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# Performance of industrial companies after ownership transformation

**Rezime:** Koristeći pristup kroz totalnu faktorsku produktivnost (TFP) u radu su empirijski odredjene razlike u ekonomskoj efikasnosti privatnih industrijskih preduzeća u Srbiji. Na panel uzorku od 567 firmi u periodu 2005-2007 utvrdjeno je da su firme u većinskom stranom vlasništvu, izvozno orjentisane i novoformirane firme imale  za 18%, 37% i 26% veću produktivnost od prosečne produktivnosti na teritoriji Srbije.   Regionalno posmatrano najveće razlike u produktivnosti po osnovu stranog vlasništva utvrdjene su na području Centralne Srbije dok su izvozno orjentisane i novoformirane firme bile najefikasnije na području Beograda.

**Ključne reči**: totalna faktorska produktivnost(TFP), strano vlasništvo, izvoz

**Summary:** Using the total factor productivity (TFP) approach we empirically estimated the differences in economic efficiency of private industrial firms in Serbia. On the panel data from a sample of 567 companies in the period 2005-2007, it was found that majority-foreign owned companies, as well as export-oriented and newly-founded private firms recorded higher productivity than the average in Serbia by 18%, 37% and 26% respectively. From the regional aspect, the biggest differences in productivity resulting from foreign capital ownership are seen in the region of Central Serbia, whereas export-oriented and newly-founded firms were most efficient in the area of Belgrade.

**Keywords:** total factor productivity (TFP), foreign ownership, exports

## 1. INTRODUCTION

One of the key issues of the modern microeconomics is exploration of the factors that influence productivity. Private or state-owned and domestic or foreign-owned businesses, exports or sale in the local market, sophisticated, information-based and flexible or obsolete technological processes, advanced vs. traditional organisational models are the most frequently empirically tested internal factors of influence on the productivity of

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firms. Quality of infrastructure, level of development and flexibility of the market of goods and production factors, as well as efficiency of the legal and bureaucratic system and control of corruption are evaluated factors of influence of the business environment on the productivity growth. Ownership transformation and political reforms in transitional countries dramatically change internal and external factors that influence productivity.

There are some empirical studies which are analysing the effects of privatisation on the efficiency of the Serbian industrial companies (1),((3) pages 13-25)),((4),((6) pages 213-234)),(9). One group of these studies (6),(8),(9) gives qualitative assessments and quantitative overviews of privatisation processes. Another group of studies (1),(3),(4), use in the empirical analysis various econometric approaches to assessment of efficiency during and after ownership transformation. Empirical studies at the level of company have comparative character and assess efficiency by comparing total factor productivity of companies in Serbia with the productivity of companies in other transitional economies. (4).The study (1) evaluates impact of various aspects of business environment on productivity.

Unlike the former empirical studies (3),(4), which stressed the positive differences in the productivity of privatised companies compared to state and socially-owned enterprises, this paper evaluates on the balanced panel sample the differences in productivity between privatised companies and new private industrial companies. While in the former studies sales revenue was used as a dependent variable in the evaluation of total factor productivity, in this paper superior value added of the company is used.

In this study, which is related to the privatized and new private industrial companies in the territory of Serbia differences in productivity have been estimated on the basis of majority foreign capital ownership, share of exports in total sales and the fact that companies are newly founded and have no socialist inheritance.

## 2. METHODOLOGICAL FRAMEWORK

For estimation differences in productivity at the level of company, total factor productivity (TFP) is used as a measure. Ordinary, the neoclassical concept which attributes productivity to all production factors has more recently become a predominant approach for empirical evaluation of companies' performance in the countries in transition. ((2) pages 739-792)). The core of the approach is production function of different specifications, whereby in the econometric evaluation the following linear production function is most frequently used:

$$\ln(y_{jt}) = \beta_0 + \beta_k \ln(k_{jt}) + \beta_l \ln(l_{jk}) + \beta_m \ln(m_{jt}) + \omega_{jt} \tag{1}$$

where $\ln(y_{jt}), \ln(k_{jt}), \ln(l_{jt}), \ln(m_{jt})$ are values or quantities of production, capital, labour and materials of firm (j) in year (t). Parameter $(\beta_0)$ is measuring the mean efficiency level across firms and over time, whilst an error term $(\omega_{jt})$ defines specific deviation from that mean which a company (j) records over time (t). This measure (deviation) can be further decomposed to the part which is observable (known) by the entrepreneur, but not by the researcher and the part which is unknown to the researcher and which results from nature of data, measurements and omissions in the calculation procedure:

$$\ln(y_{jt}) = \beta_0 + \beta_k \ln(k_{jt}) + \beta_l \ln(l_{jk}) + \beta_m \ln(m_{jt}) + \delta_{jt} + \mu_{jt} \qquad (2)$$

where $(\delta_{jt})$ represents a level of productivity of the company (j) over time (t).

In order to measure the productivity at the level of the company, empirical researchers usually estimate equation (2) and solve for $(\delta_{jt})$ :

$$\delta_{jt} = \ln(y_{jt}) - \beta_k \ln(k_{jt}) + \beta_l \ln(l_{jk}) + \beta_m \ln(m_{jt}) \qquad (3)$$

whereby the level of productivity is obtained as exponential of $\delta_{jt}$ (TFP=$\exp(\delta_{jt})$ ).

The obtained measure is further used for assessment of influences of different variables on productivity. Evaluation of influences is in this paper defined through decomposition of the error in such a manner that allows identification of factors related to changes in productivity across firms over the observed period:

$$\delta_{jt} = \Phi_{jt}(\upsilon_{jt}) + \phi_{jt} \qquad (4)$$

where $\Phi_{jt}$ is a vector of specific attributes of the company (j) over time (t), $\upsilon_{jt}$ describes how such attributes influence total factor productivity, whereas $\phi_{jt}$ represents a random error.

Production in the equation (1) is in empirical researches expressed as sale revenue, operating revenue or added value, depending on the data available. Capital value is usually measured as a value of fixed assets, labor as average number of employees and value of materials as direct costs of materials. In our research, production is measured as added value, capital as fair value of fixed assets and labor as an average number of employees. Company ownership structure, export orientation and company's historical heritage are used as specific company attributes. The first two attributes vary from company to company, whereas the last attribute varies from company to company and is fixed in the observed period. Thus, the equation (2) is transformed as follows:

$$\ln(VA_{jt}) = \beta_0 + \ln(k_{jt}) + \ln(l_{jt}) + fd_{jt} + ed_{jt} + nfd_j + \mu_{jt} \qquad (5)$$

where $\ln(VA)$ is a logarithm of the value added, $\ln(k_{jt})$ is a logarithm of fixed assets value, $\ln(l_{jt})$ is a logarithm of number of employees, $fd_{jt}$ is a company (j) with majority foreign ownership in a given year (t), $ed_{jt}$ is a company (j) which records exports in a given year (t), $nfd_j$ is a newly-founded private company without socialist heritage and $\mu_{jt}$ is a random error. In addition to Cobb-Douglas (CD), linear approximation of the CES function and Translog production function are used for determination of parameters. Based on F test of the common significance of variables, the best approximation of data from our sample represents a translog production function:

$$\ln(VA) = \beta_0 + \beta_1 \ln(k_{jt}) + \beta_2 \ln(l_{jt}) + \beta_3 \frac{1}{2}\ln(k_{jt})^2 \beta_4 \frac{1}{2}\ln(l_{jt})^2 + \beta_5 \ln(k_{jt})\ln(l_{jt}) + \beta_6 fd_{jt} + \beta_7 ed_{jt}$$
$$+ \beta_8 nfd_j + \mu_{jt}$$
(6)

Translog production function is the best data approximation in relation to other specifications when it is extended with variables which describe companies' specific attributes.

## 3.  DATA AND SAMPLE

The sample contains panel data referring to the industrial companies that have been privatised through tender, auction or capital market by the end of 2007. For the 2005-2007 period the statistics cover the privatised companies from 27 industrial sectors (standard two-digit classification of activities). For certain number of companies, the collected data was not complete. Some companies were in the period under review closed down or did not have any employees. Due to that, the number of observed companies was significantly reduced. For the needs of our analysis, we also excluded the companies with negative value added in some of the years under review. In the final selection of the sample, the analysis included privatised companies with complete data (473) and new private companies established by 2005 with more than 10 employees (94). The final number of companies observed in the sample was 567. Considering that the planned analysis includes regional aspect, the final selection of the sample equally represents, both by the criterion of the number of companies and the criterion of sector coverage, the region of Vojvodina (205 companies), area of Belgrade (136 companies) and Central Serbia (226 companies).

The primary information on firms comes from different data sources. The official financial reports submitted annually and semi-annually under uniform accounting procedures provide information on firm's revenue from domestic and foreign sale, material inputs and firm's capital stock. The financial reports are provided directly from firms, National bank of Serbia, Belgrade stock exchange and from independent auditing firms. The Serbian Business Register provided information on the firm's ownership structure. The data on value of exports comes directly

from firms and from the Serbian Chamber of Commerce. Output and capital price deflators come from the Serbian Statistical Office.

## 4. VARIABLES

For measurement of the level of efficiency, value added is used as a dependent variable. Explanatory variables are divided into two groups. The first group consists of absolute variables, while the second includes binary (dummy) variables. Absolute variables are capital value and number of workers. Qualitative variables used in this analysis define whether the company has certain percentage of foreign ownership or the company is major foreign owned, whether the company exported in the period under review or whether the company is established as a new private company.

Value added is calculated on the basis of the value of production and subsidy reduced by costs of tax on products and value of intermediate consumption. Value of production is determined on the basis of the turnover value (market sale of goods and services to third parties), corrected with changes in stocks of finished goods and work in progress and reduced by the values of purchases of goods and services purchased for resale. The calculation of the value added includes the value of production and subsidy reduced by costs of tax on production and products and the value of intermediate consumption, which includes costs of material, costs of tangible and non-tangible services and other personal expenses. Nominal values of the items used for calculation of the value added are corrected with appropriate price indices, whereby the Year of 2004 is taken as a base period. The value of turnover is deflated by appropriate sectoral price indices. Nominal value of the direct costs of material and goods intended for resale is deflated by weight price index of the sector from which the material or goods originate. Considering that for the Serbian economy there are still no input-output tables, weights were calculated, where applicable, at the level of the company on the basis of the General Ledger. General Ledger contains a detailed structure of costs and allows determination of relative participation of certain type of costs in the total costs, as well as the assumption on sector of origin. Index for deflation of material costs of the company is calculated as a sum of weighted indices of the main cost components, whereby weighted indices of cost components represented multiplication of relative participation of certain type of costs in the total costs and the price indices of the sector of such cost origin.

Value of the capital is measured through value of company's fixed assets. Value of fixed assets in the balance sheets of privatised and private companies is purchase value corrected with the depreciation amounts. According to the new accounting standards, applied in the practice since 2004, companies are obliged to revalorise, in case of any major discrepancy between bookkeeping and actual value, the value of fixed assets at fair value, which represents the assessed market value of the fixed assets.

Production factor labour is measured as average number of employees (headcount) at the end of each month. Average number of employees is calculated on the basis of working hours.

To assess the effects of export on production efficiency of the privatised and newly-founded private companies, the variable of participation of export in the total sale on the domestic and foreign market was used. Value of export represents a current FOB value expressed in Dinars (RSD). To calculate the real share of export in the total sale, the current Dinar values of export are deflated with the same sectoral indices which are used for deflation of sale revenues.

Effects of foreign ownership on production efficiency are measured through participation of foreign capital in the total capital of the company. As the ownership structure of the privatised and private companies changes over the year and the unit timeline, during which the value of the variable is observed, is one year, the information on percentage volume of share of foreign ownership in the company at the year-end is used for the purposes of this study.

For assessment of effects of competition on production efficiency, in this type of empirical studies Herfidahl-Hirchman Index or share of company in sale on domestic market are mainly used as measures of level of concentration and/or competition. Company's market share is calculated, for the needs of this study, as share of sale of certain firm in the total sale of the industrial sector to which the firm belongs.

#### Table 1. Statistics of variables in the sample (2005-2007)

| Variables (mean values) | Serbia |
|---|---|
| Value added ( 000 RSD) | 277193 |
| Cpital (K) ( 000 RSD) | 464099 |
| Labour (L) | 264 |
| Market share (%) | 4,43 |
| Export share (%) | 12,36 |
| Foreign ownership (%) | 13,79 |
| Domestic private ownership (%) | 82,5 |
| State and social ownership (%) | 3,72 |

*Authors calculations*

Average firm in the sample is a medium-sized company with average market share from 4.43 %, share of export in the sales revenues from 12% and participation of foreign ownership from 14%. Herfindahl Index from 1386 indicates oligopolistic competition (Herfindahl index $= \sum_{j=1}^{n} S_j^2$ , where (Sj) is the share of firm (j) in sectoral sale in the sample of n firm in the sector).The biggest number of

firms in the sample (55%) is in food processing industry, construction, non-metallic and mineral production. Besides companies in construction and food processing industries, which are most frequently privatised in all regions, the sample also includes chemical industry, rubber industry, basic metal processing, wood and furniture industries are typically in Central Serbia. Privatised firms in the fields of non-metallic mineral production are most frequently located in Vojvodina, while privatised firms engaged in production and maintenance of machinery and electrical devices, transport machines and publishing are typically based in Belgrade.

New private companies included in the sample had on average 82 employees, average market share of 4.18%, average participation of export in sales revenues of 8.14% and participation of foreign ownership in the total ownership structure of 19.3 %. Regionally observed, new private companies from the territory of Belgrade had the biggest market concentration and participation of foreign ownership in the total ownership structure, whereas new companies from the region of Central Serbia had the biggest participation in export.

**Table 2. Statistics of  new private industrial companies in the sample (2005-2007)**

| Variables (mean values) | Serbia |
|---|---|
| Value added ( 000 RSD) | 100038 |
| Capital (K) ( 000 RSD) | 148617 |
| Labour (L) ( 000 RSD) | 82 |
| Market share (%) | 4,18 |
| Export share (%) | 8,14 |
| Foreign ownership (%) | 19,26 |

*Author's calculation*

From the aspect of industrial sectors, the biggest number of new private companies operates in construction, food, non-metallic minerals, wood and furniture industries (50%). From the regional aspect, however, sector prevalence is almost identical. In Belgrade, in addition to construction, which is by far the most dominant sector with most new private companies established, other prevailing sectors are machine industry and publishing. In Central Serbia, most dominant sectors are wood processing and furniture production, and in Vojvodina, food industry and non-metallic mineral production.

Value of export in the observed period 2005-2007 at constant prices increased at the rate of 14.5% (from 6% in Vojvodina to 19% in Central Serbia).

Share of export in the sale in the domestic and foreign market fell at the level of the country by average rate of 2%, whereby the biggest fall of 16% was recorded in the territory of Belgrade. In the Central Serbia, however, a 5% growth in the share of export in the total sale was recorded.

**Table 3. Value of export in the sample (2005-2007)-000 RSD**

| 2005-2007 | Serbia | Belgrade | Vojvodina | Central |
|---|---|---|---|---|
| Value of exports | 300577263 | 31306720,3 | 74394057,85 | 194876484,5 |

*Author calculation*

In the sample, for the period under review, high sector concentration of export value was recorded. About 96% of export was concentrated in 13 industrial sectors, whereby about 72% of the total export was concentrated in the sectors of food and beverage production, basic metal processing and machine industry. Regionally observed, the territory of Belgrade had the lowest sector concentration of export, while in Vojvodina companies operating in the sectors of food and beverage production, and production of electrical machines and devices (78%). In Central Serbia, in the sample of 226 privatized and new established private firms about 83% exports is concentrated in production and processing of basic metals, machinery and food and beverage production.

Regional sector structure of foreign ownership in the period under review shows slightly higher level of concentration. At the level of Serbia, the biggest average sector concentration of foreign ownership is in tobacco industry, in basic metal production, recycling industry, chemical industry, food processing and non-metallic production.  In the territory of Belgrade, the highest percentage foreign capital participation was in recycling, food processing and chemical industry, as well as in metal product industry and production of machines and electrical devices. In Vojvodina, the participation of foreign capital is more evenly distributed across sectors. In addition to tobacco production and production of basic metals, whose sector participation of foreign capital results from small number of privatised companies in those sectors, significant foreign capital participation is typical for chemical and food industry, as well as production of non-metals and non-metallic minerals.

Firms in Central Serbia also had similar ownership structure by sectors. Tobacco industry has considerably high participation of foreign capital, since the sample includes practically two only large tobacco producers, which are foreign owned. Apart from chemical industry and basic metal industry, relatively high participation of foreign ownership in the sector of metal products is characteristic for the region of Central Serbia.

## 5.  EMPIRICAL ESTIMATION AND RESULTS

Empirical value of the parameters is estimated by the ordinary least squares (OLS). The OLS method requires that inputs in production function should be independent from the productivity level (error term). Since, however, an entrepreneur is aware of the productivity level in the previous time period, in the time series there is usually a correlation between the error term (productivity level) and quantity of variable production inputs. In the two-factor production function where labour is the only variable input and where is a positive productivity shock, there is an increase in labour input use. Estimated regression

coefficient of the factor labour $(\beta_2)$ in the equation (6) is therefore upward biased. In production functions with more variable factors where there is correlation between selection of quantities of such factors and productivity level, it is impossible to define the direction of the bias of the regression coefficient of the factor capital. In two-factor functions where there is a positive correlation of labour and capital, estimated regression coefficient for the factor capital is downward biased. This problem in consistent estimation of parameters of production function is known as a problem of endogeneity of production inputs and in empirical researches there are numerous attempts at solving this problem (fixed effects method, method of instrumental variables, GMM, Olley-Pakes ((7) pages 1263-1297), Levinsohn-Petrin ((5) pages 317-341)). Each of the above approaches is used subject to the data availability. In order to overcome the problem of endogeneity, the parameters are in our research estimated by the fixed effects method. Fixed effects method in estimation of production function parameters contains assumption that the value of the error (productivity) varies from company to company, but not over the observed time interval. This helps to avoid dependence of choice of variable inputs and productivity level and function parameters are consistently estimated.

Applying the model (4) on panel data from the 2005-2007 period for the total number of 567 companies regression dependence of companies' value added at the level of Serbia was estimated.

**Table 4. Estimation of impacts of firm variables on total factor productivity in Serbian industrial firms (2005-2007) - Dependent variable ln(VA)**

| Variable | CD | CES | Translog (OLS) | Translog (Fixed-Effects) |
|---|---|---|---|---|
| const | 3,45318*** (14,9018) | 4,91497*** (11,6424) | 6,19408*** (7,8288) | |
| ln ($k$) | 0,27304*** (12,2122) | -0,2166* (-1,8184) | -0,4595*** (-3,0983) | -0,5544*** (-3,583) |
| ln ($l$) | 0,72791*** (22,5444) | 1,22992*** (9,6525) | 1,29591*** (6,1004) | 1,33491*** (6,4114) |
| 1/2(ln $k$-ln $l$)² | | 0,07479*** (4,1765) | | |
| 1/2( ln $k$)² | | | 0,07422*** (3,8803) | 0,08804*** (4,4481) |
| l/2(ln $l$)² | | | -0,0893* (-1,7222) | -0,0533 (-0,9996) |
| ln $k$ * ln $l$ | | | -0,0161 (-0,5813) | -0,0332 (-1,1244) |
| fd | 0,17606*** (3,2053) | 0,16467*** (2,7535) | 0,16639*** (2,8111) | 0,09688 (1,4474) |
| ed | 0,34608*** (5,6229) | 0,33627*** (4,9989) | 0,31324*** (4,6968) | 0,39364*** (5,3571) |
| nfd | 0,23964*** (3,7297) | 0,22507*** (3,3261) | 0,23018*** (3,4157) | dropped |
| Industry dummy | Yes | Yes | Yes | Yes |
| N=567 | N=567 | N=567 | N=567 | N=567 |
| Adjusted R² | 0,693658 | 0,697447 | 0,699887 | 0,713871 |

Regression coefficients of dummy variables referring to majority foreign ownership, export companies and new private firms at the level of Serbia are positive and statistically significant. Productivity of the firms which were in the observed period in foreign ownership was by 18% higher than the average productivity of all firms in the territory of Serbia (Calculated as ($100*(e^{0,16639}-1)$)). Regionally observed (Table 5.) these differences range from 26% in Central Serbia to 2.53% in the territory of Belgrade. Companies, which in the observed period exported, recorded by 37% higher level of productivity than the productivity at the level of Serbia. Regional differences vary from 23% in Central Serbia to 104% in Belgrade.

**Table 5. Difference in total factor productivity in Serbian industrial firms (2005-2007) by region (%)**

|  | Serbia | Central Serbia | Vojvodina | Belgrade |
|---|---|---|---|---|
| Foreign firms | 18.10454 (10.17502) | 26.06154 (18.67281) | 22.18914 (21.10648) | 2.531512 (11.29343) |
| Export firms | 36.77951 (54.5365) | 23.0967 (28.80121) | 35.39145 (62.98696) | 103.8267 (121.8874) |
| New firms | 25.88518 | 29.53747 | 7.939425 | 113.3577 |

(.)Fixed effects estimates

Newly established private firms had 26% higher productivity than the average productivity of all private companies in Serbia. At the regional level, the least difference in productivity on this basis was in Vojvodina (8%) and the biggest in Belgrade (113.6%).

## 6. CONCLUSIONS

In this paper influence of foreign ownership and exports on productivity of the privatised and newly-founded private industrial companies in Serbia was empirically estimated. Observing of the panel sample of 567 firms from 27 industrial sectors showed that the productivity of the companies with majority foreign ownership in the period 2005-2007 was by 18% higher than the average productivity in Serbia. The biggest differences in productivity resulting from majority foreign ownership were recorded in the regions of Central Serbia and Vojvodina and the least differences in the area of Belgrade. Unlike empirical results in transitional countries in the region, the research showed that the biggest differences arise on the basis of exports. Productivity of the firms which recorded exports in the observed period was by 37% higher than the average productivity in Serbia. Those differences range from 23% in Central Serbia to 103% in the territory of Belgrade. In addition to the differences in productivity based on foreign ownership and exports, influence of companies' socialist heritage on productivity of industrial firms was also tested in this paper. Newly-founded private companies that have not gone through the ownership

transformation process recorded productivity which by 26% exceeds the average productivity of the sampled companies. Regionally, based on this attribute, the biggest differences in productivity were recorded in the area of Belgrade and the least in Vojvodina.

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