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Internal and external effects of privatization in industry[1]

Abstract

A modified labor productivity function is applied to measure effects of privatization. We put forward the hypothesis that the internal effect of privatization is increase in the elasticity of labor productivity with respect to capital/labor ratio.

The external effect of privatization is growth in the total factor productivity being a function of a lagged share of privatized labor in industry as a whole.

Data on Polish manufacturing and mining industries form the sample.

Estimation implicates a growth of labor productivity up to 64% as an effect of internal privatization process and up to 132% as an effect of external privatization process.

Introduction

According to the property rights theory a transfer of property from the public to the private sector enhances economic efficiency, which is due to a better system of motivations, enforcement of harder budget constraints and financial discipline (Kornai 1994, pp. 49–50; Podlasiak 1999, pp. 81–84).

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Privatization produces incentives to use resources more efficiently and consequently improve their allocation, which involves the elimination of surplus employment and a better use of fixed assets (see Boycko, Shleifer, Vishny 1996). When „...the state holds the property rights and not individuals, then no individual entity is motivated (...) to care whether resources are efficiently employed" (Brüggemann et al. 1997, p. 8). Privatized enterprises can implement the principle of a free transfer of property rights. This results in a more efficient allocation of resources, but also encourages the introduction of new technologies. Those activities should lead to a higher efficiency of production processes that is measured in the labor productivity function by elasticity of the labor productivity with respect to the capital/labor ratio or total factor productivity.

The paper aims at investigating whether this elasticity increased in the years 1988–1997 together with progress in privatization in the Polish manufacturing and mining industries. The scale of privatization will be measured by means of private sector's share of employment (including cooperatives) in the total employment. In the period in question this share grew in industry considerably (from 23.1% to 63.1%[2]).

Estimation of the impact of the industry privatization scale on the elasticity of labor productivity with respect to the capital/labor ratio allows to measure not only the present effects of privatization in terms of output, but also the future industrial efficiency once the privatization process will be completed.

1. Modified labor productivity function

Let us start with the classical labor productivity function:

$$\ln \frac{X}{L} = \ln \alpha + \beta \ln \frac{K}{L} \tag{1}$$

where:
X – gross value added in constant prices,
K – capital stock in constant prices,
L – number of workers,
α – total factor productivity TFP,

[2] The shares have been estimated on the basis of *Rocznik Statystyczny Przemysłu* (*Statistical Yearbooks of Industry*) 1998, p. 117 and 1990, p. 125. Privatization comprised privatization of SOEs and setting up new private enterprises. The former was relatively slow and the latter was much faster (Milewski 1998, pp. 76–78).

$\frac{K}{L}$ – capital/labor ratio,

X/L – labor productivity in constant prices,

β – elasticity of labor productivity with respect to capital/labor ratio.

In every enterprise or a branch of industry the privatization effects appear not only because a given enterprise or a branch of industry is privatized, but also due to the privatization undertaken in their economic environment. The former effect can be called an 'internal privatization effect' and the latter 'external privatization effect'. We are putting forward the hypothesis that the growth in productivity that accompanies privatization can be expressed by an increase in parameter β – i.e. the elasticity of the labor productivity with respect to the capital/labor ratio as well as an increase of α – TFP. We shall try to relate the increase in α to total privatization of the entire industry (external effect) and growth in β to privatization of a particular branch of industry (internal effect)[3].

Our aim is to find out whether β is a function of PR – the share of the private sector employment[4] in the total employment. We start with the simplest linear function that corresponds to the hypothesis that privatization brings about steadily growing effects:.

$$\beta = \beta_0 + \beta_1 PR \quad \text{and} \quad \beta_1 > 0 \tag{2}$$

However, we rather expect the effects to grow faster and faster, especially, in the successive years of privatization[5]. To reflect the phenomenon of the accelerated, expanding effect of privatization it seems more appropriate to use functions that grow faster and faster, for instance, polynomials of the second or third degree:

$$\beta = \beta_0 + \beta_1 PR^i \quad \text{and} \quad \beta_1 > 0 \tag{2'}$$

where: $i = 2$ or 3.

[3] Such approach was discussed with T. Tokarski.

[4] The private sector incorporates: private property, cooperative property, foreign property and mixed property with prevailing capital (property) of the private sector's entities. Within the public sector the following forms of ownership can be enumerated: public property (owned by the Treasury and public legal entities), municipal property and mixed property with prevalence of capital held by the public sector's entities (*Rocznik Statystyczny Przemysłu 1998*, p. XXV).

[5] This proposal is close to the „critical privatization mass" that, when exceeded, allows to observe a multiplied privatization effect (Roland 1993, p. 537).

The growth of α – total factor productivity will be related to *PRTOT* – the share of the private sector employment in the total employment in the entire industry:

$$\alpha = e^{\gamma_0 + \gamma_1 PRTOT^h}$$

or

$$\ln\alpha = \gamma_0 + \gamma_1 PRTOT^h \tag{3}$$

where: $h = 1$ or 2 or 3.

After inserting (2') and (3) into (1), we arrive at the modified labor productivity function:

$$\ln\frac{X}{L} = \gamma_0 + \gamma_1 PRTOT^h + (\beta_0 + \beta_1 PR^i)\ln\frac{K}{L} \tag{4}$$

The level of labor productivity depends here on the level of privatization. As it is stressed by Berg, Borensztein, Sahay and Zettelmeyer, though, most of the literature has output (productivity) growth on the left and levels of structural reforms on the right[6]. Still, the authors give arguments in favor of both approaches and estimate functions in both specifications (1999, p. 12–14).

Making the output growth rate conditional on the variable that characterizes the level of reforms would mean entering the path of the growth speeding up together with the ongoing reforms. Yet, this is not the case if we look at the most advanced economies that have lower GDP growth rates than the developing countries. We believe that this specification is also inconsistent with the convergence hypothesis. A state whose economy undergoes transition or privatization, temporarily speeds up its economic development, catches up with the better-developed countries, thus entering the upper growth path at an angle similar to the initial one (cf. Romer 2000, pp. 46–50; Olson 1996, pp. 20–21). We arrive at the same conclusion showing that the growth of parameter β leads to a new point of equilibrium. The transition is accompanied by a higher labor productivity (output) growth rate. When a new point of equilibrium is reached, the growth rate goes down and acquires the initial value (cf. Romer 2000, pp. 149–151)[7].

[6] The example of such model can be found in S. Fischer, R. Sahay, C. A. Vegh (1996a and 1996b), as well as O. Havrylyshyn, I. Izvorski, R. von Rooden (1998) and others.

[7] T. Tokarski drew my attention to D. Romer's argument.

2. Inflation and growth of industry

Let us ask one more question. What was the impact of the transformation shock on the labor productivity growth? We propose to measure this shock's intensity using the level of inflation.

There is a wide economic discussion on how inflation affects economic growth (Wojtyna 1996, Walerysiak 2000). The prevailing point of view is that the influence is negative. A low inflation is accompanied by monetary discipline leading to the macroeconomic stability, which is a necessary condition for achieving a steady path of growth. M. Friedman added that inflation increases uncertainty, economic agents make mistakes, the allocation and coordination mechanism is impaired, investment activities are reduced. Another cost of inflation was described in Lucas' model (Wojtyna 1996, pp. 311–312; Tokarski 2001, pp. 90–92). When the actual price increase is higher than expected managers tend to interpret it as a growth in relative prices.

The other so-called structural and short-term Keynesian concept is that in an economy characterized by a lot of bottlenecks the monetary and fiscal discipline makes capacity utilization go down and unemployment grow. Inflation reduces real wages, which sends a positive impulse for employment growth. Inflation lowers real interest rates, which stimulates investment activities and private consumption[8].

Many authors try to estimate the threshold value of inflation, above which inflation has a negative effect on the economic growth. The values are assessed at the level of 6–50% (cf. Barro 1996, p. 159; Havrylyshyn, Izvorski, R. von Rooden 1998, p. 25). As Fischer, Sahay, Vegh (1996a, p. 63) have stated, for the growth rate to be positive, inflation should be below 50%. M. Bruno and W. Easterly claim that „...causal relationship between inflation and growth remains unclear. But it is clear that a discrete high inflation is associated with low growth and that the end of such a high inflation crisis is associated with high growth" (1998, pp. 12–14; pp. 19–21). Another difficulty for the analysis stems from the fact that inflation cannot be treated as an exogenous variable, since the economic growth affects inflation, too, e.g. „...if monetary authorities react to economic slowdowns with expansionary policy" (Barro 1996, pp. 161–162).

Assuming that the influence of inflation is displayed in the changes of parameter α:

[8] Berg, Borensztein, Sahay and Zettelmeyer (1999, s. 26) have observed a negative impact of inflation on the private sector growth and a positive influence of inflation on the public sector growth.

$$\alpha = e^{\gamma_0 + \gamma_1 PRTOT^h} e^{\gamma_2 price^j}$$

we can formulate a modified labor productivity function as follows:

$$\ln\frac{X}{L} = \gamma_0 + \gamma_1 PRTOT^h + \gamma_2 price^j + (\beta_0 + \beta_1 PR^i)\ln\frac{K}{L} \qquad (4')$$

where:

X – gross value added in constant prices,

K – capital stock in constant prices,

L – number of workers,

$\frac{K}{L}$ – capital/labor ratio,

X/L – labor productivity in constant prices,

PR – the share of the private sector employment in the total employment in a given branch of industry,

$PRTOT$ – the share of the private sector employment in the total employment in the entire industry,

$price$ – GDP deflator – percentage change over previous year.

The estimated function (4') is shown in Table.

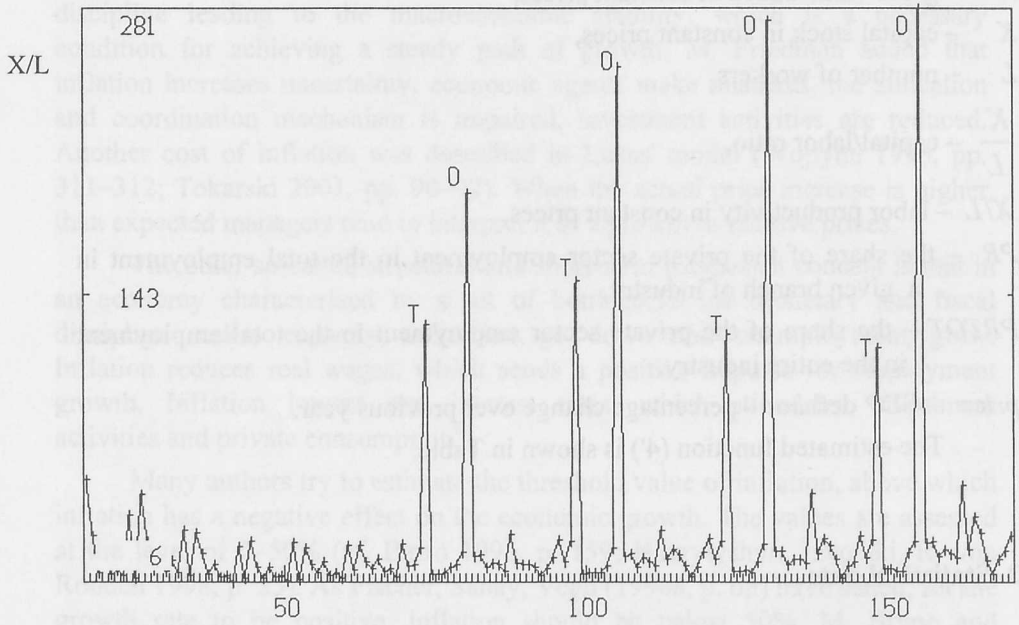
3. Statistical data

Model (4') was estimated by the ordinary least squares method based on a time series cross section data of the branches of the Polish industry (1988–1993 – 9 branches of industry; years 1994–1997 – 25 sections and sectors of industry, no. of observations – 154).

The use of the cross-section time series sample results from the intention to describe transitional and privatization processes in the economy during the last 10 years, for which annual time series are too short. Due to the cross-section time series sample we have over 150 observations; unfortunately, another problem arises at this point – a change in the classification of the national economy and industry. The year 1993 was the last year when the Classification of the National Economy was used in the statistics of the Central and Eastern European countries. From 1994 onwards the European classification of activities NACE has been in force. Since the problem in question requires an analysis of a period when both classifications were in use (years 1988–1997) we applied

data produced according to the two different classifications, which are not directly comparable. We will try to make them comparable using dummy variables that reflect the shifts of the constant term or the slope parameter.

Graph 1. Productivity of labor – gross value added per worker – X/L, thousand zl, fixed prices of 1993, 9 branches of industry in the years 1988–1993, 25 sectors of industry in the years 1994–1997[9]



Source: Author's calculations on the basis of the data published by Central Statistical Office.

Since 1994 two sectors of industry have been distinguished which show a very high productivity of labor, because of high taxation on prices, (the productivity is ca 20–30 times as high as in the majority of industrial activities). These are tobacco products industry (T in Graph 1) and coke and crude oil products (O in Graph 1), where the application of dummy variables seems indispensable[10].

[9] Observations 17–25 refer to 9 industry branches in 1988, etc., observations 62–70 refer to 9 industry branches in 1993. Observations 71–95 refer to 25 industry branches in 1994 etc., observations 146–170 refer to 25 industry branches in 1997.

[10] Instead of dummy variables a variable can be used that characterizes the „taxation efficiency", value of VAT and the excise tax per worker. This much higher productivity of labor

4. Estimation of labor productivity function

Table shows estimation results of the labor productivity function (4') with β as a polynomial of the third degree (2') of the lagged scale of industry privatization PR_{-1}. As expected, for linear function (2) lower t-Student statistics and a determination coefficient were obtained (similar to the polynomial of the second degree)[11].

Table: The OLS estimation results of productivity function (1)–(2), 143 observations

Variable name	Parameter	Mexval	t-value
ln (X/L)			
ln α constant	1.455	29.8	9.5
$PRTOT_{-1}^{2}$	1.167	2.2	2.4
$price^{0,5}$	0.138	2.1	2.4
$price_{-1}^{0,5}$	–0.169	3.5	–3.1
ln (K/L)	0.279	27.9	9.1
$(PR_{-1})^{3}$ *ln (K/L)	0.293	8.1	4.7
FUEL & ENERGY *ln (K/L)	0.143	8.2	4.7
PETROLEUM*ln (K/L)	0.477	94.4	19.1
FOOD*ln (K/L)	0.250	17.9	7.2
TOBACCO*ln (K/L)	0.551	82.6	17.5
T*COMPUTER*ln (K/L)	0.031	19.8	7.6
poztr*ln (K/L)	–0.139	5.6	–3.9
SEE = 0.25	R^2 = 0.9034	MAPE = 5.97	

Source: Author's calculations.

where:

in the tobacco products and crude oil products industries results from the taxation policy, being at the same time another example of the arbitrariness of gross domestic product statistics. A source of anxiety is a considerable increase in the productivity of labor in the coke and crude oil products' industries that may result from miscalculation of production in constant prices.

[11] Polynomials of a higher degree were also analyzed, but the estimates did not improve but even deteriorated. Introduction of full polynomials resulted in multicollinearity. Time variable expressing neutral technological progress was not significant.

PR the share of the private sector employment in the total employment in a given branch of industry;

PRTOT the share of the private sector employment in the total employment in the entire industry;

price GDP deflator – percent change over previous year;

FUEL & ENERGY dummy 1 for fuel and energy industry (1989–1993)
0 elsewhere

FOOD dummy 1 for food industry (1989–1993)
0 elsewhere

PETROLEUM dummy 1 for petroleum industry (1994–1997)
0 elsewhere

TOBACCO dummy 1 for tobacco industry (1994–1997)
0 elsewhere

COMPUTER dummy 1 for computer industry (1994–1997)
0 elsewhere

Mexval – marginal explanatory value,

ln – natural logarithm.

4.1. Effects of industry privatization

Estimation results confirm a hypothesis that parameter β is a function of the lagged industry privatization scale PR_{-1}

$$\hat{\beta} = 0.28 + 0.29\, PR_{-1}{}^{3}$$

the shape of which is shown in Graph 2.

Assuming that the maximal scale of industry privatization is 0.85 we have:

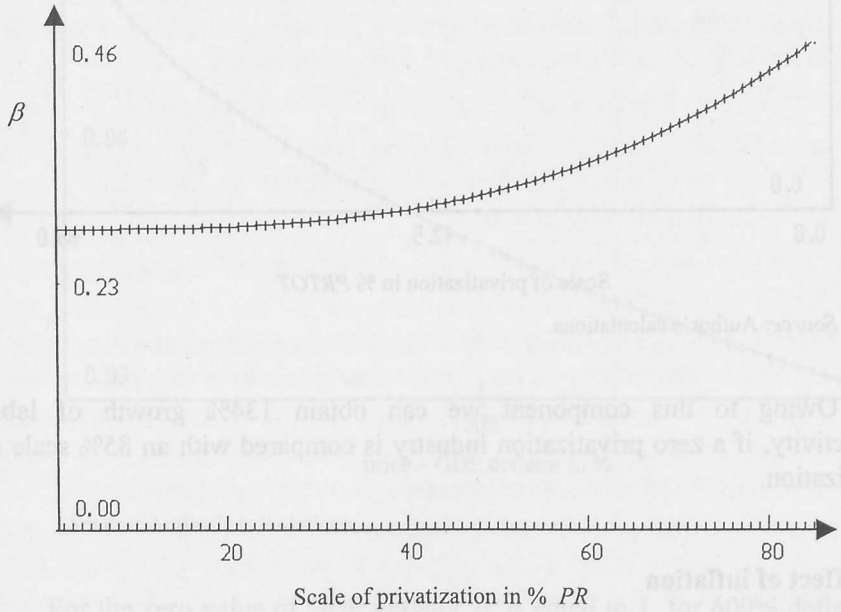
$$\hat{\beta}_{max} = 0.28 + 0.29 \cdot 0.85^{3} = 0.46$$

which accounts for a 64% growth in parameter β as an effect of theinternal privatization. This growth is considerably higher than that estimated in the earlier analyses – sample (1988–1993) (Sztaudynger 1995, 1997a)[12].

[12] W. Welfe estimated that the elasticity of labor productivity with respect to capital labor ratio is within the range 0.4–0.6 (sample 1960–1969, Welfe 1992, p. 149). In the sample 1965–1993 elasticity varied, as a result of fixed assets depreciation, in the interval 0.56–0.60 (J.J. Sztaudynger 1997b, p. 26–27). Results comparability is limited due to some specification differences, one of them being time variable expressing a neutral technological progress.

We can attempt to estimate of the internal privatization effect accomplished in 1998. An average scale of privatization *PR* lagged by one year was 0.631, which leads to the 1998 value of β amounting to 0.35. Therefore, in that year the elasticity of productivity with respect to the capital/labor ratio was ca 26% higher in industry than that which would have been reached in a non-privatized industry. It also shows that the year 1998 brought slightly more than 2/5 of the privatization effects that could have been expected if the industry had been privatized in 85%.

Graph 2. Internal effect β - *e*lasticity of the labor productivity with respect to capital/labor ratio as a function of *PR* – the scale of industry privatization

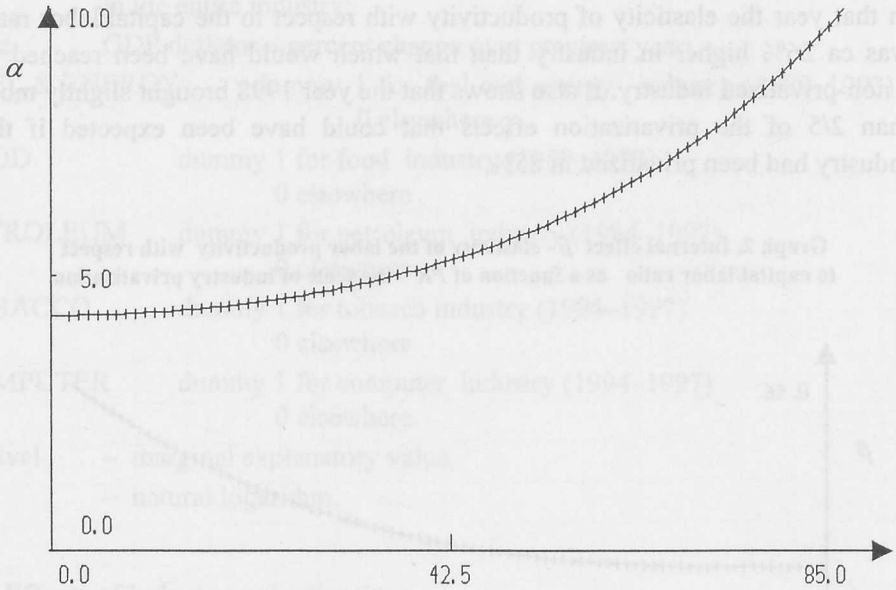


Source: Author's calculations.

Total factor productivity α is a function of economic environment efficiency expressed by lagged total privatization *PRTOT* (external effect of privatization):

$$\alpha = e^{1.45+1.17*PRTOT_{-1}^{2}}$$

Graph 3. External effect – total factor productivity as a function of *PRTOT* – scale of the privatization of the entire industry



Source: Author's calculations.

Owing to this component we can obtain 134% growth of labor productivity, if a zero privatization industry is compared with an 85% scale of privatization.

4.2. Effect of inflation

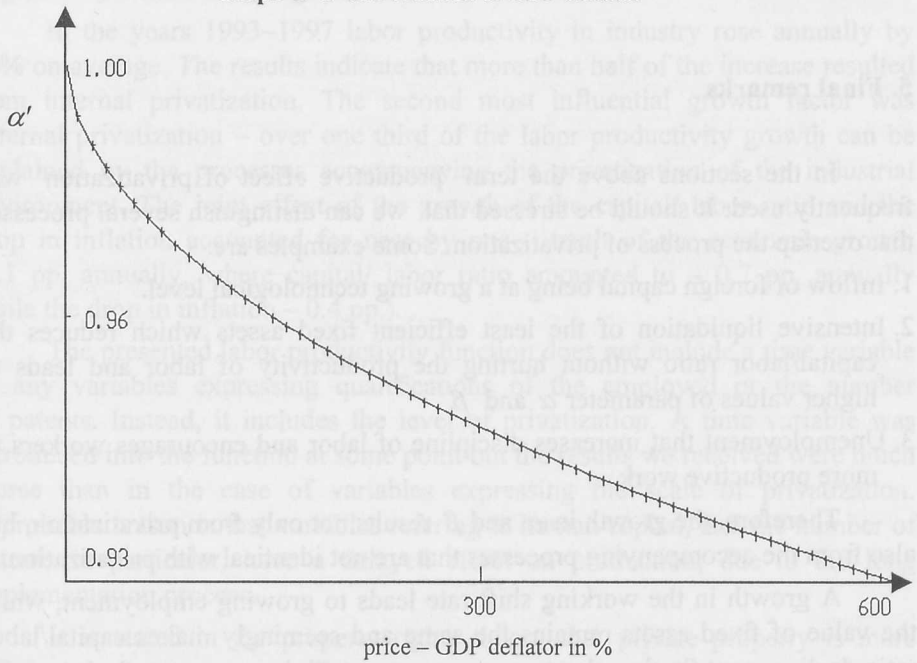
We introduced inflation in α component (Table):

$$\alpha' = e^{0.138 * price^{0.5} - 0.169 * price_{-1}^{0.5}}$$

The current influence is positive, influence lagged by one-year is stronger and negative. Hence the total result is negative. The shape of α' function is shown in Graph 3.

In the year when inflation appears its impact on α' and labor productivity is positive and, therefore, it can be assumed to be of Keynesian nature. The influence lagged by one year is negative and stronger[13]. Thus, the total impact of inflation on labor productivity is negative. With time, the mechanisms described by Friedman and Lukas intensify. In order to observe them, though, at least two years should pass. The α' function takes the shape as shown in graph 4.

Graph 4. α' as a function of GDP deflator



Source: Author's calculations.

For the zero value of GDP deflator α' is equal to 1, for 600% deflator in two successive years (the range of GDP deflator in 1990) α' is equal to 0.93. It gives the estimated value of a negative inflation effect.

In J.R. Barro and B. Motley cross country investigation 10 pp increase of inflation produces a 0.2–0.3 decrease in the GDP growth rate (Wojtyna 1996, pp. 319–320). For Polish industry we obtained:

[13] The values of exponent were searched for in the interval [0.1–4.0] by way of estimation experiments.

- increase of inflation from 1%–11% gives 0.7% decrease of industrial production;
- increase of inflation from 11%–21% gives 0.3% decrease of industrial production.

A stronger result for lower inflation is a consequence of the chosen analytical form of function and it is consistent with conclusions of Motley's research (Wojtyna 1996, p. 320).

5. Final remarks

In the sections above the term 'productive effect of privatization' was frequently used. It should be stressed that we can distinguish several processes that overlap the process of privatization. Some examples are:

1. Inflow of foreign capital being at a growing technological level.
2. Intensive liquidation of the least efficient fixed assets which reduces the capital/labor ratio without hurting the productivity of labor and leads to higher values of parameter α and β.
3. Unemployment that increases discipline of labor and encourages workers to more productive work.

Therefore, the growth in α and β results not only from privatization, but also from the accompanying processes that are not identical with privatization.

A growth in the working shift rate leads to growing employment, while the value of fixed assets remains the same and seemingly makes capital/labor ratio decline, contributing also to an apparent growth in parameter β.

Using the example of the Polish industry we have confirmed the hypothesis originating from to the property rights theory, that a transfer of property rights from the public to the private sector leads to a significant increase in effectiveness of the production processes. We have estimated a modified labor productivity function, which shows that in 1998 privatization increased the efficiency of manufacturing ca 26%, compared with the situation when the entire industry had remained state-owned. It is assumed that in the future private property will account for 85% of industry. Then, on the basis of the estimated function, productivity can be expected to be 64% higher than productivity before privatization as a result of the internal effect and 134% higher because of external effect. The total effect would exceed 280%. All the presented values are of approximate nature and indicate that due to

privatization we can only partly close the distance between Poland and the developed countries[14].

J.R. Barro and B. Motley have estimated that inflation growth by 10 pp caused the slow-down of the GDP growth rate by 0.2–0.6 pp. Our estimations of the impact of inflation on the labor productivity in Polish industry are similar – the inflation rise by 10 pp diminishes productivity by 0.1–0.7 pp. Similarly to Motley, every subsequent 10 pp of inflation results in gradually diminishing negative effects.

In the years 1993–1997 labor productivity in industry rose annually by 10% on average. The results indicate that more than half of the increase resulted from internal privatization. The second most influential growth factor was external privatization – over one third of the labor productivity growth can be explained by the processes accompanying the privatization of the industrial environment. The joint effect of the growth of the capital/ labor ratio and the drop in inflation accounted for near by one – tenth of the economic growth (1.1 pp. annually, where capital/ labor ratio amounted to – 0.7 pp. annually while the drop in inflation – 0.4 pp.).

The presented labor productivity function does not include a time variable or any variables expressing qualifications of the employed or the number of patents. Instead, it includes the level of privatization. A time variable was introduced into the function at some point but the results we received were much worse than in the case of variables expressing the scale of privatization. A probable reason is that variables refering to human capital, and the number of patents in particular, have a delayed effect on production, due to the long implementation process.

It is stated in the property rights theory that private property is more efficient than state property. Private property motivates people to use resources, more effectively including an effective use of employees' qualifications and more efficient implementation of patents. In this respect the presented approach bears some similarities to the approaches that take account of human capital.

The above model of the growth processes in the transition period overlooks the two factors commonly included by the researchers studying the Countries of Central and Eastern Europe and the former Soviet Republics (cf. Fischer, Sahay, Vegh 1996b; Berg, Borensztein, Sahay, Zettelmeyer 1999; Merlevede 2001 and other). These are the initial conditions preceding transformation and the „share of state" (the ratio of the budget expenditure to the

[14] Taking into account the purchasing power parity, the GDP per capita in Poland is 3 to 4 times lower than in the developed countries (RSRP 2000, p. 707). According to the official foreign exchange rates, the difference is ten times (Czyżewski, Łapińska-Sobczak 2001).

GDP). The initial conditions significantly differentiate the growth in individual branches. Unfortunately, as in cross-national studies, the definition of initial conditions is not unambiguous[15]. On the other hand, although the „share of state" does not differentiate along individual branches, it varies from year to year. Both the factors will be considered by us in further studies.

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