Ownership and efficiency: The case of Poland

by

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ABSTRACT:

This paper investigates whether the economic transition has resulted in more efficient firms? And how? The focus is on the role that ownership transformations have played including a discussion and test of why foreign owned firms should be expected to exhibit a higher level of technical efficiency. As empirical case is used aggregates of firms into branches in Polish manufacturing in the period 1993-98. The frontier production function approach is adopted at the industry level to estimate technical efficiency. Results confirm that the transition has had a general efficiency enhancing effect, however, with an average larger dispersion of firms from the moving technological frontier over time. Results do not confirm that foreign ownership lead to higher efficiency in at least half of the industries included in the study. But the remaining state owned enterprises including the minority owned firms resulting from the Polish mass privatisation programme are clearly the least efficient groups of firms in all industries during the period of the study.

1. Introduction

Central to the economic transition is whether firms will respond to the systemic changes by improving their efficiency. At least three types of systemic changes associated with the transition will bear on firm performance through more efficient resource allocation across firms (reallocation) and economic activities and more efficient organisation of work in the firm (restructuring) (Blanchard, 1997). These three types of changes are: the liberalisation or introduction of markets, ownership transformations and institutional changes.

The research question of this paper is whether the transition has resulted in more efficient firms? This question is asked for one of the more successful countries – namely Poland - where transition policies have followed a fortunate mix and timing pattern of 1) markets (prices) first and fast followed by 2) a quite slow transformation of ownership coupled with 3) institutional changes to eradicate inefficient behaviour. See also Kornai, 2000.

More specifically, the paper also inquires into the role of ownership transformations and which implications different types of ownership have had for efficiency? In particular the paper provides a theoretical discussion and empirical test of whether and why foreign owned firms are expected and observed to be more efficient in a transition economy setting?

The success of the economic transition in large part hinges on the subsequent behaviour and performance of firms. From a systemic point of view the question of efficiency is central. A general problem voiced about the socialist system was its inability to give rise to more intensive forms of growth (Kornai, 1992), exactly through the type of technological dynamism and learning that generates what an economist would include under the label efficiency. In that perspective multinational firms can be important contributors from the beginning of the transition since they control both technology, capital and other important resources including organisational forms and governance frameworks necessary to institute efficiency-seeking behaviour.

But voiced concerns about vast inefficiencies under socialism usually went far beyond the firm level to the national plan and its international co-ordination in CMEA. Firms operating under socialism and central planning were not truly autonomous and often lacked decision-making power over resources, investments, hiring, firing and other crucial variables such as with whom to form relationships (Kornai, 1992). Quite central to the transition is therefore decentralisation of decision-making towards a market-based system with profit-maximising owners (capitalists) expected to emerge. This is one of the main problems of ownership transformation: to create or attract both effective owners whom will not be eradicated when the firm faces a hard budget constraint and to build institutions that can promote rational and efficient behaviour.
Finally, the transition is not only about creating internal markets but also about adapting to and integrating with external markets according to a largely market-based international system. The external dimension of the transition is also expected to affect firm level efficiency since firms may reap both static and dynamic economies of scale by engaging in international trade. At the same time heightened import competition from Western Europe is expected to induce domestic firms to search for better practices and provide new opportunities for technology transfer.

The ultimate success of transition can thus be meaningfully represented by efficiency. Though underlying causes of lacking efficiency are much harder to understand and may vary for individual industries and countries. The paper will inquire into the role the transition has had on technical efficiency. As empirical case is used aggregates of firms into branches in Polish manufacturing which are analysed individually by industry using the production frontier approach. The data covers the period 1993-98 during which Poland experienced annual GDP growth rates close to or in excess of 5 percent – almost covering bottom to top of a business cycle with the Russian crisis affecting manufacturing outputs negatively only during the last quarter of 1998. See UN/ECE, 2000. The period also reflects increasing entry rates of multinational firms.

Section 2 provides for a discussion of the connection between ownership and efficiency. The data is introduced in section 3, followed by some stylised facts in section 4 and data estimating procedures in section 5. Section 6 reports the econometric results while section 7 summarises and concludes the paper.

2. Firm-level efficiency: Theory and evidence

A large number of studies are available on the topic of firm-level efficiency. For a very extensive and informative overview see Nelson (1981) or the more recent by Fagerberg (1994). From a theoretical viewpoint much of this literature is grounded if not in the metaphor of the neo-classical firm then in a 'normally functioning' market economy-based firm. When evaluating empirical studies it is therefore often important to keep in mind the type of countries that the study focus on: 1) market economies, 2) developing or emerging market economies or 3) transition or former socialist economies. This review will in particular focus on two types of empirical lines of work: 1) transition-related literature often focussing on ownership and 2) globalisation-related literature often focussing on particular aspects of multinational firms' behaviour in the process of economic development. Finally, some general factors that may affect efficiency are also discussed including inherent biases of firm level empirical studies.

2.1. Transition and ownership

Early on in the transition a number of theoretical papers discussed the distinction between defensive and deep restructuring. See Carlin and Mayer, 1992. This focus owes to the heavily oversized state owned enterprises (SOEs) inherited from the past. A social contract between state and enterprise had remained in vigour throughout the socialist period securing full employment or employment as a citizen right. Many therefore expected that transition would be followed by a shedding of superfluous pools of labour that also would result in an immediate jump in efficiency. However, this was also defined as a defensive strategy since in the long run the real problems of enterprises would still be unresolved (e.g. poor product quality, wrong product mix, poor market access, outdated machinery). The task of mobilising intensive forms of growth thus became synonymous with the expression 'deep restructuring'. Much of the subsequent research is therefore interested in the particular question of relationships between ownership forms and types of restructuring behaviour. There is now widespread agreement among economists that privatisation itself is only a halfway measure towards curing the ailing enterprises. See for example Brada, 1996. For a generalisation of the argument see Blanchard, 1997. Blanchard shows that if insiders remain effective owners after privatisation there may be little incentive in the

context of deep economic recession to disengage from the past social contract. In that case inefficiency at the firm level is explained in part by macroeconomic conditions. For the significance of country-specific fixed effects see also Frydman et al., 1999. Strategic investors (outsiders), whether foreign or domestic, may be important to securing deep restructuring since they have access to the crucial resources: capital and perhaps, technology and knowledge. Therefore, the prevailing view has been that privatisation to insiders will produce less efficiency gains than privatisation to outsiders. Apart from the insiders' deficient resource access the outsider is assumed to act more rationale when approaching issues of labour shedding and profit maximisation. Some also propose that privatisation to a concentrated group of outsiders is to be preferred over privatisation to a dispersed group of outsiders. Claessens and Djankov (1999) contend that monitoring and management (governance) of firms will be much improved under concentrated ownership forms. Theoretical models of a more formal kind rarely accompany these arguments. Explanatory power has thus often remained in the domain of empirical work.

Many empirical studies on the connection between ownership transformation and efficiency in the former socialist countries focus on variables such as: improvements in sales, reductions in the labour force and combinations of both. Some studies also include more inventive measures of restructuring such as product and process innovations and organisational changes in firms. See EBRD, 2000, page 165. Often a capital variable is not available. Instead some studies include an investment variable also as an indicator of restructuring. See for example Carlin and Aghion, 1996.

The first step in the analysis is to ask whether privatisation has improved performance. Most studies find that privatisation has been effective. Especially by raising labour productivity through increases in sales. Massive reductions in the labour force that systematically depends on certain types of ownership have been less common. See Barbone et al., 1999, Earle and Estrin, 1998, Frydman et al., 1999 and Jones and Mygind, 1999. But there may also be problems with directly aligning experiences in this respect for the different transition countries. See for example Hunya, 1996 and Carlin and Landesman, 1997. Privatisation has followed very different paths in these countries. In some countries some restructuring prior to privatisation has been preferred. This has been the case in East Germany, Poland and

Hungary. In other countries this has been much less common. See Lavigne, 1999. In some countries where the process of ownership transformation has been very protracted there is still little evidence of improvements even among the privatised firms. See for example Estrin and Rosevar, 1999. This may exactly be, as contended by Blanchard (1997), because insiders in these firms refrain from entering a new social contract under open and quite high levels of unemployment.

2.2.Globalisation and ownership

The research on impacts of multinational firms in a developing context has become established as a specific tradition. This largely empirical body of research proves to overlap well with the general question of differences in efficiency and productivity across firms and countries. See Fagerberg, 1994, page 1158 for a specific extension of the discussion in Nelson (1981) on this issue. FDI theory renders some explanations to why foreign and domestic owned firms should or could be expected to exhibit diverging performance. According to Dunning's eclectic theory (Dunning, 1981, Dunning, 1993) the multinational firm has an incentive to invest in a foreign location (host country) when in possession of an ownership advantage. The ownership advantage should be compatible with a location advantage of producing in the target host country rather than exporting to it. Finally, the ownership advantage is better exploited by establishing a majority owned subsidiary instead of seeking a licence or joint venture agreement with an existing producer in the host country. The ownership advantage and its actual exploitation through a subsidiary is the key towards understanding the efficiency advantage of this subsidiary vis-à-vis domestic competitors. In some cases the ownership advantage refers back to proprietary aspects of the firm's technology. The entry of a multinational firm into a new market could also be seen as an innovation – a new combination in Schumpeter's words. For example, the firm may enjoy a real technological edge over competitors including brand recognition. In other cases the ownership advantage may be poorly explained by a technological edge and perhaps better explained by economies of scale, international division of labour, strategic portfolio management including access to transfer-pricing practices. Dunning (1993) calls the latter type of advantages common governance advantages. These advantages based on 'network synergies' are not quite the same as those based on critical resources that can be singled out such as technology and capital.

Many authors have pursued these questions empirically, testing for both a direct and indirect effect of FDI in the manufacturing sector in economies classifiable as developing. This research typically incorporates a production function to estimate the relative efficiency (total factor productivity - TFP) of foreign and domestic owned firms. It is also quite common to test the hypothesis that foreign firms generate spillovers (or an indirect effect) in the developing host country.

The evidence on a direct effect of foreign ownership on technical efficiency or other performance measures such as labour productivity is quite strong. See for example Tyler, 1978, Globerman, 1979, Blomström, 1989. Newer contributions report a strong positive direct effect for the manufacturing sector as a whole and after having controlled for additional factors that may affect efficiency. Such controls include economies of scale, human capital, capacity utilisation and industry affiliation. See for example Blomström and Sjöholm, 1999 or Aitken and Harrison, 1999. Haddad and Harrison (1994) provide data at a more detailed level for Moroccan manufacturing. Their tables show that industry variation is quite big. There are several incidences at the 2-digit industry level where in fact foreign firms do less well than their domestic counterparts.

Several studies are also available with similar evidence for the transition economies. Konings (1999) find for a sample of Bulgarian, Romanian and Polish firms that those with some foreign investment perform better than firms without. Frydman et al. (1999) find for a sample of Czech firms that foreign ownership has a strong positive effect on sales. However, Frydman et al. (1999) find little difference in firm level performance between those firms with foreign investors and those with domestic strategic investors (concentrated outsiders). Similarly, Jones and Mygind (1999) find for a sample of Estonian firms little difference in performance across different types of majority owned firms. Zukowska-Gagelmann (1999) show that the direct aggregate effect of foreign investment on performance (labour productivity and total factor productivity) in Polish industry as a whole is positive.

There are of course obvious overlaps between the literature on efficiency and ownership in transition countries, and efficiency and ownership in the context of

foreign direct investment. These overlaps refer importantly back to resource- and governance-based perspectives on firms and how these perspectives explain differences in efficiency. Both resource and governance perspectives seem to be able to explain simultaneously why foreign owned firms or outsider concentrated ownership should or could result in efficiency gains related specifically to an ownership category. However, it is also clear that resource and governance perspectives do not necessarily agree on the underlying mechanism that generates higher efficiency.

2.3. Control factors

The classical explanation of differences in efficiency across firms in the same industry is size. According to standard microeconomic theory firms producing on the downward sloping part of the average cost curve will be less efficient compared to firms operating at the minimum efficient scale. From the empirical point of view the documentation of the impact that size has on efficiency is very robust. However, one should also be aware that firm size in a normal market economy setting could really reflect the coexistence of a larger number of critical factors (interdependence). Related hereto is the fact that size may result from higher efficiency over time. Size may also mirror that of an innovative firm. At the same time size will typically also reflect market size and export orientation in cross industry and country comparisons.

Size is often seen adopted as controlling factor in studies comparing the efficiency of foreign and domestic firms in the emerging market economy setting. See for example Caves, 1996, page 185. For a recent empirical application controlling for size see Blomström and Sjöholm, 1999. The inclusion of the size control factor is seen much rarer in the transition literature, possibly because of the ambivalence of the systemic transition to this target. See for example Amsden et al. (1994) for an extensive discussion of this ambivalence. Further, if firms are overstaffed some traditional measures of firm size may not be very good in this context or certainly highly misleading to show any causal relationship between size and efficiency. But some studies now also ascribe a more normal explanatory role to firm size in transition. For example Jones and Mygind (1999) show that size and ownership are often not independent since large and capital intensive firms are much more likely to be owned by outsiders.

Another traditional explanation for variations in firm-level efficiency within industries is the age structure of capital also popularly known as vintage models. The basic idea of these models is that new technology is embedded in new capital. This new technology is in principle available to all firms, but adopted by individual firms at different points in time. Thus the newer the age structure of the capital owned by the individual firm, the more efficient that firm is expected to be. Vintage models may thus be seen as an extension to work concerning the general problem of assessing the firm's physical capital. It is an obvious problem to studies of more recent and older ownership phenomena (e.g. foreign vs. domestic or private vs. state) that the quality of capital is not taken into account. For example de novo firms are always documented to be more efficient that older firms in transition economies. See Bevan et al. 1999. However, the role that the age structure of capital plays has not been documented.

Much debated in the transition literature while rarely seen mentioned in other literature on efficiency are issues of selection. Various selection biases may reduce the credibility of specific cause-effect models that explain efficiency. If historical factors (past efficiency) can stand instead of the explanatory factors of the model (such as ownership) little new insight may have been gained. It is notorious to the economic transition that some type of selection was involved in the privatisation process. See for example Carlin and Landesmann, 1997.

In Poland the small firms were typically favoured for insider privatisation. In the Balcerowicz Programme Mark I relatively well performing firms were sometimes targeted for programmes involving strategic investors. See UN/ECE, 1994, page 199. The huge giants were typically targeted for a stalled mass privatisation programme. Since here the perspective of disengaging from the past social contract was politically too troublesome during the first years of transition.

3. The data

The database on Polish manufacturing, 1993-98 was obtained from the Central Statistical Office of Poland. The optimal data set would allow to follow the path of individual firms during the privatisation process. See Jones and Mygind, 1999. That is not possible when relying on Polish national statistical resources where individual firm-level data is regarded as confidential. Instead data was obtained for groups of firms operating in the same ownership group and branch of economic activity (NACE, 3-digit) at the end of each year. This also means that in groups with high concentration (1-2 firms) the data is censored. These observations are missing on all variables except the unit variable (no. of firms).

The potential data set encompasses 103 branches x 7 ownership groups x 6 years = 4,326 observations. Of these 1,093 are missing because of concentration (censored observations) while remaining missing observations are either lacking on one or several of the variables used in the regression analysis (missing observations) or simply not reported because there is no activity in the group. The latter is especially relevant for some of the 4 SOE groups (see table 1 below) in the last years of the period 1993-98 as some of these groups are really only transitional ownership forms. This leaves a total of 1,848 observations for analysis. But since the production frontier is estimated for individual industries, 4 of the most highly concentrated industries (tobacco, fuels, office machinery and recycling) with very few observations available for analysis are omitted from the regressions. This further reduces the number of observations used in the regression analysis to 1,805.

The exact number of observations by year and industry are shown in the lower part of appendix table A1.1. The panel used in the regression analysis is really a pseudo panel derived from more aggregate data. See Baltagi, 1995, page 175. The most appropriate way to label this panel is that it is incomplete. Each observation refers back to a group of firms that may vary quite extensively in number. The real panel is unbalanced as the real population itself but the pseudo panel is instead incomplete when observations are censored (because of very few firms in the group). Secondly, the transition will often lead to a diversification of ownership forms, at least initially. For the pseudo panel the consequence is a shift in completeness over time resulting often

in a higher number of observations available for the latter part of the period 1993-98. It is important to note that the way the panel is incomplete may bias results in accordance with the hypothesis that state owned enterprises are the least efficient and foreign owned firms the most efficient. This simply because there are more observations available on the state owned enterprises before ownership transformations speed up (1993-95). A period where also the general level of efficiency is lower. While oppositely there are more observations available on foreign owned firms during the later years of the transition (1996-98) where also the general level of efficiency is higher. However, the econometric strategy adopted is designed to remove this bias, by estimating around a moving rather than a fixed average.

Since data variables are only observable for groups of firms (by ownership and branch in combination), variables are recalculated for the representative firm in each group of observation. The variables calculated for the first round estimations were value added Y, labour L[1], physical capital K[2] and human capital H as shown below.

To the data are then added dummies for each year and each ownership group. For an exact clarification of ownership groups please refer to table 1. However, one note of caution on these ownership groups. Most of them are straightforward to understand. In particular it is important to remember that private ownership groups can include former SOEs as well as de novo firms. The ownership group most difficult to understand and quite specific to the Polish context is that of private minority owned firms (JV). The group experiences a large increase in underlying firm populations as the Polish mass privatisation programme is finally carried through in 1995-96. The immediate result of this programme is exactly the emergence of a large group of minority owned firms. This also means that the relative number of de novo to old firms in this group and compared to the other groups of private firms (DOM and FOR) is quite small.

For the second round estimations some additional variables are calculated. These include the capital labour ratio KL, firm size $SIZE$, export intensity EXP and state subsidies in turnover SUB. A time trend t is also included. The dependent variable in the second round estimation is group and time specific inefficiencies A_{it} derived from the first round estimation.

Table 1: Variables and ownership dummies

Y_{it}	Value added	Calculated as turnover less cost of materials, energy and services for the representative firm by dividing with the no. of firms in the group and corrected for inflation using the industry specific producer prices indices for Polish manufacturers.
L_{it}	Labour	Calculated as no. of employees for the representative firm in the group.
H_{it}	Human capital	Calculated as the above industrial minimum salary of labour fetched with the representative firm in the group and corrected for inflation using the global producer price index for Polish manufacturing.
K_{it}	Physical capital	Calculated as the total fixed assets for the representative firm in the group and corrected for inflation using the global investment price index for Polish manufacturing.
SOE	Dummy for state owned enterprises	Under SOEs is included GUS's groups 1-4, where group 1 is commercialised firms formally held by the State Treasury, group 2 is traditional SOEs controlled by national government, group 3 is SOEs transferred to municipal ownership and group 4 is joint ventures where the state is the majority shareholder.
DOM	Dummy for domestic private owned firms	Under DOM (GUS's group 5) is included both new firms and privatised firms. Any type of owner (insider or outsider) may hold the majority of shares.
FOR	Dummy for foreign owned firms	Under FOR (GUS's group 6) is included foreign majority owned subsidiaries – i.e. a majority stake is held by a parent firm located abroad. This group also includes new as well as privatised firms.
JV	Dummy for joint ventures	Under JVs (GUS's group 7) is included all private minority owned firms – i.e. a majority owner or group of owners cannot be identified. Both the state and/or a foreign owner may hold a minority stake. Many firms in this group are the result of the Polish mass privatisation programme carried out in 1996-97.
A_{it}	Group and time variant ineff.	Calculated from the absolute value of estimated inefficiencies a_{it} in the first round estimation, where $A_{it} = e^{ait}$ (see also section 6).
KL_{it}	Capital-labour ratio	Calculated as the ratio of fixed assets to the no. of employees for the representative firm in the group and corrected for inflation using the global investment price index for Polish manufacturing.
$SIZE_{it}$	Firm size	Calculated as turnover for the representative firm in the group and corrected for inflation using the industry specific producer price indices for Polish manufacturing.
EXI_{it}	Export intensity	Calculated as the ratio of exports to turnover for the representative firm in the group.
SUB_{it}	State subsidies	Calculated as the ratio of state subsidies to turnover for the representative firm in the group.

Several of these variables are subject to measurement problems. This is especially the case with the capital variables *K* and *H* used in the first round estimations and the capital-labour ratio *KL* used in the second round estimations. A general problem with the capital variable is that the book value of capital (as observed here) may deviate

from the true market value of that same capital. Thus this variable is especially circumspect in a transition economy undergoing dramatic shifts in relative prices.

Because of the transition it is therefore reasonable to expect a quite large bias in the estimation of the parameter for the productivity of capital. More specifically it is expected that the elasticity of capital will be underestimated simply because the book value of capital is higher than its market value. This is the same as assuming that a large part of the inherited capital from the socialist system is redundant. However, the choice of relying only on labour productivity instead of total factor productivity (TFP) when assessing efficiency is really a choice between scylla and carybdis since results will also be biased if the capital factor is entirely ignored. Unfortunately it is not possible to construct a valid measure of a new vintage of the capital stock based on observed investment flows. This is because the panel is a pseudo panel where firms change groups over time.

An additional measurement problem relates to the assessment of human capital. Here is adopted the average wage rate in the group and corrected for the time variant minimum wage at the industry level. Mulligan and Sala-i-Martin (1995) suggest that a sensible measure of the aggregate value of human capital, is the ratio of total labour income per capita to the region-specific wage of a person with zero years of schooling. Since regions with higher physical capital also will tend to pay higher wages. Similarly, there is here corrected for the industry-specific and time variant minimum wage. Since average wages will be higher in the more profitable and fastest growing industries.

Subsidies are introduced as a control variable for the continuous interference of politicians in the productive sphere. Political interference may make firms less efficient through over-manning. See Shleifer and Vishny, 1994. But state subsidies do not reflect the full extent of political interference. Soft budget constraints may be continued through other indirect monetary channels such as payment arrears on taxes and credits to the state. Thus subsidies will only capture the more direct and visible forms of this interference. Finally, the export variable may not fully capture all of turnover that eventually is exported and especially from firms which are not yet fully privatised. Though new liberties in foreign trade are granted to individual firms there

may still be considerable path dependency in the institutional set-up. For example, some of the turnover targeted for exports will be directed to middlemen (foreign trade organisations) and thus not captured as export when the firm reports the data.

4. Stylised facts

In this section a number of stylised facts are presented prior to imposing a specific model on the data by undertaking regression analysis in subsequent sections. Table 2 presents some descriptive statistics on the evolution of efficiency at the level of industries over the period 1993-98. The first observation to be verified on the basis of the table is that efficiency when measured in terms of labour productivity has picked up very much. All industries register a real improvement in labour productivity. Average annual growth rates in labour productivity exceeding 10% are far from unusual during the period of study. Furthermore capital deepening alone does not explain labour productivity growth, at least at the aggregate level. There is no apparent correlation between aggregate investment rates and aggregate growth rates in labour productivity (compare 1st and 2nd column in table 2).

One reason may be that improvement in labour productivity can have different explanations and is not necessarily due to strategic restructuring that mobilises intensive growth. For example if productivity improvements are simply a result of defensive restructuring (labour shedding) this may be the cause of labour productivity growth. One way to illustrate this is through growth accounting. A simple exercise of growth accounting is shown in the last four columns of table 2. Assuming constant factor elasticities[3] over time the growth rate in value added may be decomposed into the growth rates of capital and labour and the residual which is growth unexplained by individual factor contributions (total factor productivity growth – TFP growth). For example the residual may capture general technological advances in society. But the residual could also reflect changes in quality of inputs or in the combination of inputs in specific firms over time. The residual largely captures the more intangible aspects of the production process where systemic and ownership differences can be included (Nelson, 1981). To be included would also be the transfer of technology (e.g. technology that is not embedded in new machinery) in the multinational firm.

Only few industries exhibit a pattern of pure defensive restructuring during the period of study (textiles and footwear to some extent). But it should not be ignored that large productivity improvements in at least half of the industries are due to considerable reduction rates in employment. These reduction rates could owe to the exit of some firms and the entry of others which would neither classify as defensive restructuring at the firm level. Another reason is that strategic restructuring need not necessarily be capital deepening. Strategic restructuring can result in reorganised and refocused firms that are more efficient without engaging in any major new investment projects. This would involve economising with or even reducing available input factors to bring forth a larger output. That pattern can actually be observed in several of the industries in table 2, for example, in Machinery & Equipment.

TABLE 2: Productivity growth in Polish manufacturing, 1993-98

All figures in percentage	**Av. Annual**		**TFP growth, 1993-98**			
	Inv. Rate[a/]	**LP Growth[b/]**				
			ΔY/Y	**-ΔK/K**	**-ΔL/L**	**~TFP[c/]**
INDUSTRY						
15 Food & Beverages	2.23	5.71	36.69	20.59	1.80	14.29
17 Textiles	2.17	10.68	9.87	-22.44	-33.04	65.36
18 Clothing	1.18	7.95	55.82	9.81	5.47	40.52
19 Footwear	1.43	14.26	27.05	-33.81	-31.54	92.41
20 Wood & Products	5.96	13.62	112.82	106.08	17.11	-10.38
21 Paper & Products	8.66	11.84	57.58	-23.71	-7.89	89.18
22 Publishing & Printing	3.21	18.17	122.33	89.30	6.34	26.68
24 Chemicals & Products	3.98	16.81	80.67	33.23	-10.06	57.50
25 Rubber & Plastic	3.33	7.30	89.95	-4.25 3	2.06	62.14
26 Non-metallic minerals	4.57	24.89	110.73	69.66	-15.49	56.56
27 Basic metal manuf.	4.53	29.34	95.27	73.68	-29.27	50.86
28 Fabricated metal prod.	1.82	28.26	174.60	39.74	1.86	132.99
29 Machinery & Equipm.	1.56	18.65	54.49	-38.95	-27.10	120.56
31 Electrical machinery	2.89	10.42	109.50	37.47	28.90	43.12
32 Communication equipm.	2.59	36.77	84.16	-20.37	-42.56	147.10
33 Precision instruments	1.42	11.08	65.38	-42.25	-0.66	108.31
34 Motor vehicles	3.54	19.79	324.71	234.30	94.11	-3.72
35 Other transport equipm.	1.59	16.36	47.75	-34.36	-25.43	107.56
36 Furniture & Other manuf.	2.38	16.82	148.68	52.85	23.74	72.09

a/ Real investments to real value added for the period 1993-98 and divided by six.

b/ Real growth in labour productivity (value added per employee) for the period 1993-98 and divided by six.

c/TFP growth is calculated as real value added growth (ΔY/Y) less the real growth rate of fixed assets (ΔK/K) less the real growth rate of the labour force(ΔL/L).

Source: Own calculations based on the Database on Polish Manufacturing, 1993-98.

FIGURE 1: Comparing labour productivity in foreign and domestic firms, 1998

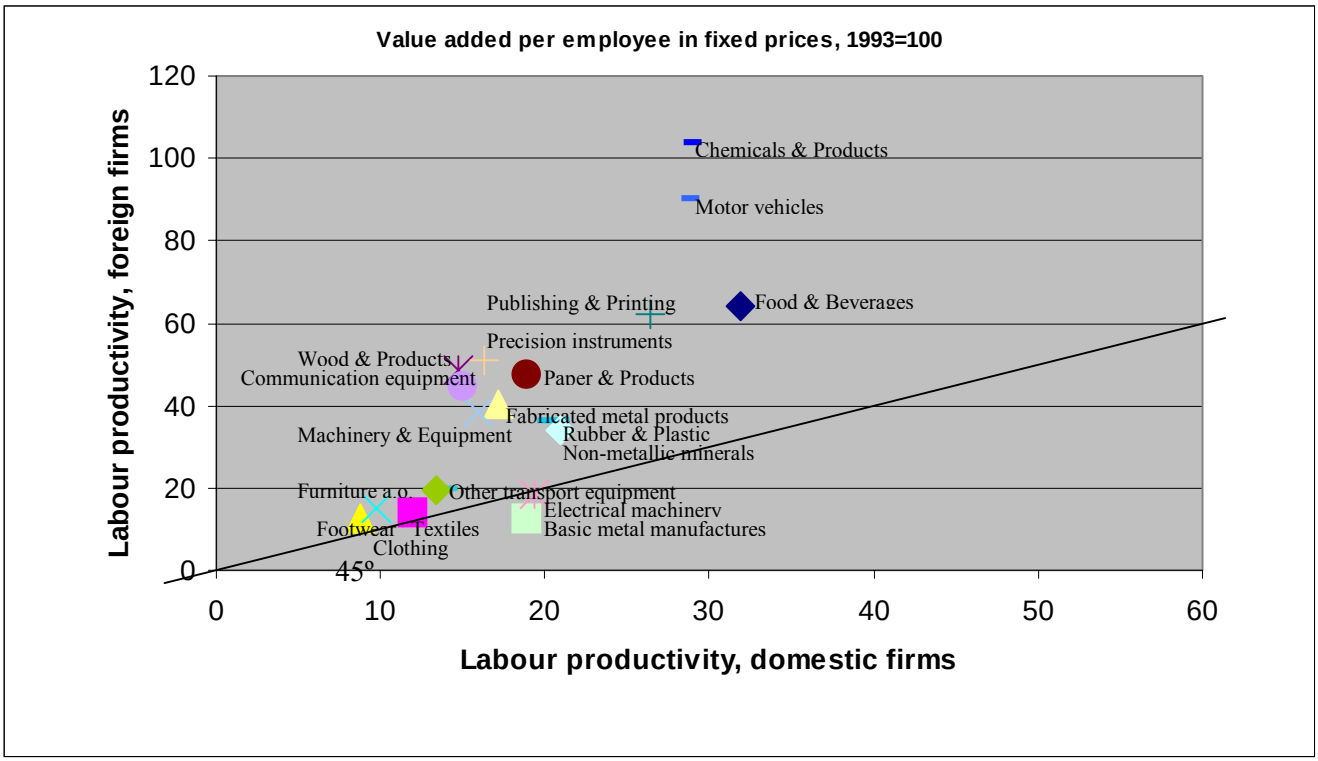
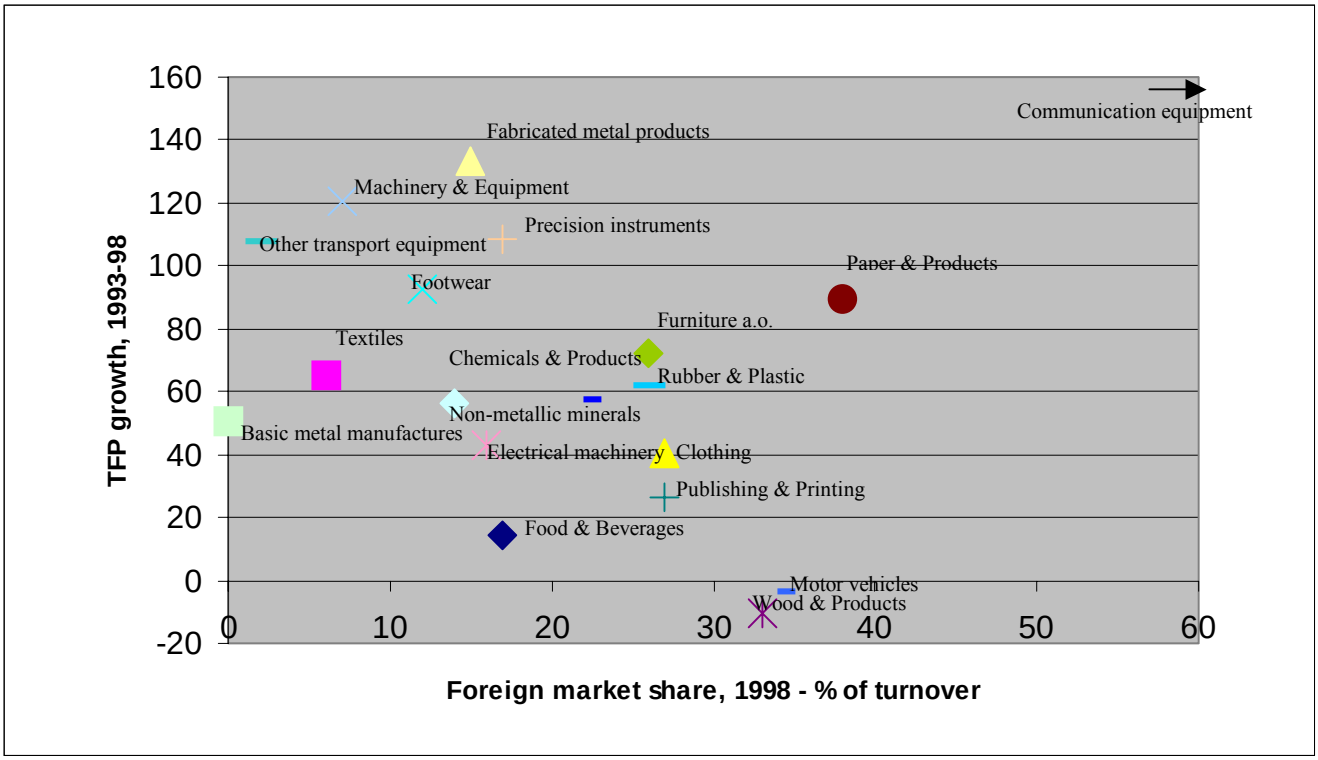


FIGURE 2: Total factor productivity growth and foreign market shares, 1993-98



Source: Own calculations based on the Database on Polish Manufacturing, 1993-98.

Some industries also exhibit patterns of the more typical capital-augmenting type such as Chemicals & Products. Finally, two industries with negative TFP growth in the period actually exhibit a pattern of extensive growth (Wood & Products and Motor vehicles) – i.e. the increase in inputs is larger than the increase in outputs. Even at the aggregate level it is thus obvious that efficiency seeking and restructuring behaviour during transition certainly is not a homogenous phenomenon. Almost any type of predictable restructuring behaviour seems to be present in the aggregate data.

Figure 1 suggests that foreign owned firms in Polish manufacturing always are more (or have become more) efficient than their domestic counterparts when estimated on the basis of labour productivity in 1998. At the same time the figure also indicates that a large part of the productivity growth observed in table 2 could be related to the entry of multinational firms. This would work to the favour of the hypothesis of extensive technology transfer taking place. But the efficiency gap between the two types of ownership also appears to increase with the capital intensity of the industry. Accordingly it is difficult to estimate differences in efficiency without controlling for other inputs such as physical capital.

At least part of the efficiency gain from being a multinational subsidiary could be related to larger annual investment rates during the transition years. See table A1.2 and A1.3 in the appendix. Finally, in figure 2 was plotted the market share obtained by foreign owned firms in 1998 against TFP growth rates at the industry level during the period 1993-98. This figure shows that once capital growth has been taken into account there is no systematic relationship between foreign market shares and TFP growth. Put differently, the simple correlation coefficient between foreign market shares in 1998 and labour productivity growth for the period 1993-98 is 0.24. The correlation coefficient between the foreign market share in 1998 and TFP growth for the period 1993-98 is only 0.02.

5. Estimating efficiency

In this section is discussed the econometric strategy used to estimate group and time specific efficiency. As general approach is adopted a frontier production function procedure as first introduced by Farrell (1957). In Farrell's original paper the idea is to apply the procedure at various levels of aggregation in the economy though subsequently most applications have been undertaken at the firm level. Interestingly, Farrell also notes that the frontier approach could be used in empirical work on the comparative efficiency of economic systems. See Farrell, 1957, page 262. Here is followed the procedure described by Cornwell and Schmidt (1996) which includes issues pertinent to panel data sets. The first step in this procedure is to estimate the standard production function parameters β's, time variant intercepts δ_t's and derive from these estimates group and time variant residuals u_{it}[1]. The production function is specified as follows (lower case letters refer to log transformed variables):

$$y_{it} = \delta_{t=1} + ... + \delta_{t=T} + \beta_l l_{it} + \beta_k k_{it} + \beta_h h_{it} + u_{it} \tag{1}$$

The parameters are estimated for each industry individually to allow for industry-specific technologies and technological changes over time. Cobb Douglas was chosen as functional form rendering a superior fit to the translog functional form in all industries. For each year t is then isolated the group with highest positive residual deviation from the time variant intercept: u^*_{it}. Given best practice in each industry and year, group specific efficiencies (which are really INefficiencies since they are derived as negative deviations from best practice) may be derived as:

$$a_{it} = u_{it} - u^*_{it} \tag{2}$$

In the subsequent steps the group and time variant inefficiences are adopted as absolute values $|a_{it}|$ meaning that the larger absolute value the larger deviation from best practice (since all a_{it}'s by definition according to (2) are negative).

Subsequently inefficiencies are sought explained with the following equation (again with log transformed variables):

$$\left|\alpha_{it}\right| = \gamma_0 + \gamma_1 kl_{it} + \gamma_2 size_{it} + \gamma_3 exi_{it} + \gamma_4 sub_{it} + \gamma_5 t + \gamma_6 DOM + \gamma_7 FOR + \gamma_8 JV + \varepsilon_{it} \quad (3)$$

Equation (3) may be estimated on the pooled data or for individual subgroups such as industries and ownership groups. It would be relevant to know whether it is appropriate to pool the data so that ownership invariably (across industries) affects efficiency in a systematic way. Thus specific tests are adopted to test for the appropriateness of pooling the data in the second round of estimations.

Notice that the time trend t in (3) has a specific interpretation. While year specific dummies δ_t in (1) are estimates of industry specific technological progress (as a moving average), t in (3) reveals to which extent individual groups conform to the frontier over time. When t in (3) is positive the interpretation must necessarily be larger average deviation from best practice over time.

6. Results

Results from estimating equation (1) for individual industries are reported in the appendix. Estimated factor coefficients for labour, capital and human capital render close to constant returns to scale (CRS) in almost every industry (with the exception of a few considerably below CRS and one above). All estimated factor coefficients (elasticities) are strongly significant except for the elasticity of capital in industry 22 (Publishing & Printing) and 27 (Basic metal manufactures). General technological progress that is estimated with the time variant intercept, is positive or not significantly different from zero in all cases. It is in particular in the latter part of the period (1996-98) that technological progress picks up, with the time variant intercept being strongly positive and significant in 1997 and 1998 in every industry except industries 20-25. In every instance the fit (adjusted R^2) is also reasonably high and always above 50%.

TABLE 3: Testing the 0 hypothesis of equally distributed mean inefficiencies A_{it}

Two sample t-test statistics	Probability of H0:			
	$\mu_{FOR}=\mu_0$	$\mu_{FOR}=\mu_{SOE}$	$\mu_{FOR}=\mu_{DOM}$	$\mu_{FOR}=\mu_{JV}$
INDUSTRY				
15 – Food & Beverages	0.23	0.09	0.54	0.84
17 – Textiles	0.46	0.43	0.79	0.12
18 – Clothing	**0.01**	**0.00**	0.10	0.85
19 – Footwear	**0.03**	**0.01**	0.06	0.37
20 – Wood & Products	0.80	0.50	0.25	0.56
21 – Paper & Products	**0.04**	**0.01**	**0.05**	0.20
22 – Publishing & Printing	0.22	0.21	0.59	0.15
24 – Chemicals & Products	**0.03**	**0.02**	**0.02**	0.13
25 – Rubber & Plastic	0.88	0.40	0.80	0.27
26 – Non-metallic minerals	0.23	**0.01**	0.22	0.61
27 – Basic metal manufactures	**0.03**	**0.03**	0.17	**0.02**
28 – Fabricated metal products	0.08	**0.00**	0.49	0.82
29 – Machinery and equipment	**0.00**	**0.00**	**0.00**	**0.00**
31 – Electrical machinery	0.82	0.94	0.42	0.47
32 – Communication equipment	0.88	0.41	0.45	0.59
33 – Precision instruments	0.16	0.40	0.10	0.15
34 – Motor vehicles	0.06	0.09	0.30	**0.02**
35 – Other transport equipment	0.35	0.34	0.42	0.08
36 – Furniture & Other manuf.	**0.00**	**0.00**	**0.04**	**0.03**

Individual group inefficiencies are then calculated on the basis of equation 2. In table 3 is reported the statistics of adopting a t-test of the 0 hypothesis that foreign firms have differently distributed mean inefficiencies compared to other types of ownership. In more than half of the cases is it not possible to reject the 0 hypothesis that the mean distributions are the same for foreign firms when compared to all other types of domestic owned firms (1st column in table 3). Thus some of the large productivity differences between foreign and domestic owned firms have disappeared by adopting the production frontier approach where higher productivity in part is explained by higher capital intensity. Adopting the same two sample t-test for foreign firms against individual groups of domestic firms shows that it is particularly state owned enterprises which have differently distributed inefficiencies (2nd column in table 3). While the frequency of rejecting the 0 hypothesis drops to less than one fourth when testing for the equality of mean inefficiencies against other groups of private domestic firms (3rd and 4th column in table 3).

Finally, equation 3 is adopted at various levels of data pooling to test whether a pure ownership factor can explain the distribution of inefficiencies across groups while controlling for other factors that aside ownership may affect efficiency. Results for the pooled data are shown in table 4. Results for testing equation 3 at the level of individual industries are shown in the lower part of appendix table A2.1.

Testing the covariance model in table 4 shows that industry is an important discriminant. A pooled model that does not allow for industry specific intercepts is not a very reliable model. The sign or size of some control factors changes by introducing industry dummies. Moving from the simple OLS model (model 1) to the covariance model with industry dummies (model 3) or industry and ownership dummies (model 4) respectively improves the fit with almost 50% and reduces the error sum of squares very much. However, introducing combined industry and ownership dummies (model 5) is an unnecessary restriction to the pooled model when looking at the small reduction in the error sum of squares gained from introducing these additional dummies. Even though they are all very significant. As a pooled version of equation 3 it is therefore model 4 that is chosen as the most reliable for a general interpretation of the ownership question.

Individual versions of equation 3 in table A2.1. reveal that in no industry is the capital intensity reducing inefficiency (deviation from best practice). In fact there are several industries where capital intensity adds to the inefficiency of particular groups of firms (significantly in 8 industries). As mentioned before this may in part owe to the poor quality of capital, former excess investment in capital or simply that the way capital is evaluated in the data is not very appropriate. On the other hand is there no reason to believe that capital intensity in itself is a qualifying factor for proximity to best practice. Perhaps, except in cases where technological progress is largely embodied in capital. Size has the expected sign and is significant in all industries. This means that firms operating in proximity to best practice are more likely to be large. Export intensity has only the expected sign in 7 industries and a larger export intensity even in these cases appear not to significantly reduce inefficiency. In several industries the export intensity in fact appears to bring firms further away from best practice. Export intensity is a significant explanatory factor of lacking efficiency in 9 industries. However, in the pooled regression it is hypothesised that large size and a high export

intensity often coincide. If that is the case, size (measured on an absolute scale) may take over explanatory power from export intensity (measured on a relative scale). One way to deal with this problem is by inclusion of an interaction term.

TABLE 4: Explaining inefficiency – the covariance model

Dependent variable: $|ait|$[1/]

t-values in parenthesis

	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5
INDEPENDENT VARIABLES:					
Intercept	1.096	1.347	4.387	5.014	5.005
	(5.41)	(6.32)	(26.99)	(30.62)	(29.57)
Capital-labour ratio (kl_{it})	0.170	0.179	0.092	0.096	0.091
	(8.30)	(8.63)	(6.29)	(6.87)	(6.34)
Firm size ($size_{it}$)	-0.074	-0.096	-0.275	-0.327	-0.331
	(-3.16)	(-3.98)	(-15.96)	(-19.18)	(-19.11)
Export intensity (exp_{it})	0.917	1.352	-2.915	-2.430	-1.997
	(1.04)	(1.52)	(-4.64)	(-4.05)	(-3.15)
Firm size * Export intensity	-0.162	-0.199	0.336	0.306	0.253
	(-1.70)	(-2.09)	(4.96)	(4.75)	(3.72)
State subsidies (sub_{it})	-1.309	-2.019	2.122	1.342	1.084
	(-1.21)	(-1.86)	(2.82)	(1.87)	(1.50)
Dummy for domestic firms: DOM	-	-0.198	-	-0.323	-
		(-4.74)		(-11.80)	
Dummy for foreign firms: FOR	-	-0.255	-	-0.401	-
		(-4.82)		(-11.48)	
Dummy for joint ventures: JV	-	-0.070	-	-0.065	-
		(-1.47)		(-2.13)	
Industry dummies:	-	-	YES[2/]	YES[2/]	-
Combined industry and ownership dummies:	-	-	-	-	YES[3/]
Time trend (t)	0.052	0.058	0.053	0.061	0.062
	(5.19)	(5.73)	(7.71)	(9.27)	(9.38)
N	1805	1805	1805	1805	1805
R^2	0.061	0.078	0.571	0.618	0.626
Error Sum of Squares (ESS)[4/]	837.33	820.60	378.70	336.79	319.16

1/ Lower-case letters refer to the logarithm of the original variable

2/ Every of the 18 industry dummies are significant at the 0.0001 level.

3/ Every of the 18*4 = 72 combined industry and ownership dummies but 4 are significant at the 0.0001 level. Only 2 dummies are not significant at the 0.01 level.

4/ The appropriate test statistic is: F= ((ESS1-ESS2)/(O+I-2))/((ESS2)/(O*I-O-I)) – where ESS1 refers to the standard OLS model (model 1) and ESS2 refers to the two dummy variant of the covariance model (model 4). O and I refer to the number of ownership (4) and industry (18) dummies respectively. The probability of the 0-hypothesis of equal intercept restrictions (model 1) is less than 0.01 (F=3.715).

The last control factor is state subsidies. In most industries subsidies have the expected effect on efficiency. Political interference tends to reduce efficiency. In a few industries the effect appears to go in the opposite way. Since it was suspected that continuous political interference and especially after privatisation was strongly synonymous with the joint ventures resulting from mass privatisation, a pooled regression was run for individual ownership groups (not shown). This test confirmed that it is mainly the joint ventures that squander state subsidies on buying inefficiency (such as over-manning).

The time trend varied a lot, but was positive in most industries (14). The time trend was also quite large and quite significant in some industries. But there seems to be no uniform effect of deviations from best practice over time. Finally, regarding the ranking of ownership groups on their relative efficiency the industry specific models tends to confirm the results obtained with table 3. The expected ranking FOR<DOM<JV<SOE (meaning FOR is more efficient than DOM etc.) was obtained or weakly confirmed (FOR<?<?<?) in 10 industries. But even in these cases the difference in estimated intercept for foreign and domestic private firms is not very large. In the remaining 9 industries the ranking DOM<FOR always holds. However, since now there is controlled for size, the hypothesis of equally distributed mean inefficiencies among the groups FOR and JV no longer seems to hold. In fact the group JV now resembles the SOE group much more. The ownership effect of being a JV is insignificantly different from the ownership effect of being an SOE in 12 industries.

The results of the pooled version in table 4 largely confirm the industry specific results. The pooled model gives a weak confirmation of the hypothesis FOR<DOM<JV<SOE. This is an ‘average’ result. At the same time we also know that in up to half of the cases (industries) it is not warranted at the more specific level. These two statistical results are not contradictory. The average result is affected by the sizes and weights of inefficiencies in individual industries, while the industry-by-industry comparison entirely removes any such type of structural effect.

The pooled model confirms the industry specific results concerning capital intensity and state subsidies. By introducing an interaction term between size and export intensity the expected sign is obtained also for export intensity. Now both larger size and a higher export intensity is associated with the more efficient firms.

7. Discussion and conclusion

The paper shows that according to expectations the transition has resulted in more efficient firms. Groups of firms are found to be more efficient both when estimating efficiency on the basis of labour productivity and total factor productivity. The latter is an important result since it testifies to the fact that the transition has been able to mobilise the intensive forms of growth much sought for by the socialist regimes. It is also found that in many instances average annual growth rates in both labour productivity and total factor productivity exceed 10 percentage.

With the available data it is also possible to gain some (though rather aggregate) insight into the restructuring strategies followed in individual industries during the period 1993-98. At the level of industries there is found no typical pattern of adaptation. Technological change has not followed a standard capital deepening scenario. This is perhaps not surprising due to the often excessively high investment rates undertaken under the former regime. All types of strategies co-exit from the most pronounced being labour shedding, but often co-existing with intensive growth strategies, then followed by some instances of capital deepening strategies and finally 2 industries still reflecting the formerly so pronounced external growth strategy.

Similar results can not be obtained for individual ownership groups, since firms change groups over time. This is of course a major deficiency associated with the data reducing the ability to formulate strong conclusions on the basis hereof.

But it is found that even though firms seem to follow similar strategies of defensive and deep restructuring, there are also some differences. It is found that foreign owned firms tend to follow more capital deepening strategies due to the large jump in labour productivity combined with above average investment rates in this particular group over the period 1993-98.

This also leads to the question of whether the analysis gives cause to conclude that foreign owned firms always are more efficient in the context of a transition economy such as Poland? The answer to this question really depends on the statistical tool. On average the answer is yes, but this may often be because of a structural effect that does not disappear by inclusion of industry dummies as contended by several other authors in this field. The present results should document this well. Because taking the same question to the industry level leads to the answer that foreign owned firms only are observed to be more efficient than other types of firms in half of the cases. Concerning a pure ownership effect there is found to be a large resemblance between domestic and foreign majority owned firms on the one hand and minority and state owned firms on the other. Therefore, and even though the model explaining efficiency controls for factors such as size and export intensity, other underlying factors could explain some of the remaining differences in efficiency.

For example, the results do not control for the influence of de novo firms. The fact that many firms are new in particular in the groups of private majority owned firms could also bias results and combined with the fact that the age structure of capital is not documented. Finally, a selection bias most likely has played some role in yielding present day firm efficiencies. It is now a well-established fact that ownership and ownership transformations often are truncated rather than purely random processes. But would it not have been more surprising to find that ownership transformation had followed a purely random distribution?

The results obtained in this paper are novel because they include estimates based on the production frontier approach at the level of industries and they include the capital factor. Importantly the results here bring together a comparison of efficiency estimates when based on labour and total factor productivity respectively. The stylised facts presented in the paper mirror this problem well. There is found to be a strong correlation between foreign market shares and labour productivity, while the correlation between foreign market shares and total factor productivity is much weaker. Regression analysis at the more detailed level confirms the latter results.

ENDNOTES

[1] Employment data at the branch level *i* was not available for 1993 and 1994. Figures were therefore estimated by calculating an index of employment change at the more aggregate industry level *I* where employment data was available from GUS:

$$No.of\ employees_{it} = No.of\ employees_{it+1} * \frac{No.of\ employees_{It}}{No.of\ employees_{It+1}}$$

[2] Fixed assets *K* were not available for 1998 from the financial statement, thus they were estimated as fixed assets of the previous year less depreciation plus investment outlays since both of these figures are available from the income statement:

$$Fixed\ \ assets_{it} \approx Fixed\ \ assets_{it-1} - Depreciati\ \ ons_{it} + Investment\ \ \ outlays_{it}$$

[3] Note that the TFP estimate will be upwards biased if factor elasticities increase over time. For example, if an economy undergoes structural changes of the Lewis type (shifting labour from agriculture to industry) the TFP estimates will be strongly upwards biased and partly reflect resulting increases in factor elasticities due to structural change.

[4] Note that it is necessary to assume a deterministic frontier in the first round estimation to derive time variant residuals. See also Cornwell and Schmidt, 1996, page 864. This means that u_{it} is really a composite term that includes the normally distributed random error term ε_{it} and time and group specific efficiency v_{it}.