Incentives for Acquisition under a Free Trade Area for the Insider and Outsider Firm

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Abstract

First, we develop a model that analyzes incentives for acquisition of state-owned enterprises (SOEs) by multinational enterprises (MNEs) in a presence of a free trade area (FTA). The model predicts that as SOE's productivity increases, the Insider MNE's incentives to acquire the SOE rise as it can strategically prevent Outsider MNE from becoming as stronger competitor in the FTA market. Insider MNE is a firm located within the FTA and the Outsider MNE is non-FTA firm that will enter the market by either acquisition of SOE, Greenfield investment, or export. Second, using firm-level privatization data from Eastern Europe, we find that although Insider MNEs buy more productive SOEs, the probability of acquisition by the Insiders goes down as productivity increases. Insiders' acquisition is motivated by producing with higher productive SOEs and not by strategic motive to prevent market access for the Outsider MNEs.

1 Introduction

Privatization of state-owned enterprises (SOEs) by transitional and developing countries has provided foreign multinational enterprises (MNEs) an alternative method of foreign direct investment (FDI) into these emerging countries. MNEs have three options of entering emerging countries - acquisition of SOEs in privatization, Greenfield investment, and export. In this paper, we study the incentives that MNEs have for acquisition of SOEs when emerging governments are liberalizing by carrying out privatization and by entering into a Free Trade Area (FTA) with neighboring developed countries.

We define two types of foreign MNEs; Insider MNEs as foreign MNEs that are initially located within the FTA, and Outsider MNEs as foreign MNEs that are located outside the FTA. The FTA allows any firm that locates production in one member country market access to all countries without paying any additional trade costs. Acquisition of the SOE by the Outsider provides the Outsider with market access to all of the FTA. The Insider MNE will recognize the SOE as a potential means for market entry by the Outsider and will attempt to acquire the SOE for its own benefit and in doing so, will force the Outsider to either Greenfield invest or export into the FTA.

We develop a theoretical model that explains these incentives for acquisition by

each foreign MNE. We demonstrate how emerging countries' membership in the FTA increases the value of the SOEs to both foreign MNEs. We solve for the equilibrium ownership structure in the FTA and show that with high trade costs and Greenfield costs, the Insider MNE can prevent the Outsider MNE from entering the FTA market by acquiring the SOE. We then explore the impact of SOE's increasing productivity on the incentives for acquisition by both MNE. We show that as productivity of the SOE increases, the value of the SOE to both MNEs increases as each MNE wants to acquire a more productive SOE. The model predicts that although SOE's value increases for both potential foreign acquirers, the Insider MNE acquires the SOEs and prevents the Outsider MNE from easy market entry.

The predictions of the model are analyzed using a new firm-level panel data on former SOEs from Eastern Europe. We gather information on SOEs from Eastern European countries that are now part of the European Union. Controlling for various characteristics of the SOEs, we find little support for the notion that SOEs are acquired by Insider MNEs for the sole purpose of preventing the Outsider MNEs from acquisition. The data shows, however, that Insider MNEs acquire more productive and profitable SOEs as compared to Outsider acquisitions. This indicates that Insider acquisition is motivated more by SOE's productive ability and in order to compete with the Outsider MNEs by serving the FTA with higher productive SOE.

Our research builds on previous work done on MNEs, FDI, and role of FDI in privatization. We examine the incentives for FDI through acquisition carried out by MNEs by allowing MNEs to have three different forms of market entry available, and by introducing a FTA and productivity of the acquired SOEs. The theoretical literature on MNEs and FDI is surveyed in Markusen (1995). Literature that looks at cross-border mergers and acquisitions (M&As) includes Horn and Persson (2001), Bjorvatn (2004), and Neary (2004). Other papers have analyzed the choice of market entry by MNEs by allowing MNEs to have several methods of serving the market. These papers include Görg (2000), Norbäck and Persson (2002), Nocke and Yeaple (2004), Müller (2007), and Eicher and Kang (2005).

Very little in literature has focused on privatizing firms as alternate means for market entry by MNEs. Our theoretical model closely follows work done by Norbäck and Persson (2004) where they address the issue of how privatization of SOEs interacts with the pattern of FDI and international trade. We extend their work to allow for existence of multiple countries through the presence of FTA, and by allowing SOEs to have productivity that is valued in the market. We then test these predictions using privatization data from Eastern Europe. Empirical literature on privatization has mainly concentrated on performance of SOEs after privatization and on comparing private firms to public firms. Summary of this literature can be

found in Megginson and Netter (2001) and (Frydman et al. 1999).

2 Model

There are two free trade regions, the inside region I and the outsider region O. Each region has one firm, insider firm I and outsider firm O. Both firms produce a homogenous good sold in region I, where they compete in oligopoly fashion. There is also a transitional country E, where State Owned Enterprise (SOE) E is located, which possesses one unit of productive assets k_E. Country E will join region I which implies that firms located in country E will be able to sell their product in region I facing no trade tariffs. The government of country E will also liberalize by allowing foreign firm to acquire the SOE and it will allow foreign firms to build new plants within country E, i.e. it will allow greenfield investment.

As shown in Figure 1, the interaction in country E will take place in three stages. In the first stage, firms $E's$ assets will be sold to one of the foreign firms, firm I or firm O. In the second stage, the foreign firms, I and O, will have the option to invest in new assets, denoted by k_G, in country E, i.e. undertake greenfield investment. Finally, in the third stage both firms will sell their homogenous product q_i ($i = I$ *or* O) in the market of region I. Firm O will have to pay trade costs, $t > 0$, to sell in region I if it does not acquire firm E or greenfield invest in new asset k_G.

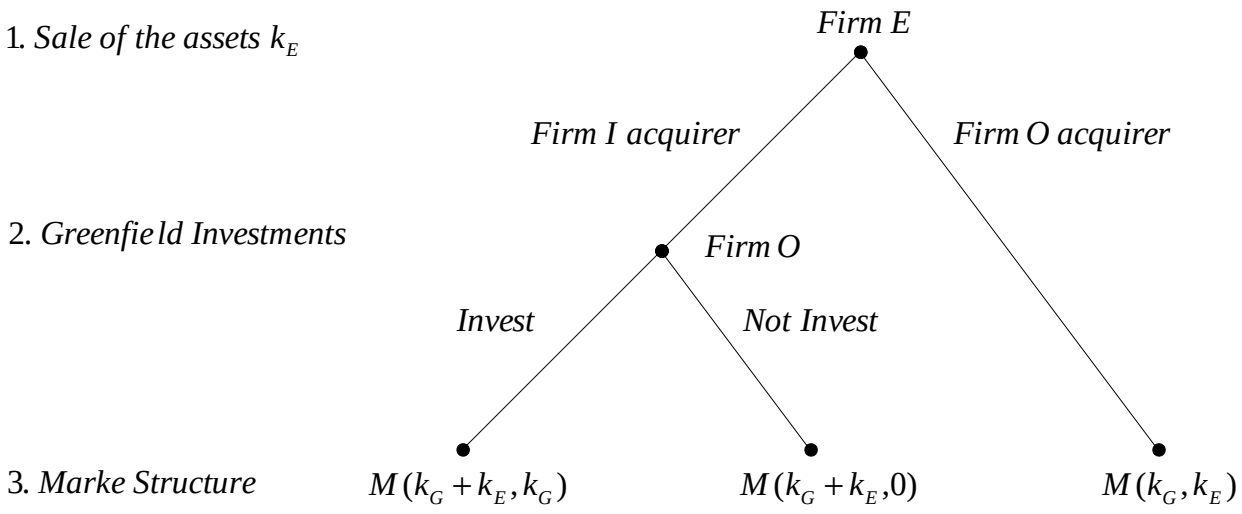


Figure 1: The three-stage game

2.1 The Oligopoly Market

In the third stage, firms compete in Cournot fashion in a homogenous good market. It is assumed that firms face a strictly concave inverse demand function, so that $P'(Q) < 0$ and $P''(Q) < 0$. In Lemma 2, it is shown that the assets k_E will be sold at the auction in equilibrium. As illustrated by Figure 1, this implies that three different ownership structures are to be considered. To keep track of these we, we denote the ownership structure where the insider firm I possesses k_I units of assets (in region I and country E) and the outsider firm O possesses k_O units in country E, by $M(k_I, k_O)$. For example, $M(k_G + k_E, 0)$ is then the duopoly where firm I owns greenfield assets (in region I) and firm $E's$ assets in country E, while the outsider firm has no assets in region I or country E and export from region O.

Figure 1 also displays the firm's marginal costs in the different ownership structures. If a firm possesses one unit of productive assets within the newly formed free trade area between region I and country E then it is assumed that firm produces with zero marginal cost. The outsider firm O has a cost disadvantage, t, per unit of output that it pays as it serves region I from region O, t captures the trade costs. Firm O can avoid paying the trade costs if it acquires firm E or it greenfield invests in country E.

Figure 1 also shows the productivity gain to each foreign firm if they acquires

firm E. Upon acquisition of firm E, each foreign firm can use γk_E of the productive asset of firm E, where $\gamma \geq 0$ is the productivity of firm E. Higher productivity of firm E lowers the cost of production for the foreign owner. Foreign firms can take advantage of firm $E's$ productivity in production and exporting back to region I.

The final row of Figure 1 displays profits for each foreign firm. $\pi_i^D(t)$ denotes the equilibrium duopoly profit for firm $i = I, O$ when firm I faces zero variable cost and firm O faces variable cost t. $q_i^D(t)$ denotes the corresponding equilibrium quantity and $t^{\max}$ is the t satisfying $q_O(t) = 0$. Finally, π^M denotes the monopoly profit when the monopolist faces a zero production cost.

2.2 Acquisition and productivity

Firm $E's$ assets are assumed to be in fixed supply and of low value outside the industry. The latter is motivated by the fact that asset k_E and the productivity γ achieved by asset k_E are designed to fit production in a given industry and to restructure them into suitable assets for another industry would require a high cost. These assumptions imply that the cost of asset k_E will be determined by their value in this specific industry.

In order to focus on role of productivity and trade costs incentives for international decision to acquire firm E, a simple cost structure is introduced where by

acquiring firm E the outsider firm avoids paying international trade costs and is able to benefit from productivity of asset k_E. The insider firm I benefits from acquisition of firm E by using $E's$ productivity and by forcing firm O to seek alternative mode of market entry into region I, i.e. greenfield investment or export.

2.3 Greenfield Investment

The cost of greenfield investment is assumed to be fixed. Greenfield assets are created by new investments in country E where supply of inputs (labor and capital) used to create greenfield assets are inputs which are used in many other industries in the economy and because of this investor in greenfield assets is seen as a price taker. In the greenfield investment stage, the outsider firm O may undertake greenfield investment if it was unsuccessful at acquisition of firm E and establish greenfield asset at a fixed cost of G. Firm $O's$ costs are then reduced from t to 0 by greenfield investment. Define $\bar{G}(t)$ as the value of the greenfield cost, such that the firm O is indifferent between the alternative of supplying the market by exports or investment in new assets, k_G, and produce locally (within the free trade area). Formally, we thus have that

$$\bar{G}(t) = \begin{cases} \pi_O^D(0) - \pi_O^D(t) \; if \; t < t^{\max} \\ \pi_O^D(0) \qquad\qquad\qquad otherwise \end{cases}$$

Since export profits $\pi_O^D(t)$ decrease monotonically in t, the critical greenfield cost $\bar{G}(t)$ is increasing in t and reaches its maximum at $t = t^{\max}$. For $t > t^{\max}$, the goods are not exported (i.e. non-tradable) and $\bar{G}(t) = \pi_O^D(0)$.

2.4 The selling procedure

In order to focus on the market forces as the determinants of the equilibrium market structure, we assume that firm E is sold to the highest bidder at an auction. More specifically, the acquisition process is depicted as an auction where the two firm simultaneously post bids and the bidder with the highest bid obtains the state assets. If more than one firm post such a bid, each such firm obtains the assets with equal probability. The winning buyer pays an amount equal to his bid. The auction will be solved for Nash equilibrium in undominated pure strategies. There is assumed to be a small monetary unit, denoted ε. We assume ties to be randomly broken, and all equalities in valuation to be ruled out. The smallest amount ε is chosen such that all inequalities are preserved as ε is added or subtracted.

To define firm $E's$ valuation some notation is introduced. Denote π_{ij} as the profit made by firm i when firm j has acquired firm E and π_{ii} as profit made by firm i when it has acquired firm E. Then, the valuation for firm i, v_i, is defined as:

Definition 1 $v_i \equiv \pi_{ii} - \pi_{ij}$.

In the case with two firms in the industry, the analysis is straightforward as show by the following lemma:

Lemma 2 *Let firm i be the firm with the highest valuation. The state asset is then acquired by firm i, at price equal to firm $j's$ valuation of obtaining the state asset instead of firm i, v_j.*

Proof. See the Appendix. ■

2.5 Equilibrium Market Structure

The game is solved backwards. The graphic solution to the Equilibrium Market Structure (EMS) is illustrated in Figure 2. In Figure 2 three regions of interest emerge in the $G - t$ space.

The difference between the outsider and the insider firms' valuation of the state asset is $v_I - v_O$. As is proved in Norbäck and Persson (2004), the equation $v_I = v_O$ has two solutions; one with strictly positive trade costs $t^*, 0 < t^* < t^{\max}$ and one where $t^* = 0$.

It can be shown that when $G > \bar{G}(t)$, and trade costs are low $t < t^*$, (Region 2), firm O will acquire firm E at the value of $v_I = A > 0$, where A is the acquisition price. This is due to the trade-cost savings effect, that is, as trade costs increase there is more incentive for firm O to acquire firm E. When $t > t^*$, (Region 3), firm I

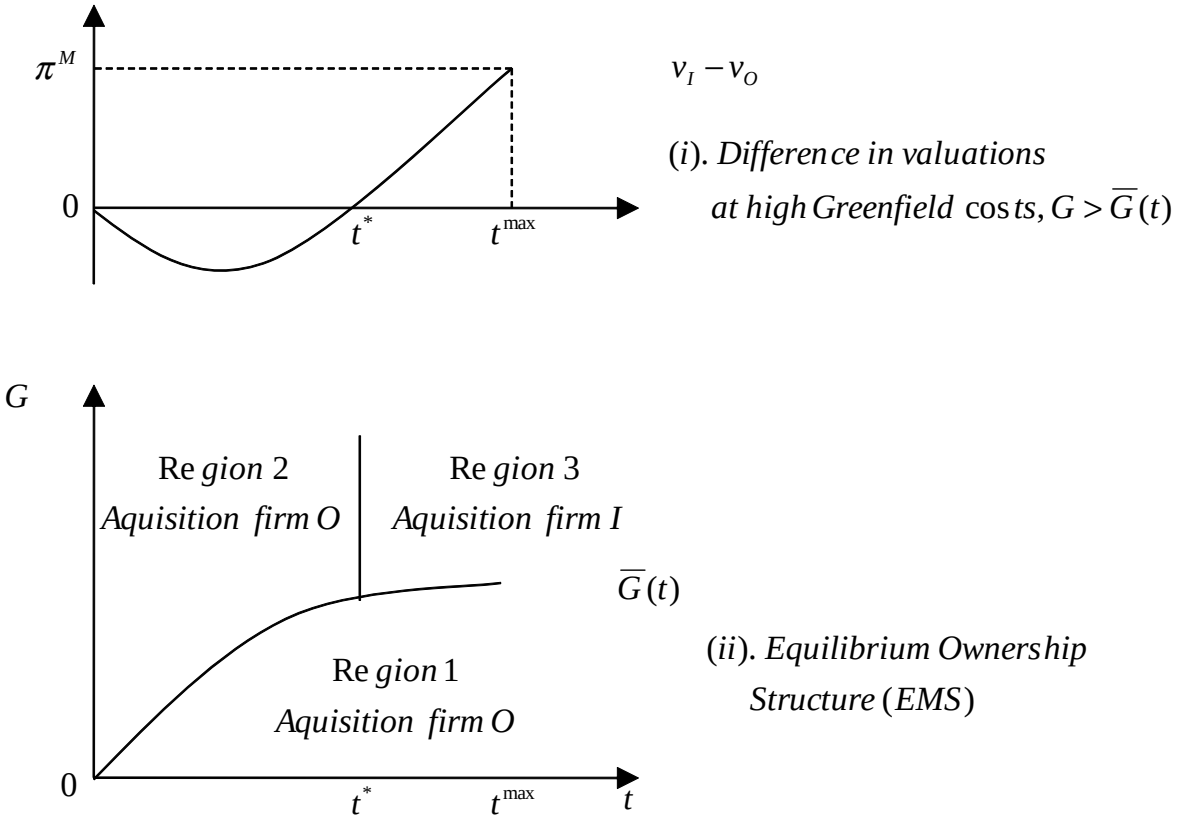


Figure 2: Equilibrium Market Structure (EMS)

will acquire firm E at the value of $v_O = A > 0$. In this situation the anti-competitive effect induces firm I to acquire firm E and prevent firm O from having easier access to the market, that is, firm I will face a competitor with high trade costs. When $G < \bar{G}(t)$, (Region 1), firm I cannot prevent firm O from entering the market and therefore, firm $I's$ valuation of firm E is 0, i.e. $v_I = 0$. However, firm $O's$ valuation is equal to $v_O = G > 0$ and therefore, firm O will acquire firm E at price $A = v_I = 0$.

The EMS shows that greenfield investment is only used as a strategic threat by firm O and is actually never implemented. Even though greenfield investment is profitable for firm O in region 1, firm O will instead acquire firm E at an auction and forgo the cost G. In region 1, both firms earn equal duopoly profits. In region 3, for $t > t^{\max}$ export is unprofitable for firm O and firm I secures monopoly position within the market. Once firm E is sold, firm I will be indifferent as to whether to produce using firm E or to shut it down. The only purpose for buying firm E was to prevent firm O from entering the market.

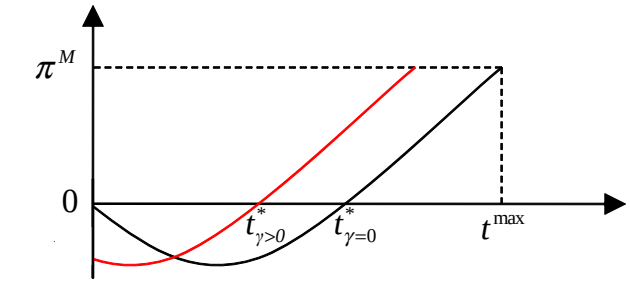
Table 6 in the Appendix describes the EMS under linear Cournot model, where firms decide on quantities rather than prices. Demand is assumed to be a linear function $P = a - b(q_I + q_O)$ where profit of each foreign firm is $\pi_i^D = (P - c_i)q_i$, where $i = I, O$. The productivity parameter γ is incorporated into the cost structure, where higher γ increases profitability of the foreign firm owning firm E.

2.6 EMS with increasing productivity

We introduce increasing productivity of firm E to the EMS. The graphical solution to EMS with $\gamma > 0$ is demonstrated in Figure 3 . The linear Cournot model which positive productivity, $\gamma > 0$, is fully described in Table 7 of the Appendix.

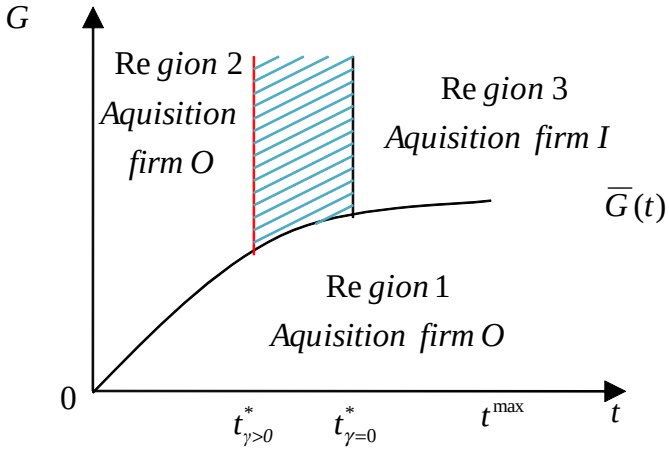
Again three regions that emerge in the $G - t$ space in Figure 3 . Looking at Figure 3 (i), when productivity is increasing the critical value of t^* shifts to the left as compared to when productivity is not considered. This suggests that when productivity is increasing and $G > \bar{G}(t)$, region 2 becomes smaller, that is, trade-cost savings effect is less important as compared to the anti-competitive effect. Region 3 expands, as indicated by the blue dashed region, and firm I has higher incentives to prevent firm O from acquiring firm E. By preventing firm E from being acquired by firm O, firm I is not only forcing firm O to pay higher trade costs but firm I prevents firm O from obtaining a higher productivity firm that would be a stronger competitor for firm I. By acquiring firm E, firm I gains a higher productive firm that it can use for production and export back to region I. Proposition 1 summarizes the effects of increasing productivity on EMS.

Proposition 3 *When $G > \bar{G}(t)$, as productivity of the State Owned Enterprise rises, i.e. as $\gamma > 0$, the incentives for acquisition by the insider firm I rise as the anti-competitive effects grows larger; and Region 3 in EMS expands.*



$v_I - v_O$

(*i*). *Difference in valuations at high Greenfield costs,* $G > \overline{G}(t)$ *and* $\gamma > 0$



(*ii*). *Equilibrium Ownership Structure* (*EMS*) *with* $\gamma > 0$

Figure 3: Equilibrium Market Sturcture with increasing productivity of firm E.

Proof. This follows from Table 6 and Table 7 in the Appendix, where it is shown that $t^*_{\gamma=0} > t^*_{\gamma>0}$, and therefore region 3 in Figure 3 (ii) expends to the left as $\gamma > 0$.

■

3 Data and Empirical Model

Proposition 3 summarizes the main theoretical prediction that we will empirically test. Using data on SOEs from Eastern Europe we can see what happens to the probability of acquisition of SOEs by Insider firms when productivity of SOEs rises. If we find that there is a positive probability of acquisition by Outsider firms as compared to Insiders when productivity of SOEs increases, then we will establish that the anti-competitive effect is important incentive for acquisition by insider firms.

3.1 Data

Data on former SOEs was obtained from two databases of the Bureau van Dijk Electronic Publishing. First database, Zephyr, contains Merger and Acquisition (M&A) data along with company financial and ownership information. Using Zephyr, we identified 708 SOEs as being privatized in Eastern European countries that are now part of the European Union. All the SOEs were privatized through direct sale to

a foreign MNE or domestic investors[1]. The information gathered from Zephyr about the 708 SOEs was then matched to the second database, Orbis, which publishes financial information gathered from government filings and from other specialized information providers. The final database includes information from 1998 to 2005 on ten countries, giving a panel data of 5664 firm-year sample observations. Table 1 provides the breakdown of firms by country.

Table 1: SOE Statistics by country

Country of Origin:	**number of SOEs**
Bulgaria	146 (21%)
Czech Republic	62 (9%)
Estonia	9 (1%)
Hungary	45 (6%)
Latvia	19 (3%)
Lithuania	44 (6%)
Poland	165 (23%)
Romania	159 (22%)
Slovakia	35 (5%)
Slovenia	24 (4%)
Total	708 (100%)

The 8 year panel data provides detail financial information on all the SOEs in-

[1]There are other forms of privatization that governments used to dispose SOEs including sale to managers and employees and voucher privatization.

cluding: revenue, profit before and after tax, cash flow, total assets, shareholders funds, employment levels, profit margin, gross profit, cost of goods sold, material costs, cost of employees, and operating profit and loss or EBIT. The data also contains the information on who acquired the SOEs, what percent was sold to the investors, and how much was the deal valued. All the variables are provided in Euros allowing for a comparison of financial statements across the firms and countries.

Out of the 708 SOEs, 233 were acquired by foreign MNEs and 475 were acquired domestically. In our model we look at the incentives that foreign MNEs have for acquisition of SOEs. We therefore, concentrate our analysis on the 233 SOEs that were acquired by foreign MNEs. We can then break down these SOEs as either being acquired by foreign Insider firms, i.e. acquired by MNEs from other European Union member countries and foreign Outsiders firms, i.e. acquired by MNEs originating from outside the European Union. Table 2 summarizes this information.

Table 3 illustrates summary statistics for characteristics of the SOEs acquired by Insiders and Outsiders. Both revenue and value added productivity is significantly higher for SOEs that were acquired by Insiders. This evidence is of support to Proposition 3 where it was shown that Insiders have incentives to acquire more productive SOEs. There is no significant age difference between SOEs acquired by foreign MNEs. The price paid for SOEs does significantly differ; price that Insiders

Table 2: SOE Statistics by foreign acquirer

Country of Origin:	**Insider acquisition**	**Outsider acquisition**	**Total**
Bulgaria	29	8	37
Czech Republic	21	8	29
Estonia	3	1	4
Hungary	6	4	10
Latvia	6	1	7
Lithuania	16	3	19
Poland	51	11	62
Romania	23	19	42
Slovakia	13	3	16
Slovenia	4	3	7
Total	172	61	233

paid is on average higher than price paid by Outsiders. This is however not surprising, as Insiders are buying more productive and profitable firms, as indicated by the significant difference in profit before tax and profit after tax.

Table 3: SOEs Characteristics by Ownership

SOEs acquired by:	**Insider**	**Outsider**	**t-test**
TFP Revenue	1.43	1.12	-3.23***
TFP Value Added	1.23	0.86	-3.78***
Age	25.12	24.93	-0.12
Acquisition Price	181628.8	44680.36	-9.14***
Profit Before Tax	25285.67	7759.35	-3.65***
Profit After Tax	12687.77	4467.65	-2.11**

Note: Means of all values are given, where Acquisition Price, Profit Before Tax, and Profit After Tax are in Thousands Euro.
* significant at 10%, **significant at 5%, *** significant at 1%.

3.2 Empirical Approach

To test Proposition 3, a probit model is specified to estimated the probability of Insider acquisition as productivity of SOEs increases. The model is:

$$\Pr(Ivs.O_i = 1|\mathbf{X}_i, \boldsymbol{\gamma}) = \Phi(\mathbf{X}_i^{'}\boldsymbol{\gamma})$$

where the dependant variable is

$$Ivs.O_i = \begin{cases} 1 \; if \;\; firm \; i \; acquired \; by \; Insider \\ 0 \; if \;\; firm \; i \; acquired \; by \; Onsider \end{cases}$$

Only 233 foreign acquired SOEs are used in the initial estimation and all the SOEs that were domestically acquired are omitted. The specified model will estimate whether SOEs have a higher probability of being acquired by Insider or Outsider as their productivity increases.

The main independent variable of interest is productivity, (TFP_i). Productivity is calculated as Total Factor Productivity (TFP) is using the Levinsohn and Petrin (2003) method. Both value added and revenue base TFP are obtained. A detail description of how the value added TFP was calculated is provided in the Appendix.

Other control variables that will be included to account for individual characteristics of each SOE are:

Age of SOEs (Age_i) is calculated using initial date of incorporation provided for each SOE in the data.

Acquisition Price ($Acquisition\ \mathrm{Pr}_i ice$) is the amount paid by acquiring foreign firm for each SOE in the privatization process. It was given as the total deal value in the mergers and acquisitions database. Industry fixed effects are also used to control for the heterogeneity in acquisition price by industry.

A full set of country and industry controls is also used, where industry controls where obtained using single digit US SIC codes.

Table 4: Probit Results

$Ivs.O_i$	I	II
TFP Revenue$_i$	0.0206	-0.0845 ***
	(0.0382)	(0.03112)
Age$_i$		-0.2543 ***
		(0.0503)
Acquisition Price$_i$		0.0106
		(0.0133)
Country and Industry FE	No	Yes

Note: The coefficients provide marginal effects.
* significant at 10%, **significant at 5%, *** significant at 1%.
Robust Standard Errors are reported in parenthesis.

3.3 Empirical Results

Table 4 provides the main probit estimation results when productivity is measured as revenue based TFP, and table 5 provides the same estimation but with value added productivity[2] . Column (I) of both tables provides the results for productivity regressed on the dependant dummy variable without controlling for characteristics of SOEs and without industry and country fixed effects. In column (I), the results are not significant, which can be interpreted as productivity does not influence whether a SOE will be acquired by Insider firm or Outsider firm.

Results change as we introduce firm controls. Column (II) of tables 4 and 5

[2]Significance and signs of results in Tables 4 and 5 do not change when logit model is specified.

Table 5: Probit Results

$Ivs.O_i$	I	II
TFP Value Added$_i$	0.0318	-0.0729 ***
	(0.0401)	(-0.0311)
Age$_i$		-0.2516 ***
		(0.0513)
Acquisition Price$_i$		0.0091
		(0.0136)
Country and Industry FE	No	Yes

Note: The coefficients provide marginal effects.
* significant at 10%, **significant at 5%, *** significant at 1%.
Robust Standard Errors are reported in parenthesis.

includes controls for SOEs' characteristics as age and price paid for the SOEs in acquisition. Also, full set of industry and country fixed effects is included. Controlling for age, price, and country and industry differences, negative and significant coefficients are obtained on productivity. Interpretation of these results implies that as productivity of SOEs increases, the probability of the SOEs acquisition by Insider firms decreases. Table 3 demonstrated that Insiders buy more productive firms but tables 4 and 5show that the probability of buying SOEs decreases for Insiders as productivity goes up. These results conflict with Proposition 3, which demonstrated that incentives for acquisition by the Insider increased as productivity of SOEs increases.

Therefore, the data reveals that Insiders buy more productive firms, but probability of acquisition decreases with rise in productivity. We interpret these results in terms of Proposition 3, and the significance of the anti-competitive effect. The anti-competitive effect does not appear to be significant in the data. The probability of acquisition increases for the Outsider as productivity goes up. Outsiders motivated by the trade cost savings effect have an increased probability of acquisition when productivity increases as they can save on trade costs and produce with more productive firm. Table 3 results suggest that SOEs acquired by Insiders are acquired because of the higher productivity as Insiders want to have a more productive firm to produce with and export. Insiders are motivated by ability to produce and export with a higher productive SOE and are not motivated by preventing Outsider from easier entry into the Free Trade Area.

4 Conclusion

There is little in the literature that analyzes acquisition of SOEs as a form of FDI for MNEs. We allow for three different methods of serving the market of the FTA for the MNEs, acquisition of the SOEs, Greenfield investment, and export. The paper develops a partial equilibrium model where the analysis centers on the existence of an exogenous free trade area and productivity of the SOEs. The model predicts that

Insider MNEs have increased incentives for acquiring the SOEs when productivity of the SOEs increases. Not only does the Insider want to produce with a higher productive SOEs, the Insider MNEs prevents the Outsider from entering the market of the FTA because of the anti-competitive effect.

We test the model using a novel firm-level privatization data from Eastern Europe. The data shows that more productive SOEs are acquired by Insider MNS but not as a preemptive measure to prevent Outsider MNEs entry. Instead, as productivity increases the probability of Insider acquisition decreases, which suggests little support for the anti-competitive effect described in the theory.

Productivity of the SOE and international trade costs play an important role in the acquisition of the SOEs. By joining a FTA, the privatizing government provides a method of market entry for Outsider MNEs by allowing sale of its SOEs. Many of the SOEs that were privatized existed as monopolies in the local market and provided a good opportunity for foreign MNEs. Examining SOEs and their link to FDI is important as MNEs constantly are looking for a better way to enter markets that were previously difficult to enter. Privatization is still prevalent in many countries and SOEs continue to play an important part in many economies.

5 Appendix

Proof of Lemma 2

Let $v_i > v_j$ without loss of generality. First, consider the equilibrium candidate where firm i acquires the state assets. Consider the equilibrium candidate b^*, where $b_i^* > b_j^*$, $j \neq i$. Let owner i be the owner obtaining the state assets. Note that $b_i^* > v_i^*$ is a weakly dominated strategy, since no owner will post a bid over its maximum valuation of obtaining the assets. If $b_i^* < v_j^*$, firm j benefits from deviating to $b_j^{**} = b_i^* + \varepsilon$, since it then obtains the assets and pays a price for the assets lower than its valuation of obtaining them. Last, consider candidate $b_i^* = v_j^*$, $b_j^* = v_j - \varepsilon$. Then, no owner has an incentive to deviate. Thus, this is a Nash Equilibrium (NE) and the only NE where firm i obtains the assets.

Let us now show that this is the only NE. First, consider the situation where firm j obtains the assets. Consider the equilibrium candidate b^*, where $b_j^* > b_i^*$, $j \neq i$. But we know that in equilibrium, $b_j^* < v_j$, since firm j otherwise plays a weakly dominated strategy. But if $b_j^* < v_j$, firm i benefits from deviating to $b_i^{**} = b_j^* + \varepsilon$, since it then obtains the assets and pays a price which is lower than its valuation of obtaining them. Thus, firm j obtaining the assets is not an equilibrium.

Second, note that the situation where firms i and j do not obtain the assets cannot occur if there is no reservation price at the auction. ■

Table 6: Linear Cournot Model	
Demand:	$P = a - b(q_I + q_O)$
π_i^D :	$b\left(\frac{a - 2c_i + c_j}{3b}\right)^2$
π_i^M	$b\left(\frac{a - c_i}{2b}\right)^2$
c_I:	0
c_O:	$c_O^A = c_O^G = 0 < t = c_O^E$
Critical greenfield investment, critical trade costs:	
$\bar{G}(t)$:	$\begin{cases} \frac{4(a-t)}{9b}t & if \quad t < t^{\max} \\ b\left(\frac{a}{2}\right)^2 & if \quad t > t^{\max} \end{cases}$
$t^{\max}$:	$\left(\frac{a}{2}\right)$
Low greenfield costs, $G < \bar{G}(t)$: [Region 1 in Figure 3.1]	
$v_I - v_O$:	$-G < 0$
High greenfield costs, $G > \bar{G}(t), 0 < t < t^{\max}$: [Region 2 in Figure 3.1]	
$v_I - v_O$:	$-\frac{(2a-5t)}{9b}t \begin{cases} < 0 \ if \quad t < t^* \\ > 0 \ if \quad t > t^* \end{cases}$
t^* :	$\frac{2a}{5}$
High greenfield costs, $G > \bar{G}(t), t > t^{\max} > 0$: [Region 3 in Figure 3.1]	
$v_I - v_O$:	$\frac{a^2}{36b} > 0$

Table 7: Linear Cournot Model when $\gamma > 0$	
Demand:	$P = a - b(q_I + q_O)$
π_i^D :	$b\left(\frac{a - 2c_i + c_j}{3b}\right)^2$
π_i^M	$b\left(\frac{a - c_i}{2b}\right)^2$
c_I:	$c_I^A = (0 - \gamma) < c_I = 0$
c_O:	$c_O^A = (0 - \gamma) < c_O^G = 0 < c_O^E = t$
Critical greenfield investment, critical trade costs:	
$\bar{G}(t)$:	$\begin{cases} \frac{4(a-t)}{9b}t & if \quad t < t^{\max} \\ b\left(\frac{a}{2}\right)^2 & if \quad t > t^{\max} \end{cases}$
$t^{\max}$:	$\left(\frac{a}{2}\right)$
Low greenfield costs, $G < \bar{G}(t)$: [Region 1 in Figure 3.1]	
$v_I - v_O$:	$-G < 0$
High greenfield costs, $G > \bar{G}(t), 0 < t < t^{\max}$: [Region 2 in Figure 3.1]	
$v_I - v_O$:	$-\frac{(2a - 5t - 8\gamma)}{9b}t \begin{cases} < 0 \ if \quad t < t^* \\ > 0 \ if \quad t > t^* \end{cases}$
t^* :	$\frac{2(a - 4\gamma)}{5}$; *and* $t^* \geq 0 \ if \ a \geq 4\gamma$
High greenfield costs, $G > \bar{G}(t), t > t^{\max} > 0$: [Region 3 in Figure 3.1]	
$v_I - v_O$:	$\frac{1}{36b}\left(a^2 + 10a\gamma - 11\gamma^2\right) > 0 \ if \ a > \gamma$

5.1 Total Factor Productivity description

Levinsohn and Petrin (2003) method estimates value added TFP by assuming Cobb-Douglas production function (gross output net materials) is estimated

$$v_{it} = \beta_o + \beta_l l_{it} + \beta_k k_{it} + \varpi_{it} + \eta_{it} \tag{1}$$

where v_{it} denotes value added and l_{it} and k_{it} are labor and capital, respectively. Labor is defined as the natural log of number of employees. Capital, also in natural log, is defined as total assets less cash flow for a given firm in a given year. The error term is split into the observable firm-level productivity ϖ_{it} and the unobserved error term η_{it} that captures the measurement error and other unexpected circumstances. The main issue in estimating productivity functions is trying to address the fact that unobservable productivity shock can be correlated with firm inputs of production. This method of productivity estimation uses intermediate inputs to production as proxy for the unobservable productivity shocks. In this specification, firms' material costs for firm i in year t were used as intermediate inputs. Estimation coefficients on labor and capital are provided in Table 2 (in the Appendix). After estimating the coefficients on labor and capital, total factor productivity is obtained by

$$Prod_{ijt} = v_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it} \tag{2}$$

where $Prod_{it}$ is given for each firm i in country j at time t.Revenue based TFP is obtained in similar fashion, the Cobb-Douglas production function is adjusted accordingly.

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