61 | 1.08 |
| Machinery & equipment | 0.78 | 2.21 | 2.11 | 0.50 | 1.44 |
| electrical and optical equipment | 1.38 | 2.36 | 0.91 | 0.61 | 1.27 |
| transport equipment | 0.61 | 1.30 | 1.21 | 1.41 | 1.01 |
| Furniture | 1.11 | 2.13 | 0.72 | 0.77 | 1.62 |
| Electricity, gas and water supply | 3.24 | 5.56 | 3.20 | 4.05 | 2.52 |
| Construction | 0.98 | 2.36 | 0.43 | 1.61 | 1.49 |
| Wholesale trade | 1.72 | 1.98 | 1.44 | 0.67 | 1.38 |
| Retail trade | 2.57 | 2.28 | 0.93 | 0.56 | 1.61 |
| Total | 2.3 | 2.39 | 1.47 | 1.08 | 1.43 |

**Note**: Each number is obtained as: Mean(Variable)Foreign Firm/Mean(variable) Domestic Firm. While Gap is constructed as the ratio of mean technical efficiency of foreign firms with mean technical efficiency of local firms.

**Table 4: Fixed effects estimates of the effect of technology transfer on productivity growth for different domestic owners.**

| Variables | Manager-Owned | Employee-Owned | Domestic-Outsider | State-Owned |
|---|---|---|---|---|
| **Inputs** | | | | |
| $Capital_t$ | 0.19*** | 0.16** | 0.18** | 0.09** |
| | (2.85) | (2.23) | (2.04) | (2.01) |
| $Labor_t$ | 0.39*** | 0.23*** | 0.45*** | 0.33*** |
| | (2.62) | (3.16) | (4.24) | (3.2) |
| $Materials_t$ | 0.15** | 0.11*** | 0.105*** | 0.20*** |
| | (2.44) | (4.31) | (3.1) | (5.2) |
| **Firm and Industry Characteristics** | | | | |
| Spillovers of Tech. $Transfer_{t-1}$ | 0.4** | 0.15 | 1.21** | 0.11 |
| | (2.02) | (0.99) | (2.56) | (1.65) |
| Technology $Gap_t$ | 0.17** | 0.4* | 0.82** | -0.2 |
| | (2.15) | (1.9) | (2.01) | (-1.01) |
| $Spillovers_{t-1}$ x Technology $Gap_t$ | 0.85 | 0.54 | 1.24*** | 0.077 |
| | (1.46) | (1.3) | (3.55) | (0.97) |
| Investment in New $Technology_{t-1}$ | 0.08 | 0.06 | 0.24*** | 0.04 |
| | (1.31) | (0.76) | (2.85) | (1.0) |
| Export $Intensity_t$ | 0.31** | 0.18 | 0.94*** | -0.271 |
| | (2.43) | (1.12) | (4.91) | (-1.22) |
| Firm $Size_t$ | 0.019*** | 0.07*** | 0.026*** | 0.008*** |
| | (3.81) | (2.83) | (4.91) | (3.93) |
| $Competition_t$ | -0.21** | -0.17** | -0.31*** | -0.11* |
| | (2.26) | (2.5) | (3.62) | (1.95) |
| Inverse Mills Ratio | yes | yes | yes | yes |
| Industry Dummies | yes | yes | yes | yes |
| Time Dummies | yes | yes | yes | yes |
| Hausman Test (Fix vs. Random) | 5.21*** | 4.12** | 4.48*** | 3.38*** |
| F-Test of joint significance of coef | 4.58*** | 8.97*** | 9.15*** | 7.18*** |
| Adjusted R-squared | 0.79 | 0.62 | 0.71 | 0.68 |
| Nr of observations | 626 | 368 | 876 | 912 |

Note:

- ***, **, * significant at 1%, 5% and 10% respectively. t-statistics in parenthesis
- a constant term is included in all regressions
- competition is proxied with the Herfindal index.