CASE Network Studies & Analyses

Pay More, Earn Less, Work Harder - New Evidence on Foreign Subsidiary Performance and Market Efficiency in Emerging Markets

Camilla Jensen

No. 391/2009

Warsaw Bishkek Kyiv Tbilisi Chisinau Minsk

This paper was produced in the framework of MICRO-DYN www.micro-dyn.eu , an international economic research project focusing on the competitiveness of firms, regions and industries in the knowledge-based economy. The project is funded by the EU Sixth Framework Programme (www.cordis.lu). This publication reflects only the author's views, the European Community is not liable for any use that may be made of the information contained therein.
The project was carried out by a consortium of 16 European universities and institutes (including CASE - Center for Social and Economic Research) and led by WIIW - Vienna Institute for International Economic Studies.

The publication was financed from an institutional grant extended by Rabobank Polska S.A.

Keywords: **multinational firms, economic growth, firm performance, spillovers**

JEL Codes: **F23, L25, O14, O33**

EAN 978-83-7178-494-1
Publisher:
CASE-Center for Social and Economic Research on behalf of CASE Network
12 Sienkiewicza, 00-010 Warsaw, Poland
tel.: (48 22) 622 66 27, 828 61 33, fax: (48 22) 828 60 69
e-mail: case@case-research.eu
http://www.case-research.eu

The CASE Network is a group of economic and social research centers in Poland, Kyrgyzstan, Ukraine, Georgia, Moldova, and Belarus. Organizations in the network regularly conduct joint research and advisory projects. The research covers a wide spectrum of economic and social issues, including economic effects of the European integration process, economic relations between the EU and CIS, monetary policy and euro-accession, innovation and competitiveness, and labour markets and social policy. The network aims to increase the range and quality of economic research and information available to policy-makers and civil society, and takes an active role in on-going debates on how to meet the economic challenges facing the EU, post-transition countries and the global economy.

The CASE network consists of:

- CASE – Center for Social and Economic Research, Warsaw, est. 1991, www.case-research.eu
- CASE – Center for Social and Economic Research – Kyrgyzstan, est. 1998, www.case.elcat.kg
- Center for Social and Economic Research - CASE Ukraine, est. 1999, www.case-ukraine.kiev.ua
- CASE –Transcaucasus Center for Social and Economic Research, est. 2000, www.case-transcaucasus.org.ge
- Foundation for Social and Economic Research CASE Moldova, est. 2003, www.case.com.md
- CASE Belarus - Center for Social and Economic Research Belarus, est. 2007.

Contents

Camilla Jensen *has a Master of Art (Cand.negot.) in Languages and Economics and a PhD in Economics from Odense University, Denmark. Her specialisation is in applied economics and industrial organisation with a focus on multinational firms. She has worked as Assistant and Associate Professor at Copenhagen Business School and is currently Visiting Professor at Kadir Has University in Istanbul, Turkey. She has published numerous articles and chapters on the role of multinational firms for economic development and growth in the transition and emerging market economies.*

Abstract

Foreign subsidiary performance and market efficiency effects are estimated and confronted in this paper using a rich firm-level panel for Polish manufacturing. Besides estimating total factor productivity, other performance measures are calculated and contrasted such as labor productivity, employment growth, markup levels and profitability. The findings show that foreign subsidiaries in Poland pay more (in wages and capital), earn less (in terms of profitability or ROA) and work harder (in terms of TFP and labor productivity) relative to their domestic counterparts. Foreign subsidiaries contribute with higher employment growth than other domestic and new firms. There is no evidence that foreign subsidiaries have significantly reduced market efficiency within the period of study and across the industries and entry modes investigated on average. Controlling for competition (which is found to have a negative effect on efficiency) the paper documents significant intra-industry spillovers. The effect is estimated to be twice as high within the foreign owned industrial communities as compared to the cross effect to domestic firms.

1. INTRODUCTION

The objective of the paper is to contribute to the literature on the impact of foreign direct investment (FDI) on firm performance in emerging markets. The paper distinguishes between the direct (within firm) and indirect (across firm within industry) effects emanating from the presence of a foreign ownership class, following the established traditions of the field. The direct effect is strong and well documented in the literature and often ascribed to the superior technology of multinational firms. Oppositely is the indirect effect disputed and prone for measurement problems and errors due to difficulties of disentangling e.g. competition and spillover (technology diffusion) effects.

In relation to these overall research questions about the direct and indirect effects, the study seeks answers to some of the following questions using a panel data set for Poland: Is performance higher in foreign subsidiaries established as new firms (Greenfield)? Are foreign acquisitions as detrimental to market efficiency as the theoretical literature seems to suggest? Having the possibility to control for competition is there any evidence of a positive FDI spillover effect in the firm level panel for Poland?

The paper seeks to contribute to the ongoing debate about FDI and the welfare effects of globalization. By building a bridge to the literature on privatization the study offers a more leveled approach to the question about direct impacts in emerging markets that underwent a rapid process of asset sales to owners abroad. Heterogeneity in terms of asset history (new vs. old assets equating with the differential entry modes of Greenfield and acquisition FDI) is often not controlled for in the literature that focuses on FDI.

It is shown that a part of the foreign firm premia can be ascribed to the differential degree to which the ownership classes have been ‘burdened’ with assets that are inherited from the past. However, the study shows that this ‘burden’ more readily has been changed to one of future competitive advantage. Perhaps under the more capable but certainly also less resource restrained hands of foreign subsidiary managers.

In terms of performance, the applied economic literature often focuses on total factor productivity or other measures of productivity such as labor productivity. But other measures of performance should perhaps receive more weight in combined considerations of the efficiency of self-interested firms and the efficiency of the market. By including a broader

variety of performance measures the competitive process that foreign entry entails can be studied in more detail.

The results offered here suggest that in the balancing act of ownership advantages, location advantages and disadvantages foreign subsidiaries may in fact pay more (in wages and in capital investment), earn less (in terms of ROA) and work harder (in terms of TFP). At the same time is there found no evidence, within the period of study that the higher capital investments have resulted in significant barriers to entry (in terms of increases in markup levels). But markups are found to grow much faster among foreign and new firms.

By focusing on the broader within industry effects of the entry process of foreign firms in Poland during the period 1993-2004, the study provides some new evidence on spillover effects from FDI. Intra-industry spillovers are modeled with considerably more detail than any previous study, by combining firm level data with 3-digit industrial aggregates on number of competitors and foreign held market shares.

The findings show that total factor productivity, markups and ROA may have an important common component that depends on the share of the market held by foreign firms. This effect, even though positive for all firms, is often found to have twice the impact on other foreign firms relative to the impact it has on domestically held firms. Other performance indicators are documented to have cross effects. For example increases in foreign market shares tend to reduce employment growth with domestic firms.

Section 2 introduces the literature on FDI and host country benefits focusing on control factors of firm heterogeneity in the literature and the extent to which past studies have been able to disentangle competition from spillover effects. Section 3 describes the data. Section 4 provides descriptive statistical results on the foreign held and new firm premia. This is followed by dynamic panel regression results on the direct and indirect effects of foreign entry into Polish manufacturing. Section 5 concludes the paper by expanding on the results summarized here in the introduction in terms of potential policy implications of the study.

2. HOW AND WHY DO FOREIGN SUBSIDIARIES PERFORM BETTER?

Several theories offer explanations for why ownership classes should matter to performance. Multinational firms are expected to exhibit superior performance relative to local firms both according to the knowledge capital model proposed by Markusen (1995) based on theories of imperfect competition and the eclectic paradigm proposed by John Dunning (1981). In the eclectic paradigm the ownership advantages of the multinational firms are explained by the resource based theory of the firm (Hymer, 1970, Demsetz, 1988). Ownership advantages include not only firm-specific technology of the multinational firm, but also its access to better exploitation of scale economies through its established network and its access to other mobile network resources such as capital. However, the eclectic paradigm includes the perspective that subsidiaries are established in a weighing of the strength of the ownership advantages and the location advantages and disadvantages. In the eclectic paradigm the ownership advantages must be sufficient to outweigh any potential location disadvantage due to e.g. lack of developed social infrastructure, institutional or cultural favoritism, sensitivity of assets deployment to local skill and knowledge or due to intense rivalry in the host country (Anand and Delios, 1997).

With background in theory it is therefore not surprising that foreign ownership is generally found to come with a performance premium. Typically the performance premium is found to increase with the development gap between host and home countries (see e.g. Görg and Strobl, 2001). In particular taxing, hostile and/or competitive environments the performance premium may be absent even though it has been rarely observed in practice. A study of the United States shows that it matters with whom the multinational firms are compared. Multinational firms investing in the United States are not exhibiting higher performance relative to those domestic counterparts that are themselves multinationals abroad (Corrado et al., 2008).

2.1. What factors are usually controlled for?

Several aspects of firm heterogeneity have been addressed in the literature to test for the robustness of the performance premium result. Standard controls include firm size, capital intensity and industry affiliation. The most stringent control test to date includes the difference in difference approach whereby especially the performance premium in foreign

acquisitions have been subjected to a rigorously controlled for comparator sample. In a study of Indonesia, Arnold and Smarzynska (2005) include controls for skill intensity and company history (age). Karpaty (2007) on acquisitions in Sweden includes controls for R&D intensity and region of the firm. Instead of structural variables such as industry and region some studies operate with a firm specific effect see e.g. Conyon et al., 2002. Other studies of mergers and acquisitions include dynamic aspects of entry, such as time having passed between the events studied and outcomes observed (see e.g. Berger et al., 2005, Conyon et al., 2002). Especially the literature on mergers and acquisitions has driven results towards the inclusion of a larger number of control factors. (Perhaps because the effects have been more difficult to discern and because of selection biases.) In practice controls reflect the particular objectives of the study, type of performance measurement and data availability.

2.2. Should asset history not matter?

The differential performance of ownership classes has been an important area of investigation among the new EU member states. The research has been driven by the objective to understand how FDI is affecting the restructuring process in the former socialist countries. Related policy concerns are how to maximize technology spillovers for domestically held firms (see e.g. Damijan et al., 2008). Somewhat in overlap herewith is the question about the impact that privatization has on firm performance. However, little attention has been paid to the combined role of asset history and relative performance of firms from different ownership classes in this literature. This is peculiar and might be of some importance to better understand the developmental role of FDI under the specific circumstances facing many new market economies (trying to implement technological upgrading policies in combination with undergoing fundamental institutional changes). New meta-analytical studies on privatization (see e.g. Estrin et al., 2009) showing the combined roles of ownership and asset history in the restructuring process of former socialist countries suggest that some firm heterogeneity is left uncontrolled for in studies that only focus on ownership. New studies of internationalization in the banking industry include controls for both ownership and asset history (see e.g. Berger et al., 2005).

2.3. Disentangling competition and spillover effects

The topic of spillovers has been subject to particular scrutiny in the literature due to its high importance for policy makers and the overall welfare prospects of globalization for local firms and consumers. The main issue in spillover studies has been to investigate the sign of spillovers. A fairly high number of meta-analytical studies have become available. They try to factor out by comparing results across individual research papers the underlying reasons for

different spillover effects across countries (see e.g. Görg and Strobl, 2001, Lipsey and Blomström, 2005, Crespo and Fontoura, 2007, Damijan et al., 2008). But neither the literature nor its overview provide us with any easy answer.

A main underlying theme in some of the recent literature is that there is a need to disentangle the pure externality or what is rightfully a spillover effect from another effect which is due to the competitive pressure that the emergence of a foreign ownership class in the local economy exerts on domestic firms.

Early studies of spillovers such as Haddad and Harrison (1993) and Kokko (1996) recognized the role of competition in their results but had to lump together spillovers with the competition effect in order to interpret their results.

As better data and new techniques have become available more recent studies have tried to tackle the question about a separate competition effect and how it interacts with or differs from the 'true' spillover or externality effect of FDI. Some of these studies are reviewed in Table 1.

The results in the available studies show a very low degree of homogeneity in several ways. None of the studies reviewed used the same concept of competition. Few of the studies used a dynamic concept of competition.

What is perhaps common to the studies reviewed is that they all are concerned with combined events of trade and investment liberalization. (Note that Fernandes (2007) focuses exclusively on trade liberalization and does not include ownership controls). Only Romania and Hungary may be different in their timing since the Europe Agreements allowed for more sheltering from foreign trade competition relative to a very liberal policy of opening up to foreign direct investors in the early years of transition. Continued subsidies to locally held firms may have given room for a honeymoon effect in some transition countries. Both available studies for Eastern Europe report that the spillover effect declined over the period of study and spillover effects became negative in late transition due to stronger competition. In terms of timing of the two effects Barrios et al. (2005) argue for the reverse pattern, however, studying a much more mature market economy with a longer and different history of liberalization.

None of the studies used competition as a dynamic control variable, but either studied competition in a way that made it impossible to disentangle from the spillover effect or studied it in a cross sectional way in order to observe how spillovers vary with the level of competition. Hence the studies have a problem that seems to be ontological before methodological in character due to the lacking theoretical conception of competition and spillover effects as separate phenomena in the overall process of competition. For example some studies argue for an additive effect (Barrios et al., 2005 and Altomonte and Pennings, 2005). Other studies consider one effect (e.g. competition) as a precondition for the other (spillovers) or as multiplicative (e.g. Blomström and Sjöholm, 1999).

Another but methodological problem of many studies (and all panel studies, see e.g. Frees, 2005) is that of attrition or in other words how exit by firms are handled in the data collection procedures. It is possible that the competition effect is more likely to take a negative sign in studies that rely on data collected by local authorities (censor studies) that may follow exiting firms to the door. Oppositely in studies relying on cross sections at different points in time or databases such as Amadeus and Orbis published by Bureau van Dijk, the competition effect (or spillover effect if lumped together) may be more likely to show up as positive because only the surviving firms will be included in the published data sensitive to the specific time perspective.

TABLE 1: Disentangling the competition and spillover effects from FDI

Author(s)	Country/Year(s)	Competition proxy	Results
Sjöholm (1999)	Indonesia 1980 and 1991	Herfindahl Index ERP (effective rate of protection)	Firms in high competition industries benefited more from spillovers
Blomström and Sjöholm (1999)	Indonesia 1991	Dummy control for local firms that are exporters	Spillovers are restricted to the non-exporters ⇔ FDI increases productivity in domestic firms through competition
Altomonte and Pennings (2005)	Romania 1995-2001	No. of foreign entrants over time (dynamic)	Spillovers are maximised at a certain threshold level after which the marginal effect of more foreign entrants become negative
Barrios, Görg and Strobl (2005)	Ireland 1972-2000	Net entry rate of new domestic firms (dynamic)	Initially the competition effect is so strong that it deters entry, eventually it is outweighed by a positive externality effect that crowds-in domestic entry
Fernandes (2007)	Colombia 1977-1991	Herfindahl Index Turnover rates	Trade liberalization affects more strongly TFP in less competitive industries
Görg, Hijzen and Murakozy (2009)	Hungary 1992-2003	Dummy control for export oriented MNCs	Local market oriented MNCs have a negative impact on TFP levels with domestic firms whereas export oriented MNCs have no impact

3. DATA

The data used in the study comes from two main sources – the Amadeus Databank published by Bureau Van Dijk in Holland and information about number of active firms at the industry level including industry specific market shares obtained from GUS (National Statistical Office of Poland) in Warsaw.

The firm specific data which is an unbalanced panel covering the period 1993-2004 was downloaded in 2005 as unconsolidated data (for the plant level). In this data there is the possibility to identify owners through information about the majority shareholder. Foreign firms are hence classified as those firms being held by a foreign majority shareholder. Domestic firms are classified when held by a domestic majority shareholder. Old firms are classified as those firms having been established prior to or in 1989 and oppositely for new firms after 1989.

All the variables, exact calculations and their sources are summarized in Table 2.

The panel dataset is bound together by a number of identifiers. The main identifier in the panel is the individual plant. The firm level data is combined with the industry level data using industry codes (NACE) at the 3 digit level.

Sample characteristics on the main classifying variables are shown with Table 3. (More descriptive statistics and correlation coefficients are reported in Appendix 2.) This is a snapshot in time of the panel. The year 2000 has the highest number of observations, whereas the panel tends to become more unbalanced around the start and end dates. Juxtaposing the firm level data with GUS industry level data (here at the 2 digit level) gives an estimation of sample representation (last column). On average the sample is drawn representing half of industry sales. Generally the least and most concentrated industries have lower representation or in some industries unknown representation. In industries or subgroups of industries with only a few active firms GUS is not allowed to publish the sales data. From an industrial economics perspective a firm level panel of this type will typically cover all or some of the main actors in the industry, whereas the smaller fringe firms will be left out. Hence results will reflect those of the industry main actors, whereas knowledge about the typically more adaptive fringe will remain unknown. In terms of competitive pressure however, the fringe may be very important. The study tries to control for this by

including information about the total number of competitors in each industry (at the more detailed 3 digit level). Other measures of competition such as the Herfindahl index or concentration ratios cannot be calculated since firm level data is only available as a sample. (Exact stratification of which remains uncertain since most of the population characteristics are unknown).

TABLE 2: Overview of study variables

COMP	The number of firms active at the 3-digit NACE industry level according to aggregate GUS census data.
CAPITAL	Real capital assets of the firm approximated using the book value of total fixed assets in 1,000 PLN from the Amadeus Databank. The GDP deflator from the World Bank's WDI Database is used to calculate real values.
DOM	A dummy variable taking the value of 1 when the firm is owned by a domestic majority shareholder according to the Amadeus Databank
FOR	A dummy variable taking the value of 1 when the firm is owned by a foreign majority shareholder according to the Amadeus Databank.
FORMSH	The share of turnover at the 3-digit NACE industry level with foreign owned firms according to aggregate GUS census data.
KL	Capital intensity calculated as capital over number of employees (labour).
LABOUR	Number of employees of the firm using year end data from the Amadeus Databank.
MATCOST	Real materials used in production in 1,000 PLN from the Amadeus Databank. The GDP deflator from the World Bank's WDI Database is used to calculate real values.
MARKUP	Calculated as total sales divided with total cost (total sales less EBIT) from the Amadeus Databank as an approximation to the ratio of price over average cost.
NEW	A dummy variable taking the value of 1 when the firm was established after 1989.
OLD	A dummy variable taking the value of 1 when the firm was established prior to or in 1989.
ROA	Return on assets, calculated as EBIT over total assets taken from the Amadeus Databank.
TFPOLS	Total factor productivity estimated using ordinary OLS on the pooled dataset (see Appendix 1).
TFPLP	Total factor productivity estimated by controlling for the simultaneity bias between inputs and productivity shocks called the Levinsohn-Petrin procedure (see Appendix 1).
SALES	Real output of the firm approximated using sales data in 1,000 PLN from the Amadeus Databank. The local GDP deflator from the World Bank's WDI Database is used to calculate real values.
YL	Labour productivity calculated as sales over number of employees (labour).

From Table 3 follows an important descriptive statistic about the data. Foreign entrants in Polish manufacturing fall with approximately one third of firms as acquisitions of existing assets (old firms). Oppositely is the domestic population of firms covered with the sample almost equally divided in terms of half of the firms being inherited from the previous regime.

More descriptive statistics are given in the subsequent Section 4 on performance differences. Simple descriptive statistics and Pearson correlation coefficients are reported in Appendix 2.

The various performance measures used in the study capture different aspects of firm efficiency, growth and/or host country welfare. Total factor productivity growth (or TFP growth) is the most universally applied measure of efficiency advancements in economics. TFP captures the efficiency with which firms are able to transform inputs into outputs. Firms with higher TFP (TFP growth rates) are typically considered to have a higher level of firm-specific technology (technological progress). However, other aspects of firm organization including worker motivation may be important. Hence technology should be considered not only to include the hardware of the organization but also the software and perspiration of its workers. (Appendix 1 shows the exact equations that were used to calculate total factor productivity using OLS (TFPOLS) and the Levinsohn-Petrin procedure in STATA (TFPLP)).

The markup level as opposed to TFP says something about the market power of firms when selling their products. It measure the distance between the average cost of producing and the sales price. This measure of performance may be strongly affected by the number of competitors in the industry and other factors such as product quality and differentiation practices.

Whereas TFP is really an efficiency measure that should not reflect market valuation, unfortunately the two measures of performance are closer to each other than they should be. TFP should ideally be measured using only information about quantities of inputs and outputs. However, some inputs are measured using prices since there is no other way of counting up capital than by using its worth in monetary terms. The same is true for the composite of materials. Output of the firm is measured with sales since outputs nor prices are uniform enough even at the firm level to be accounted for in any other way.

Both measures may be seriously flawed when most of the sales of a subsidiary take place at transfer prices on an intra-firm basis. Estimating the production function in its gross form (materials included) may help to reduce this bias, e.g. if transfer pricing is to the benefit of the subsidiary it will show up as higher material productivity and vice versa.

Labor productivity growth is a weaker but complementary measure to TFP growth and should include control for capital intensity when applied. It estimates the efficiency of the average worker employed by the firm.

Labor or employment growth is a performance measure that shows whether individual firms are growing or shrinking over time. Better performing firms are typically expected to grow and vice-versa, except in situations where there may be increasing industry concentration or in periods where firms restructure by increasing their specialization.

Return on Assets (ROA) measures performance from the perspective of the capital owners of the firm. As it is calculated in this study (EBIT over total assets) it shows the gross return to the investment of capital with the firm. It is directly comparable across firms but is gross in the sense that it does take into account neither the cost of borrowing nor the opportunity cost of investing the capital.

All the performance measures are related. For example, assuming constant demand an increase in market power (markup levels) may come about by shrinking the size of production (and hence employment) and/or reducing the cost and/or increasing efficiency. Increases in market power are associated with higher levels of profitability or ROA and lower levels of competition in the static perspective of market efficiency. It is important to note that market power through markup levels and efficiency may co vary both in a positive and negative way. Technological progress may be equally likely to be associated with a market structure that becomes more or less concentrated over time (Demsetz, 1973). Similarly under expanding
demand or rapid technological progress, markup levels may be positively correlated with competition. In the static market efficiency perspective consumer welfare goes up with a lowering of market power. However, in a dynamic perspective (some) market power is not necessarily bad if it leads to technological progress through a cyclical process of innovation and diffusion.

TABLE 3: Basic sample characteristics

Year=2000

No. of firms	Foreign		Domestic		**Sample/Population**
	New	Old	New	Old	(% of total sales)
Industry					
15 - Food	71	39	161	102	47
16 – Beverages**	**-**	**4**	**-**	**2**	**48**
17 – Textile	13	3	17	44	63
18 – Clothing	13	5	21	16	27
19 - Leather	4	1	11	11	36
20 – Wood	18	1	30	26	52
21 - Paper	20	11	23	10	80
22 – Printing	31	1	32	26	97*
23 – Fuel**	**2**	**-**	**4**	**6**	**28**
24 - Chemical	26	14	29	49	63
25 – Plastic	47	8	47	27	43
26 – Mineral	42	32	40	46	63
27 – Metal	6	4	10	34	62
28 - Metallurgy	34	10	70	66	51
29 – Machinery	23	18	54	107	48
30 – Office mach.**	**1**	**-**	**4**	**1**	**52**
31 – Electrical mach.	26	15	30	23	53
32 – Radio, TV	11	1	12	11	66
33 – Precision mach.	3	1	8	9	20*
34 – Vehicles	26	11	7	23	50
35 – Other transp.	5	5	13	18	53
36 – Furniture, other	31	6	26	26	48
37 – Recycling	3	2	5	4	64
Total manufacturing	**456**	**192**	**654**	**687**	**50**

*The industry level data that the sample totals are compared with is not reliable for these industries because data is not released by GUS when concentration could lead to identification of individual firms.
**These industries have been excluded from the calculations due to insufficient number of observations.
Source: Amadeus Database, Bureau Van Dijk, Holland and National Statistical Office of Poland (GUS).

4. Regression results

The first method used to present the statistical results of the analysis falls in between descriptive statistics and regression analysis. Simple structural equations are adopted treating the data as a pool towards describing the basic dimensions of the sample and focusing on the characteristics that are of main interest. Subsequently the data is analyzed using more advanced panel data regression techniques. Simple descriptive statistics are reported in Appendix 2.

4.1. Basic performance differences

In Table 4 the foreign owned firms are compared with the domestically owned firms on a number of basic variables, ratios and for the specific performance variables that are used subsequently as dependent variables in the panel regression analysis. Each column in Table 4 gives a different estimate of the premium of being a foreign owned firm. The first column compares e.g. level in sales without controlling for firm-specific characteristics such as industry affiliation. The second column compares again the level in sales but through a simple structural equation that controls for the impact that covariates such as industry and year may have on the reported variable. Finally in the last column is shown the foreign premium for the annual growth rate in sales, again using the same structural equation as in column 2 to control for other relevant covariates. The first row in Table 4 reads: foreign owned firms in a simple comparison are found to have sales that are on average 84 % higher than that of domestically held firms, controlling for basic characteristics of each data point (industry and year). This premium shrinks only a little bit to 80%. Finally foreign owned firms register an annual growth rate in their sales that is 8% higher than the growth rate of domestically owned firms.

From Table 4 it is seen that the sample for Poland confirms what is found for a host of other foreign-domestic samples in emerging markets. Foreign firms are on average larger, much more capital intensive (even though this is slowly changing since the growth rate in the capital labor ratio is lower than that of the growth rate in the domestically held firms) and more productive (when measured using labor productivity and some of the measures of total factor productivity). The next two rows show that foreign firms pay considerably higher wages. The sales to material cost ratio would suggest (even though a very rough measure) that foreign subsidiaries are more specialized compared to their domestic counterparts. This is perhaps not surprising remembering that the domestic part of the sample contains a relatively larger share of firms with assets inherited from socialism.

TABLE 4: Foreign firm premia

Variable:	Level I *	Level II**	Growth rate***
log SALES	0.90	0.86	0.11
log LABOUR	0.27	0.25	0.03
log SALES/LABOUR	0.64	0.62	0.07
log CAPITAL/LABOUR	1.00	0.95	-0.02
log WAGES/LABOUR	0.37	0.38	0.04
log SALES/MATCOST	-0.13	-0.12	-0.01
log TFPOLS	-0.05	-0.04	0.02
log TFPLP	0.53	0.42	0.08
MARKUP	0.003	-0.002	0.02****
ROA	-0.40	-0.41	0.02****

*The simple level difference in the variable by ownership group.
**The level difference in the variable by ownership group controlling for the covariates of industry and year of the observation.
***The growth rate difference in the variable by ownership group controlling for the covariates of industry and year of the observation.
****For the MARKUP and ROA is shown the point difference instead of the growth rate.

The table offers some new evidence on the foreign firm premia. Markup levels with foreign subsidiaries are not higher than with domestically owned firms when other covariates are controlled for. Foreign owned firms in Polish manufacturing are on average much less profitable compared to their domestic counterparts. Even though these results are unexpected they give an indication of the severity of competition facing foreign subsidiaries in the emerging market context such as the Polish (and with respect to profitability also that large upfront investments are being made during the period of study).

Table 5 provides now comparative evidence on the new firm premia – that is instead of focusing on ownership the focus is instead on the history of assets for groups of firms. As mentioned in the data section firms are classified as new when their asset history is exclusively associated with the transition to a market economy in Poland after 1989. According to Table 5, new firms are smaller and less capital intensive and generally grow faster. In the period covered they are found to be more specialized and productive compared to firms with inherited assets even though on average the growth rate in productivity is lower than in the old firms undergoing restructuring. The new firms have generally somewhat higher markups than old firms and are found to be much more profitable than firms with inherited assets.

Overall the descriptive statistics presented in this section confirm a number of factors about the foreign firm premia, but point to a number of intervening factors in this relationship between ownership and performance. For example, the much higher capital intensity in foreign owned firms might explain their superior performance in terms of total factor and labor productivity. But when looking at ROA, the higher overall efficiency comes at significant cost in terms of lower efficiency of the invested capital. The descriptive statistics show that the institutional changes associated with the privatization process is important to control for when investigating firm performance in an emerging market context such as the Polish. Descriptive statistics on the new firm premia suggest that some firm heterogeneity is left unexplored in studies of this type.

TABLE 5: New firm premia

Variable:	Level I*	Level II**	Growth rate***
log SALES	-0.61	-0.46	0.08
log LABOUR	-1.06	-0.86	0.08
log SALES/LABOUR	0.45	0.39	0.01
log CAPITAL/LABOUR	-0.07	-0.06	-0.002
log WAGES/LABOUR	0.09	0.04	0.03
log SALES/MATCOST	-0.22	-0.16	-0.01
log TFPOLS	0.43	0.42	-0.02
log TFPLP	-0.02	0.04	0.02
MARKUP	0.015	0.017	0.002****
ROA	0.46	0.40	-0.09****

*The simple level difference in the variable by ownership group.
**The level difference in the variable by ownership group controlling for the covariates of industry and year of the observation.
***The growth rate difference in the variable by ownership group controlling for the covariates of industry and year of the observation.
****For the MARKUP and ROA is shown the point difference instead of the growth rate.

4.2. Dynamic panel regression results on owners and assets

The statistical results presented above despite controlling for basic covariates suffer among other from the disadvantage that the data is not structured as a firm-level panel but instead treated as a pool of common data only labeled with some industry codes and time specifications.

Several regression techniques can be used to exploit the panel character of the data. For example, methods such as fixed effects and first difference are obvious to use. However,

because of the structural character (time invariant) of the main explanatory factors especially a fixed effect approach is less useful as the effects to be observed will tend to be suppressed by the fixed effects. The first difference approach is useful if there are a lot of time variant explanatory factors. However, that is not the case here since the number of explanatory factors are somewhat limited as most of the dependent variables are already secondarily derived using such explanatory factors.

Instead is used a dynamic panel data approach. The dependent variables are specified as dynamic (since we are more interested in their growth rates than their levels). To account for the time series dimension is adopted the lagged dependent variable approach. The main effects are ownership classes (foreign and domestic) and asset histories (new and old). The size of firms is controlled for by inclusion of the number of employees as lagged variable. Industry, region and year effects are controlled for as dummy fixed effects. Finally to account for the cross section dimension a locally weighted equation (FGLS) is used. This specification allows for an error term component that is heteroscedastic or specific to each firm (cross section).

The results are reported with regression Table 6.

TABLE 6: Foreign and new firm premia in the panel

Z-statistics are reported in parenthesis

Dependent variable:	dlogTFPLP	dlogYL	dlogL	dMarkup	dROA
Ownership effects:					
FOR	0.14***	0.12***	0.011***	0.011***	-0.07***
	(39.62)	(40.97)	(8.49)	(13.45)	(-10.42)
Asset effects:					
NEW	0.02***	0.04***	0.03***	0.005***	-0.00
	(5.95)	(17.65)	(23.62)	(7.66)	(-0.03)
Controls:					
LDV(-1)[A]	-0.21***	-0.15***	-0.05***	-0.67***	-0.60***
	(-72.57)	(-74.69)	(-72.76)	(-141.38)	(-104.04)
Log LABOUR (-1)[B]	0.03***	-		-0.01***	-0.15***
	(20.19)			(-19.73)	(-37.86)
Log (CAP/LAB)(-1)	-	0.03***	0.03***	-	-
		(28.54)	(74.59)		
INDUSTRY	Yes***	Yes***	Yes***	Yes***	Yes***
REGION	Yes*	Yes	Yes***	Yes***	Yes*
YEAR	Yes***	Yes	Yes***	Yes*	Yes*
Obs.	8,321	8,363	8,363	8,333	8,333
χ^2	54,685	528,350	389,131	157,454	35,081

Notes

A Note that the lagged dependent variable (LDV) is not the last period growth rate but the last period level.

*/**/.. The estimated parameter is significant at the *10 percent level ** 5 percent level *** 1 percent level

From the regression results it is verified that foreign ownership and newness corroborate towards the same effects. This is seen in a simple way in Table 6, because one effect is positive still, while the other is controlled for. For example, foreign ownership has a performance premium that is independent of newness. The same is true for new firms. They have a performance premium that is independent of foreignness. This also implies that the best performers (except with respect to ROA) are the new foreign owned firms. The worst performers are the old domestic firms. Concerning all productivity related performance measures (TFP, YL and markup) ownership matters relatively more compared to the impact that asset history has on performance. With respect to employment growth, asset history is more important since new firms grow faster than the old restructured firms. For profitability the result is the opposite with the foreign owned firms being the least profitable whereas asset history alone has a weak influence on profitability.

Asset history in terms of firms endowed with inherited assets place a burden on firm performance. However, a burden that may be specific to the period of study and a reflection of the very intensive restructuring process that these firms are undergoing.

In previous Tables 4 and 5, it was reported that static market efficiency is not impacted by ownership. With the dynamic equations it is found that markup levels are growing faster

especially in the new foreign owned firms. But also other factors (and besides those of industry and region already controlled for) such as market structure, differentiation practices and export intensity may be quite important in explaining markup levels.

Despite the lower efficiency levels, the investment in old firms has been more profitable relative to establishment of new firms when the owner is foreign (not shown). It is only with respect to ROA (profitability) that the average ranking for ownership classes and asset histories is generally not confirmed. This might indicate that Greenfield investments abroad are more risky because of the downsides of location disadvantage. It might be an indication of the significant capital investment involved and that the profitability from investment in capacity has a longer time horizon. The difference in ROA could also be explained by cost of capital differences, e.g. that the capital of the old firms has been acquired at a certain rebate.

4.3. Estimating competition and spillover effects

In Table 7 the same regressions are run as with Table 6, but now including the estimation of spillover effects using the proxy *SHFOR* and controlling for competition with the variable *COMP*. Results are reported for the full sample, but the spillover proxy is interacted with the ownership groups to observe the differential impact that the emergence of the foreign ownership class has on other foreign and domestic owners. Only the latter effect is what is typically associated with the spillover effect in studies of this type. However, foreign subsidiaries themselves may benefit from the spillovers from other foreign subsidiaries. The competition proxy is included in an attempt to control for the independent effect that competition has on performance.

The hypothesis is that either effect could be positive or negative depending on the specific situation. The sign of the competition effect will depend both on changes in demand and static and dynamic changes in firms' average cost curves. Even in a scenario of constant demand and cost conditions the entry effect may be ambiguous for the competition effect. For example, if firms compete in Cournot, TFP and markups should go down because of declining prices. Oppositely, if firms compete in Bertrand, there may not be room for a price decline, hence hampering TFP if firms already operate at MES and leaving markups unchanged at zero.

TABLE 7: Competition and spillover effects in the panel

Z-statistics are reported in parenthesis

Dependent variable:	dlogTFPLP	dlogYL	dlogL	dMarkup	dROA
Ownership effects:					
FOR	0.10***	0.10***	-0.02***	0.020***	-0.16***
	(15.79)	(17.69)	(-5.64)	(11.81)	(-11.44)
Asset effects:					
NEW	0.03***	0.05***	0.04***	0.014***	0.12***
	(8.91)	(20.66)	(26.59)	(18.86)	(18.07)
Controls:					
LDV(-1) [A]	-0.22***	-0.17***	-0.05***	-0.711***	-0.18***
	(-76.63)	(-82.13)	(-72.22)	(-175.89)	(-43.24)
LABOUR (-1)	0.03*** -	-		-0.005***	-0.18***
	(18.15)			(-15.85)	(-43.24)
Log (CAP/LAB)(-1)	-	0.03***	0.03***	-	-
		(26.95)	(50.52)		
INDUSTRY	Yes***	Yes***	Yes***	Yes***	Yes**
REGION	Yes***	Yes***	Yes***	Yes***	Yes***
YEAR	Yes***	Yes***	Yes***	Yes***	Yes***
Spillovers:					
D(Log COMP)	-0.05***	0.12***	-0.10***	0.001	0.05**
	(3.06)	(10.53)	(-17.15)	(0.49)	(1.81)
FORMSH	0.09***	0.07***	-0.05	0.084***	0.12***
*DOM	(8.09)	(8.49)	(-12.56)	(37.44)	(5.82)
FORMSH	0.21***	0.14***	0.01	0.055***	0.24***
*FOR	(16.54)	(10.57)	(1.08)	(14.81)	(7.60)
Obs.	6,991	7,030	7,030	7,009	7,009
χ^2	1,318,983	$4*10^7$	116,804	$7{,}7*10^{10}$	73,152

Notes

A Note that the lagged dependent variable (LDV) is not the last period growth rate but the last period level.

*/**/.. The estimated parameter is significant at the *10 percent level ** 5 percent level *** 1 percent level

However, competition in itself may force firms to work harder or look for new markets which could give a positive effect.

The spillover effect is hypothesized in most situations to be close to zero or positive. Only in rare situation should it be negative. For example, bad product reputation from a specific firm may spill over negatively on all other producers in the same industry. We could also imagine other types of negative spillovers associated with adoption of suboptimal or flawed methods of production (industry fads) which may spill over on other firms before their inherent problems are discovered. But in most cases productivity spillovers or technology diffusion must be assumed to be either zero or positive. If the competition proxy for some reason is

not sufficient it can also be negative. (In which case the effects cannot be separated on methodological grounds).

Focusing on the results for efficiency and employment growth (dlogTFPLP and dlogL) in Table 7, it is seen that competition has a negative effect on these performance measures. Note that in the final results competition was measured with the growth rate in net entrants. (The level of competition also gave a negative result but was only weakly significant.) Oppositely does labor productivity respond positively to increases in competition in Polish manufacturing. This combined evidence would suggests that competition made firms invest in capacity but maybe reducing the ability of the individual firm to operate at MES. The results for profitability (ROA) indicate that reverse causality may be at work since it should be unilaterally negative in view to the other evidence (but maybe what is registered is that profitable industries attract more new entrants). The same regression was run with the growth rate in net entrants (Δ (Log COMP)) and the spillover terms lagged one period. The sign and significance of the results for TFPLP were maintained and strengthened. Oppositely for ROA did the sign change to negative and the size and significance of the estimated parameter increased considerably (not shown).

The spillover effects across all performance measures are unilaterally positive except with respect to long run performance or the growth of domestic firms. The expansion of foreign market shares in Poland is found to have positive spillovers on the efficiency of domestic firms and their markup and profitability levels. But foreign investment does have some crowding out effect on employment with domestic firms. Estimating the same effects among the foreign producers themselves suggest that technology diffusion or spillovers are much more rapid within the foreign producer community. Again, and due to the inaccuracy of the technology spillover proxy, the result may be caused by a third unobservable factor which could be the better ability of foreign owned firms to invest in the 'right' or expanding industries. Robustness checks were made as explained above by differencing out and lagging the spillover proxy one or two periods (not shown). The positive spillover results were maintained unilaterally across all specifications again with the exception of employment growth with domestic firms. However, only the technology spillover effect on domestic firms maintained its significance whereas only the profitability spillover effect maintained its significance among the foreign held firms.

5. POLICY IMPLICATIONS

The quantitative results obtained in the paper have already been summarized in the introduction part. The conclusion will therefore focus on addressing the potential policy and research implications of the study.

Helping firm performance in emerging markets is a balancing act between optimizing both subsidiary and local firm performance. One cannot be understood without the other as a long tradition of research on FDI and firm performance in this context shows. To optimize subsidiary and local firm performance requires attention to be paid both to the direct and indirect impacts of FDI on firm performance. This problem is very similar to the fundamental problem of economic growth being that of finding institutional setups that can give incentives for innovation, while not sheltering innovators too much from the competitive process that involves both competition per se and technology diffusion. Helping foreign subsidiary performance in emerging markets will in most cases also have a positive effect on local firms. So in the conclusion I will try to focus on areas where policy-makers in the new or emerging market economies can set in to assure that this will be the case.
The first area of general concern is the relationship between market efficiency and how FDI affects both short or static and long run market efficiency. This has rarely been addressed in the empirical literature in concrete and practical ways. For Poland it was found that especially the selling of assets to owners abroad did not raise concerns for short run market efficiency. However, this result may in some ways be peculiar to the specific polish institutional context and Poland's transition path. Privatization in Poland has followed a gradualist approach and privatization has been high quality in the sense that a relatively large amount of resources have been invested in the matching of assets to be privatized with that of new and more efficient owners. Social concerns and short run job protection has played a considerable role in these negotiations. Different institutional contexts should be studied to better understand the implications of FDI for market efficiency.

One potential area of concern with respect to market efficiency is the large gap in capital intensity across foreign and domestic held firms which could be a signal that barriers to entry are increasing over time. Hence market efficiency outcomes need to be monitored on a continuous basis. When rebates or discounts on taxes or investments are given policy-makers should be concerned that such schemes are available equally to all firms.

With respect to spillover effects the study shows that there may be a high element of antagonism and rivalry across ownership groups. This may be in particular true for long run performance or firm growth. To maximize spillovers policy-makers should support institutions and initiatives that will reduce the tendency of advancement of one ownership group at the expense of the other. No doubt socialization and communication have a large bearing on spillover effects also in industrial communities. Although not addressed in this study, barriers to communication, such as language and cultural differences, are among the most important to be removed.

The results on spillovers and competition documented in the present research should be complemented by results focusing on particular industry cases whereby it will be possible to measure the evolution in efficiency, markup levels, competition and spillover effects in more exact ways. Partly the problems incurred in the present research can also be resolved by using panels where the time dimension takes greater prominence in the results. Other long run performance measures should be the object of analysis such as entry and exit rates.

REFERENCES

Altomonte, Carlo and Enrico Pennings (2005): 'Searching for horizontal spillovers through incremental foreign direct investment', *Tinbergen Institute Discussion Paper*, TI-2005 101/4, Erasmus University, Holland.

Anand, Jaideep and Andrew Delios (1997): 'Location Specificity and the Transferability of Downstream Assets to Foreign Subsidiaries', *Journal of International Business Studies*, Vol. 28, No. 3, pp 579-603.

Arnold, Jens Matthias and Beata Smarzynska Javorcik (2005): 'Gifted Kids or Pushy Parents? Foreign Acquisitions and Plant Performance in Indonesia', *CEPR Discussion Paper*, No. 5065, London.

Barrios, Salvador, Holger Görg and Eric Strobl (2005): 'Foreign Direct Investment, Competition and Industrial Development in the Host Country', *European Economic Review*, Vol. 49, No. 7, pp 1761-1784.

Berger, Allen N., George R.G. Clarke, Robert Cull, Leora Klapper and Gregory F. Udell (2005): 'Corporate governance and bank performance: A joint analysis of the static, selection, and dynamic effects of domestic, foreign and state ownership', *Journal of Banking and Finance*, Vol. 29, pp 2179-2221.

Blomström, Magnus and Fredrik Sjöholm (1999): 'Technology transfer and spillovers: Does local participation with multinationals matter?', *European Economic Review*, Vol. 43, No. 4-6, pp 915-923.

Conyon, Marin J., Sourafel Girma, Steve Thompson and Peter W. Wright (2002): 'The Productivity and Wage Effects of Foreign Acquisition in the United Kingdom', *The Journal of Industrial Economics*, Vol. 50, No. 1, pp 85-102.

Corrado, Carol, Paul Lengermann and Larry Slifman (2008): 'The Contribution of Multinational Corporations to U.S. Productivity Growth, 1977-2000', in Reinsdorff, Marshall and Matthew Slaughter (eds.) *International Trade in Services and Intangibles in the Era of Globalization*, forthcoming from the University of Chicago Press.

Crespo, Nuno and Maria Paula Fontoura (2007): 'Determinant Factors of FDI Spillovers – What Do We Really Know?', *World Development*, Vol. 35, No. 3, pp 410-425.

Damijan, Joze P., Matija Rojec, Boris Majcen and Mark Knell (2008): 'Impact of Firm Heterogeneity on Direct and Spillover Effects of FDI: Micro Evidence from Ten Transition Countries', *LICOS Discussion Paper Series*, No. 218/2008, LICOS Centre for Institutions and Economic Performance, Katholieke Universiteit Leuven.

Demsetz, Harold (1988): 'The Theory of the Firm Revisited', *Journal of Law, Economics and Organization*, Vol. 4, No. 1, pp 141-161.

Demsetz, Harold (1973): 'Industry Structure, Market Rivalry and Public Policy', *Journal of Law and Economics*, Vol. 16, No. 1, pp 1-9.

Dunning, John H. (1981): *International Production and the Multinational enterprise*, George Allen & Unwin, London.

Estrin, Saul, Jan Hanousekm Evzen Kocenda and Jan Svejnar (2009): 'Effects of Privatization and Ownership in Transition Economies', *World Bank Policy Research Working Paper*, No. 4811, The World Bank, Washington D.C.

Fernandes, Ana M. (2007): 'Trade policy, trade volumes and plant-level productivity in Colombian manufacturing industries', *Journal of International Economics*, Vol. 71, No. 1, pp 52-71.

Frees, Edward W. (2005): *Longitudinal and Panel Data – Analysis and applications in the social sciences*, Cambridge University Press, New York.

Görg, Holger and Eric Strobl (2001): 'Multinational Companies and Productivity Spillovers: A Meta-Analysis', *The Economic Journal*, Vol. 111, No. 475, pp F723-F739.

Görg, Holger, Alexander Hijzen and Balazs Muraközy (2009): 'The role of production technology for productivity spillovers from multinationals: Firm-level evidence for Hungary', *Kiel Working Papers*, No. 1482, Kiel Institute for the World Economy.

Haddad, Mona and Ann E. Harrison (1993): 'Are There Positive Spillovers from Direct Foreign Investment? Evidence from Panel Data for Morocco', *Journal of Development Economics*, Vol. 42, No 1, pp 51-74.

Hymer, Stephen (1970): 'The Efficiency (Contradictions) of Multinational Corporations', *The American Economic Review*, Vol. 60, no. 2, Papers and Proceedings of the Eighty-second Annual Meeting of the American Economic Association, pp 441-448.

Karpaty, Patrik (2007): 'Productivity Effects of Foreign Acquisitions in Swedish Manufacturing: The FDI Productivity Issue Revisited', *International Journal of the Economics of Business*, Vol. 14, No. 2, pp 241-260.

Kokko, Ari (1996): 'Productivity spillovers from competition between local firms and foreign affiliates', *Journal of International Development*, Vol. 8, No. 4, pp 517-530.

Lipsey, Robert E. and Fredrik Sjöholm (2005): 'The Impact of Inward FDI on Host Countries: Why such different answers?' in Moran, Theodore H. , E.M. Graham and M. Blomström (eds.) *Does foreign direct investment promote development?* Peterson Institute for International Economics, Washington D.C.

Markusen, James R. (1995): 'Incorporating the multinational enterprise into the theory of international trade', *Journal of Economic Perspectives* Vol. 9, pp 169–189.

Sjöholm, Fredrik (1999): 'Technology gap, competition and spillovers from direct foreign investment: evidence from establishment data', *Journal of Development Studies*, Vol. 36, No. 1, pp 53-73.

APPENDIX 1.

Methodologies used to estimate Total Factor Productivity

Two different methods towards estimating total factor productivity have been used, re. TFPOLS (the OLS method) and TFPLP (the Levinsohn-Petrin method) reported in the paper.

Following the literature on estimates of total factor productivity, the OLS estimates may be seriously biased due to problems of simultaneity (Olley and Pakes, 1996, Levinsohn and Petrin, 2003).

Under the OLS method TFP is calculated as the residual under the BLUE assumptions (error terms are serially uncorrelated, homoscedastic and reflect random and unobserved shocks that are i.i.d.):

$$y_{iat} - \hat{y}_{iat} = y_{iat} - \hat{\alpha}_a k_{iat} - \hat{\beta}_a l_{iat} - \hat{\gamma}_a m_{iat} \qquad \text{(A1.1)}$$

Where output *y* is sales revenue (when materials are included otherwise value added), *k* is capital, *l* is labor and *m* is material inputs. (Small letters denote logarithmic transformation.)

The problem of simultaneity is widely discussed and addressed in the literature. It arises because if productivity shocks are partially and differently observed by managers across firms it may violate the BLUE assumptions. For example assume ω in this production function is observed by managers before deciding inputs and hence error terms are no longer i.i.d.:

$$y_t = \chi_0 + \alpha k_t + \beta l_t + \gamma m_t + \omega_t + \varepsilon_t \qquad \text{(A1.1)}$$

One way to approach the problem is to use semi-parametric estimation techniques. Olley and Pakes (1996) introduce the first attempt using inputs of capital as a proxy for the observed part of the productivity shock. Levinsohn and Petrin (2003) correct the Olley and Pakes method in view to non-linearity in the investment function suggesting instead usage of variable inputs such as materials or energy as a proxy for the observed part of the productivity shock. Estimates of α, β and γ in A1.1 are now obtained using that ω is a function of the inputs of capital and materials.

It has been documented that with the OLS approach the productivity parameters for labor and other variable inputs such a materials have been overestimated, whereas the parameter for capital tends to be underestimated. On balance Petrin et al. (2004) show that economies of scale are exaggerated by OLS and hence total factor productivity is underestimated.

The routine is fairly complex and described in detail in Levinsohn and Petrin (2003) and Petrin et al. (2004). However, it can easily be implemented in STATA invoking the LEVPET routine if first installed. The approach used here is based on the production function in its net form (using value added as dependent variable) and using the default set up (two lags for instruments and the nl command as minimizing routine).

Under the OLS method the parameters can be estimated with one expanded equation rendering the same results as estimating the production function separately by industry and ownership groups. Under the LP method parameters must be obtained by estimating it separately by industry

Comparative parameter estimates are reported in Table A1.1. and the estimated Kernel distributions of obtained TFP by ownership classes are reported with Figures A.1.1 and A.1.2 respectively.

It should be noted that the Levinsohn-Petrin procedure has higher computational requirements in terms of numbers of observations needed to obtain reliable parameter estimates. Hence it is not possible to calculate productivity parameters and residuals (TFP) for all industries and ownership groups separately for this specific dataset. Furthermore, productivity parameters vary at least as much with asset history as by ownership group in this specific panel. Instead common parameters are estimated by industry under this method and the remaining heterogeneity is addressed with the subsequent equations as reported in the paper. This is not an optimal but necessary solution due to the relatively low number of observations available for many industries in the study. The alternative approach being excluding industries selectively could raise other issues of selection bias.

FIGURE A1.1. TFPOLS by ownership classes

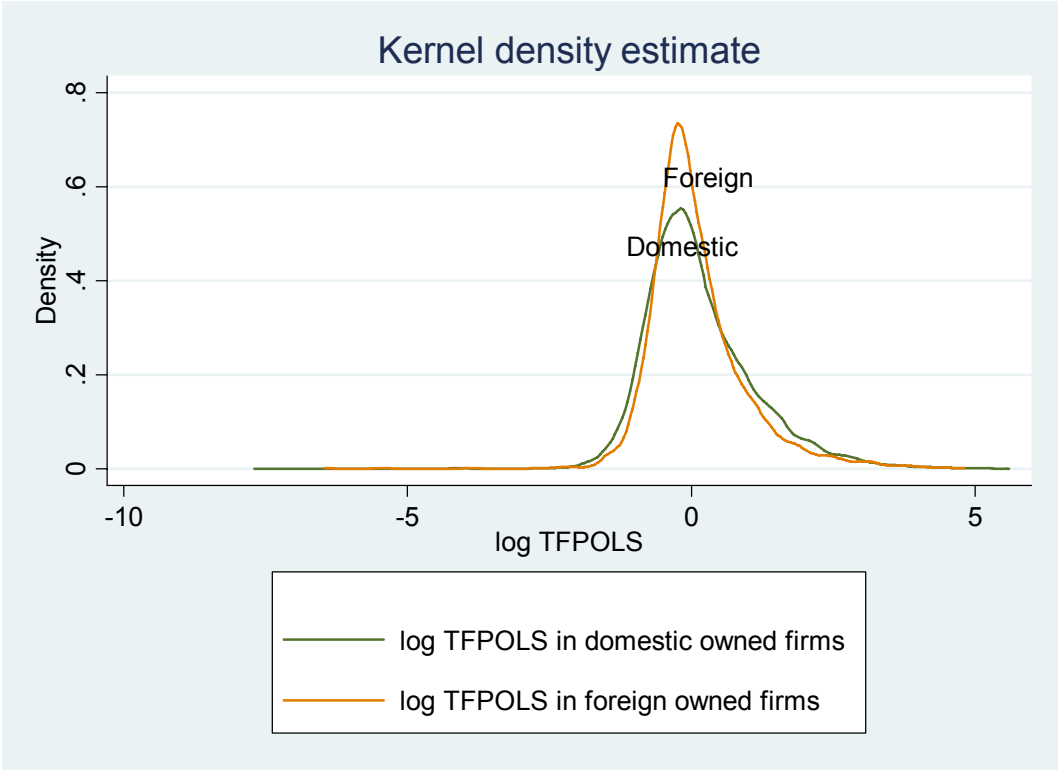

FIGURE A1.2. TFPLP by ownership classes

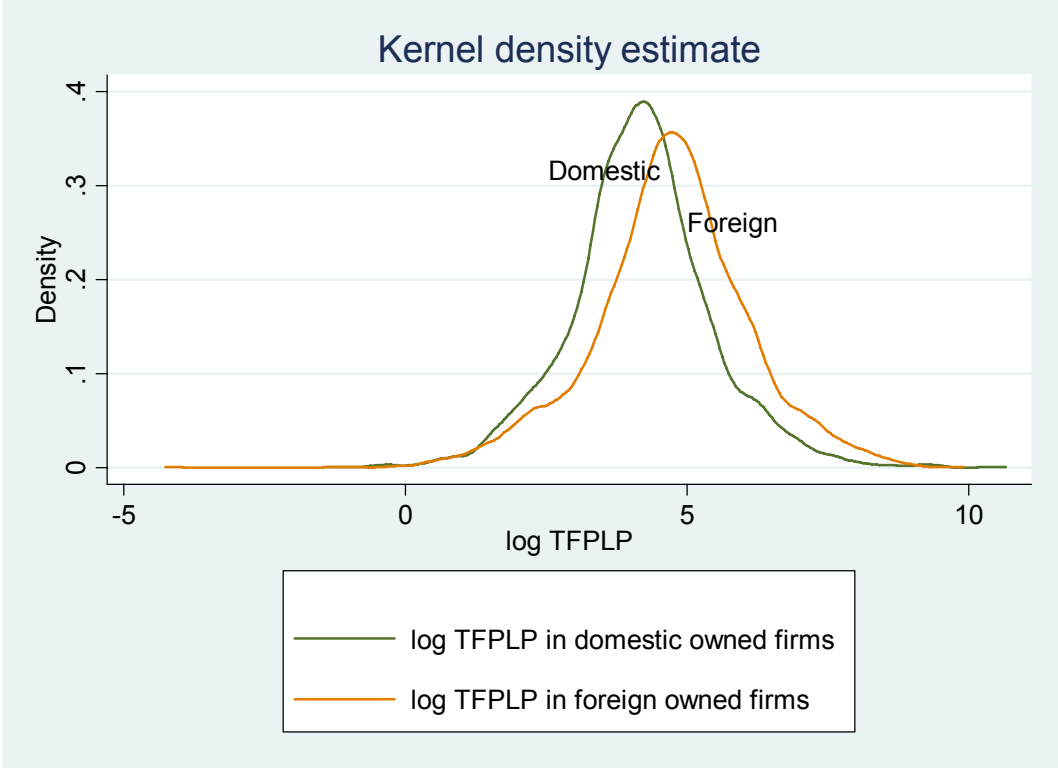

TABLE A1.1. Productivity estimates by industry, ownership and method

		OLS Method Dep. var. is sales				Levinsohn-Petrin Method Dep var. is value added		
Industry and owner		log K	log L	log M	ES (K+L)	log K	log L	ES
15 - Food	DOM	0.39	0.34	0.55	0.73	0.27	0.53	0.80
	FOR	0.42	0.33	0.51	0.75	-		
17 – Textile	DOM	0.58	0.38	0.30	0.96	0.42	0.52	0.94
	FOR	0.58	0.26	0.38	0.84	-		
18 – Clothing	DOM	0.24	0.57	0.57	0.81	0.21	0.51	0.72
	FOR	0.35	0.39	0.62	0.74	-		
19 - Leather	DOM	0.61	0.51	0.24	1.12	0.54	0.30	0.84
	FOR	0.78	-0.38	0.63	0.40	-		
20 – Wood	DOM	0.41	0.49	0.46	0.90	0.44	0.58	1.02
	FOR	0.61	0.18	0.40	0.79	-		
21 - Paper	DOM	0.48	0.23	0.54	0.71	0.43	0.46	0.89
	FOR	0.27	0.29	0.66	0.56	-		
22 – Printing	DOM	0.21	0.82	0.52	1.03	0.12	0.57	0.69
	FOR	0.56	0.63	0.29	1.19	-		
24 - Chemical	DOM	0.60	0.16	0.44	0.76	0.29	0.42	0.71
	FOR	0.38	0.27	0.59	0.65	-		
25 – Plastic	DOM	0.40	0.52	0.44	0.92	0.24	0.48	0.72
	FOR	0.41	0.46	0.46	0.87	-		
26 – Mineral	DOM	0.57	0.32	0.38	0.89	0.22	0.45	0.67
	FOR	0.54	0.45	0.27	0.99	-		
27 – Metal	DOM	0.39	0.26	0.53	0.65	-0.04	0.51	0.47
	FOR	0.56	-0.03	0.54	0.53	-		
28 - Metallurgy	DOM	0.25	0.60	0.55	0.85	0.20	0.59	0.79
	FOR	0.38	0.59	0.43	0.97	-		
29 – Machinery	DOM	0.24	0.76	0.42	1.00	0.28	0.50	0.78
	FOR	0.41	0.20	0.61	0.61	-		
31 – El. Mach.	DOM	0.18	0.89	0.46	1.07	0.04	0.49	0.53
	FOR	0.44	0.17	0.57	0.61	-		
32 – Radio, TV	DOM	0.25	0.43	0.65	0.68	0.11	0.44	0.55
	FOR	0.90	0.07	0.21	0.97	-		
33 – Prec.Mach.	DOM	0.05	0.59	0.74	0.64	0.16	0.38	0.54
	FOR	0.66	-0.18	0.61	0.48	-		
34 – Vehicles	DOM	0.43	0.52	0.38	0.95	0.40	0.40	0.80
	FOR	0.43	0.33	0.48	0.76	-		
35 – O. Transp.	DOM	0.30	0.69	0.39	0.99	0.63	0.41	1.04
	FOR	0.63	0.48	0.16	1.11	-		
36 – Furniture	DOM	0.30	0.51	0.53	0.81	0.24	0.39	0.63
	FOR	0.42	0.24	0.55	0.66	-		
37 – Recycling	DOM	0.31	0.42	0.64	0.73	-0.04	0.83	0.79
	FOR	0.45	0.56	0.41	1.01		-	

Appendix References:

Levinsohn, James and Amil Petrin (2003): 'Estimating production functions using inputs to control for unobservables', *Review of Economic Studies*, Vol. 70, No. 2, pp 317-342.

Olley, G.S. and A. Pakes (1996): 'The dynamics of productivity in the telecommunications equipment industry' *Econometrica*, Vol. 64, pp 1263-1297.

Petrin, Amil, Brian P. Poi and James Levinsohn (2004): 'Production function estimation in Stata using inputs to control for unobservables', *The Stata Journal*, Vol. 4, No. 2, pp 113-223.

APPENDIX 2.

About the data

*T*ABLE A2.1. Descriptive statistics and Pearson correlation coefficients

Calculated in STATA on full sample

			1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. COMP (number of)	Mean	166												
	SD	(143)	1.00											
2. CAPITAL (thous. PLN)		19,901												
		(91,205)	-0.097	1.00										
3. DOM (dummy)		0.67												
		(0.47)	0.023	-0.101	1.00									
4. SHAREFOR (share)		0.34												
		(0.22)	-0.151	0.031	-0.178	1.00								
5. LABOUR (number of)		323												
		(746)	-0.083	0.778	-0.036	-0.055	1.00							
6. MATCOST (thous. PLN)		25,816												
		(160,979)	-0.070	0.766	-0.123	0.062	0.690	1.00						
7. MARKUP (ratio)		1.06												
		(0.22)	-0.009	0.009	-0.003	0.050	-0.016	0.004	1.00					
8. OLD (dummy)		0.41												
		(0.49)	-0.093	0.099	0.164	-0.053	0.202	0.053	-0.029	1.00				
9. ROA (ratio)		0.57												
		(7.88)	0.006	-0.012	0.029	0.015	-0.018	-0.006	0.065	-0.027	1.00			
10. SALES (thous. PLN)		47,912												
		(156,654)	-0.089	0.818	-0.151	0.064	0.730	0.944	0.016	0.090	-0.080	1.00		
11. TFPLP (parameter)		212.15												
		(757.63)	-0.143	0.499	-0.114	0.056	0.493	0.430	0.032	0.028	0.032	0.486	1.00	
12. TFPOLS (parameter)		2.15												
		(6.29)	-0.007	-0.047	0.020	0.004	-0.076	-0.050	0.037	-0.092	0.180	-0.035	0.094	1.00