POLICY RESEARCH WORKING PAPER 1624

Structural Adjustment, Ownership Transformation, and Size in Polish Industry

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After Poland's 1990 reforms, private firms outperformed state enterprises — and large private firms did better than small private firms, except for very large enterprises (many of which were previously state enterprises and may need further restructuring).

The World Bank
Europe and Central Asia
Country Department II
Country Operations Division
July 1996.

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Summary findings

Barbone, Marchetti, and Paternostro argue that significant adjustment took place in Polish industry after Poland's 1990 reforms. They analyze data on two-digit and three-digit manufacturing industries, disaggregated by firm ownership and size. By applying a statistical model to labor productivity growth, they try to disentangle structural determinants of the recovery from cyclical determinants. They contend that structural determinants outweigh cyclical ones.

They find that the productive response of state enterprises was markedly different from that of private firms. Private firms outperformed state enterprises (just as anecdotal evidence suggested).

Size also matters, at least among private firms. Generally, there seem to be increasing returns to scale for private firms, except for very large enterprises (many of which were previously state-owned and may need further restructuring).

The fact that size does not appear to matter among public enterprises suggests that several of them have not yet adopted optimal technologies and production processes.

This paper — a product of the Country Operations Division, Europe and Central Asia, Country Department II — is part of a larger effort in the department to analyze and disseminate the lessons of the economic transformation of former socialist countries in the 1990s. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Cielito Pelegrin, room H11-123, telephone 202-458-5067, fax 202-477-1692, Internet address mpelegrin@worldbank.org. July 1996. (25 pages)

STRUCTURAL ADJUSTMENT, OWNERSHIP TRANSFORMATION AND SIZE IN POLISH INDUSTRY

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JEL Classification Numbers: D21, E63, P21.

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I. Introduction

In 1990 Poland was the first socialist country to undergo radical political and economic transformation. The Economic Transformation Program (ETP), engineered by deputy prime minister Leszek Balcerowicz and his collaborators, was introduced on January 1. It included price liberalization, trade liberalization, a fixed exchange-rate after sharp devaluation, and comprehensive budget reform. The latter was designed to achieve price stability, and to bring to an end the socialist system of inter-enterprise cross-subsidization. The program was an unprecedented attempt to change a centrally planned economy into a free market one, by letting market forces determine resource allocation in the economy, according to consumer preferences, available production technologies and comparative advantage.

Since reforming economies typically inherited from the socialist past a completely distorted resource allocation, transition - if successful - was to be accompanied by a dramatic structural change. Surprisingly enough, relatively few studies have attempted to asses the impact of adjustment policies and reforms on the structure of Polish and other transition economies. Among early studies, Borensztein and Ostry (1992) and Borensztein et al. (1993) argued that no significant structural change had taken place in Eastern Europe. They studied Bulgaria, Czechoslovakia, Poland and Romania in the first couple of years after reforms. On the other hand, Berg (1994) claims that the delays in institutional reforms -- such as those concerning the privatization process and the financial sector -- have not prevented the occurrence of structural adjustment process in Poland.

The first objective of this paper is to assess if a major process of restructuring and resource reallocation has indeed taken place in Poland. In order to properly address this issue, one needs to understand to what extent the recent output recovery reflects structural change rather than being merely a cyclical phenomenon, i.e. a demand-driven expansion. To this aim, we first look at the broad process of reallocation of labor and production, among the main sectors in the economy and within industry, in the period 1990-1994.

We chose labor productivity as a key variable, and try to differentiate the mechanical effects of increasing demand on productivity from those of industrial restructuring.

A second crucial issue for the success of transition that we address in this paper is the performance of state enterprises. The key questions concern the ability of the public sector to adjust and the degree of restructuring that has already taken place, if any. Little comparative analysis of the adjustment and performance of public and private enterprises can be found in the literature, mainly because of data availability problem. The few existing studies, to our knowledge, are limited to case-studies. Pinto et al. (1993) analyzed a sample of about 125 public enterprises; they suggest that there may be more cases of viable public firms than expected, and that management rather than ownership may be the crucial factor. Estrin et al. (1994) have considered 15 case-studies of state-owned enterprises, and found that only half of the firms examined would be viable. In this regard, the comprehensiveness, of our data set allows us to fill a gap in the literature.

Finally, we address the issue of size. We investigate whether and how firms' size affects their economic performance, in both the private and the public sector.

The content of this paper is as follows. Section II provides broad evidence on the process of resource reallocation and structural adjustment of the Polish economy during the first five years of the reforms (1990-1994). The third section analyzes the supply response and productivity performance of state-owned and private enterprises, with the use of a large disaggregate panel data set, which covers 88 three-digit manufacturing industries, in the period 1992-93. In the spirit of Stockman (1988), we decompose productivity growth in public and private enterprises of each three-digit industry into components accounted for by aggregate, macroeconomic (mainly demand) factors and those accounted for by structural, industry-specific factors. The fourth section adds evidence based on a panel data set for 1990-93 that allows to control for both ownership and size of industry. Conclusions follow.

II. Resource Reallocation and Structural Change After the 1990 Reforms

A detailed description of the Economic Transformation Plan - the ETP- can be found, for example, in World Bank (1991), Gomułka (1994), Lipton and Sachs (1990). The macroeconomic measures of the ETP consisted of substantial tightening of fiscal and monetary policies; complete internal convertibility of the Zloty, and the fixing of the exchange rate, after a large devaluation; and foreign trade liberalization. At a microeconomic level, the remaining substantial vestiges of central planning were abolished and measures were taken to remove the "soft-budget constraint" system. Almost all remaining price controls, and most enterprise-specific taxes and subsidies, were abolished, and some limits imposed to the provision of credit to enterprises. Steps were initiated to modify the legal and regulatory environment as required by the transition to a market economy.

The implementation of the reforms led to considerable changes in the economic environment and incentives faced by the enterprises. A sufficiently credible hard budget constraint was gradually established. The opening of the economy and the abolition of explicit and implicit subsidies led to marked changes in relative prices among industrial sectors, and consequently in their underlying profitability.[2] On the demand side, foreign trade provided a strong impulse and opportunity for restructuring. The demise of the CMEA, sweeping cuts of tariffs and non tariff barriers, and the major trade agreements signed with the European Union and with the other European countries, belonging to either EFTA or the former CMEA, led to a marked reorientation of trade and sharp changes in the composition of exports.[3]

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[2] Producer relative prices show considerable changes in the first five years after the reforms. The relative price of energy products, in particular, show marked increase (as much as three times the average economy-wide price increase). This means that energy-intensive enterprises in all sectors have been subject to enormous pressure on the cost side, and their profitability and competitiveness - both internally, vis-à-vis less energy-intensive firms, and externally - has changed dramatically. From 1990 to 1993, relative prices in industrial sectors other than energy have decreased by as much as 40 percent in light industry, 30 percent in food processing, and 20 percent in wood and paper and electro-engineering (with the noticeable exception, within the latter sector, of transportation equipment).

[3] Unfortunately, the available data on foreign trade by commodity are not very useful for our purposes, for a number of problems, including classification criteria. However, data on foreign trade by

A major hurdle in analyzing the response of the Polish economy to the reforms is the need to disentangle the structural determinants of the performance of the economy in the period 1990-94 from the cyclical ones. There is no issue that demand factors were at play during those years, in addition to the more permanent effects of the market-oriented reforms. Aggregate demand collapsed in 1990 and 1991, for a number of reasons, and strongly recovered in 1992-94. GDP decreased sharply in the first two years, and recovered in the latter two (see Table 1). From 1989 to 1994, total employment in Poland decreased by some 15 percent, and unemployment rose from 0 to 16 percent of the labor force.

Table 1. Poland: Main Economic Indicators

	1989	1990	1991	1992	1993	1994	1995
Real GDP (%, change)	0.2	-11.6	-7.2	2.6	3.8	5.2	7.0
Rate of Inflation (Yearly Avg.)	245.6	585.8	70.3	43.0	35.3	32.2	27.8
GDP in Industry (% change)	-2.1	-22.0	-17.1	2.6	8.6	10.0	12.0
Employment (millions)	17.4	16.5	15.8	15.4	15.1	15.3	15.2
Unemployment (% Labor Force)	0.0	6.3	11.8	13.6	16.4	16.0	14.9
Source: GUS, authors' calculations							

There is also strong evidence, however, that the demand developments just discussed were accompanied by a progressively stronger supply adjustment. Table 2 shows two sets of indicators in this regard: (i) sectoral distribution of employment and production; and (ii) ownership structure.

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destination reveal an impressive redirection of exports and imports. The share of total exports accounted for by European Union countries increased sharply from less than 30 percent in 1989 to more than 60 percent in 1993. Accordingly, the share of exports to former CMEA countries collapsed from 37 percent in 1989 to 13 percent in 1993. Clearly, the different sectors of Polish manufacturing benefited to a very diversified extent from such dramatic redirection of foreign trade, with a selected bunch of them (such as food processing and clothing) benefiting the most.

Even at this aggregate level, the data show a remarkable change in the composition of supply and employment. The share of industry (both in production and employment) has dramatically contracted, in favor of the service sector. Agriculture, largely dominated by small self-employed holdings, has by and large remained a reservoir of underemployment. Employment in manufacturing decreased by about 25

Table 2 - Indicators of Structural Adjustment			
	1990	**1992**	**1994**
I. Employment (% of total)			
Agriculture	27.9	28.6	28.7
Services	41.4	44.4	44.9
Industry & Construction	30.7	27.0	26.4
Manufacturing	...	21.9	21.8
II. GDP(% of total)			
Agriculture	8.3	6.9	7.0
Services	41.6	49.5	50.3
Industry & Construction	50.1	43.6	42.6
Manufacturing	...	28.0	27.4
III. Ownership Structure (private sector % in value-added)			
GDP	30.9	47.1	52.2
Agriculture	81.9	81.1	86.7
Services	35.1	52.1	55.9
Industry	18.3	26.5	34.5
Source: GUS, Yearly Yearbook, Various issues			

percent in 1990-93, whereas it increased in trade and finance, respectively, by approximately 40 and 30 percent. Within manufacturing, the response of individual industries to the new market conditions is also quite diversified. At one-digit level, it ranged from Food Processing, where employment increased by 15 percent during the whole period, to electro-engineering, where it decreased by as much as one third.[4]

[4] One and two-digit employment and production data for the period 1990-93 are available upon request from the authors. For this sample, during the 1992-93 recovery, employment in total manufacturing decreased by 10 percent. But employment decreased by as much as 20-30 percent in one third of the industries, whereas increased in one fourth of the industries. It is difficult to argue that these discrepancies over a two-years period can be explained simply by the different cyclical frequencies of individual industries.

Changes in employment have been accompanied by rather marked changes in the structure of production. Manufacturing output decreased by around 25 percent during 1990-93 recession, and increased by 12 percent in the 1992-93 recovery (overall, it decreased by around 25 percent in the period 1990-93). Once again, however, the data on one and two-digit industries suggest something more than a purely cyclical phenomenon. For example, in 1993, i.e. the second year of recovery, real output decreased in as many as eight out of twenty two-digit industries (i.e., coal, non-ferrous metallurgy, engineering, precision instruments, electronics, glass, clothing and leather). As a result, the shares of metallurgy and electro-engineering in total production fell, respectively, from around 20 and 25 percent in 1990, to 10 and 20 percent in 1993. On the other hand, the share of Food Processing rose from 15 to more than 25 percent of total manufacturing output.[5]

Secondly, in parallel with the changes in the structure of supply, the ownership structure in industry has been sharply modified. The private sector in 1995 accounted for more than half of economy-wide GDP and employment, and more than one third of industrial output. Most new private firms are typically small. However, in sectors such as trade and construction, the private sector accounted in 1993 for more than half of production even among medium and large enterprises. This is partly the result of privatization of previous state-owned enterprises, but mainly of creation of new firms by private entrepreneurs.[6]

Private sector growth is significant in manufacturing as well. In the last quarter of 1993, private enterprises accounted for 40-45 percent of production in Light Industry and Wood and Paper, and 25-30 percent of production in Electro-Engineering, Chemicals and Minerals. Furthermore, since these data refer to medium and large enterprises, they

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[5] An interesting exercise is the analysis of the correlation between industry-specific rates of growth in 1990-91 and 1992-93. If the correlation index were close to one, it would indicate that the industries where output decreased more during the recession are also those where it increased more during the recovery - that is, it would be evidence of cyclical behavior. On the other hand, the lack of correlation would suggest the absence of cyclical factors. Consistent with our previous observations, the correlation index computed with data on 2-digit manufacturing industries turns out to be very close to zero (precisely, it is equal to .01).

[6] Although by the end of 1993 about one fourth of all state enterprises had been privatized, their combined share in industrial output was only about 4 percent. See Chmiel (1995).

underestimate the overall size of the private sector. The only sectors where the role of private enterprises is still negligible are fuel and power and metallurgy.

The last indicator of structural adjustment that we will consider is the change in the *size* composition of industrial enterprises. The excessive vertical integration of socialist enterprises has been noted in the past (Berg and Sachs, 1992). Not surprisingly, therefore, a rapid change in the size composition of enterprises has been observed, with

Table 3. Size Distribution of Sales in Manufacturing Industry (percentage)

	1990			1993		
Size	Total	SOEs	Private	Total	SOEs	Private
6-50	1.4	0.1	1.3	4.7	0.3	4.4
51-500	15.5	8.9	6.6	24.8	12.2	12.5
>500	83.2	80.9	2.3	70.5	61.9	8.6

Source: GUS, Authors' calculations

the share of production attributable to small and medium enterprises rising substantially, even in this relatively short period of time (see Table 3). Large enterprises (defined as those with more than 500 employees) accounted for an overwhelming 83 percent of sales in 1990. Their share had decreased to 70 percent by 1993. Almost a quarter of sales were made by enterprises in the 51-500 employment category by 1993, and of these, half were private. As we will see in section IV, the change in the size distribution has been accompanied by sharply diverging productivity performances.

III. A Statistical Model of Cyclical and Structural Determinants of Productivity Growth in Public and Private Enterprises

The indicators discussed in Section II are suggestive of structural adjustment, which we define in this paper as a movement towards the production possibility frontier (possibly coupled with an outward shift of the latter), due to a resource allocation process consistent with consumer preferences, production technologies and international comparative advantages. But, as discussed, the amplitude of the business cycle observed in Poland between 1990 and 1994 has had an impact on the observed values of variables such as production, profitability and productivity (it is not difficult even for the most inefficient

state enterprise to shine if demand is growing at double-digit rates). In this section, therefore, we would like to assess, through the use of a formal statistical model, the extent of structural adjustment, as opposed to cyclical response, in the Polish industrial sector. In addition, we will pay particular attention to the differential behavior of public and private sectors. Our variable of choice is labor productivity.[7]

The analysis is based on a panel data set of 88 three-digit level manufacturing industries (Polish industrial classification system). Data cover all medium and large enterprises (i.e., enterprises with 20 or more employees) in the manufacturing sector. There are nineteen two-digit industries[8] Data span from 1992:I through 1993:IV, and report, for each industry, the amount of output accounted for by private and public firms (cooperatives being included among private firms)[9]. The period covered by the data set is particularly interesting for the analysis of the extent of structural adjustment. It was in fact characterized by recovery of demand, strong growth in private sector, and continued labor force adjustment.

Basic statistics on sales and labor productivity growth across industries are reported in Table 4. As could be expected, private enterprises have outperformed state-owned enterprises in most sectors. Sales growth has been by far higher in private enterprises than

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[7] Other possible indicators of supply adjustment would not have provided sufficiently reliable information for a formal statistical test. Measurement of total factor productivity is very difficult if not impossible, given the almost meaningless statistics on capital investment and the capital stock. Data on profitability of enterprises suffer from faulty accounting practices, due among other things to the rapid progress, particularly among private enterprises, on the learning curve of tax evasion, particularly among private enterprises.

[8] Coal, power, iron and steel, non-ferrous metallurgy, metal products, engineering, precision instruments, transport equipment, electronics, chemicals, building materials, glass, ceramics, wood, paper, textiles, clothing, leather and food processing.

[9] Residual three-digit industries within each two-digit sector (i.e. those labeled Other Industries) have been removed from the sample, because they typically cover very heterogeneous goods and production processes. Also, a number of industries with large anomalies in the data - due to strikes, other exceptional events and mistakes - have been removed from the sample. Unfortunately, because of the change of the industrial classification code used by the Polish Statistical Bureau, data for 1994 are not consistent with 1992 and 1993 data. Labor productivity is real output divided by the number of employees. Output is measured here as sales (at constant prices). In order to obtain a proper measure of output, one should of course correct the sales figures for the changes of inventory. However, given Polish accounting practices and the high level of inflation occurred in the past, obtaining a real measure of inventories is quite an arduous task. We therefore chose to use data on sales as the closest reliable measure of output.

in public ones in all industries, with the exception of transportation equipment. Across all sectors, the quarterly average sales growth is 0.3 percent in state-owned enterprises, and 11.2 percent in private enterprises. The productivity performance of state-owned firms has been slightly better. However, only in five sectors out of nineteen - coal, iron and steel, transportation equipment, clothing and leather - productivity growth in state enterprises has been equal or higher than that in private enterprises. Across all industries, the quarterly average productivity growth has been 2.6 percent in public firms and 5.4 percent in private enterprises.

While these statistics provide very useful information, there remains, as discussed, the problem of accounting for the effects of the economic cycle on the economic variables we are considering. The observed values of sales and productivity growth may be, in fact, the result of better allocation of resources, within and across firms, but also the mechanical results of an exogenous increase in demand, which would result in better performance indicators even for firms that had been passive throughout the period of demand decline.

Table 4. Sales and Productivity in Polish Industry, 1992-93 (avg quarterly growth rates)

	SOEs		Private Firms	
	Production	**Productivity**	**Production**	**Productivity**
Coal	0.6	2.0	10.2	2.0
Power	-0.5	-0.8	11.2	9.5
Iron & Steel	-1.9	0.2	19.3	-1.3
Non-ferrous metals	-3.3	-1.5	1.2	2.5
Metal Products	1.3	2.5	4.7	3.4
Engineering	0.3	2.9	10.1	5.3
Precision Instruments	0.7	7.6	14.9	8.8
Trans. Equipment	9.8	4.7	5.0	0.8
Electricity	1.7	5.0	15.6	7.8
Chemistry	-0.5	0.3	16.2	9.1
Building Materials	4.1	6.1	18.0	8.8
Glass	-0.4	3.2	8.1	3.3
Pottery	0.0	1.9	23.2	10.2
Wood	-2.2	2.4	6.5	3.1
Paper	-4.2	-1.8	4.9	2.3
Textiles	0.0	2.4	9.1	4.6
Clothing	0.2	2.2	3.9	2.4
Leather Goods	0.4	4.4	6.1	4.4
Food Processing	-2.5	-0.4	11.1	3.8
Total Industry	**0.3**	**2.6**	**11.1**	**5.4**

Source: GUS, Authors' calculations
This is an unweighted average across all industries contained in our sample. For the whole economy, sales growth in the public sector was somewhat higher.

Our strategy to disentangle structural from cyclical determinants of productivity growth is to decompose sectoral productivity growth into aggregate, cyclical components and structural, industry-specific components, with the help of a statistical model. In the spirit of Stockman (1988), we propose the use of a fixed-effects analysis-of-variance model:

$$\Delta Y(i, j, t) = \mu + c(i) + s(j, t) + m(t) + u(i, j, t) \qquad (1)$$

where $\Delta Y(i, j, t)$ is the rate of growth of labor productivity in three-digit industry i at time t. J is the index of the two-digit sector to which industry i belongs. The term μ is the overall mean. The term c(i) is a constant term specific to three-digit industry i. The term s(j, t) represents the interaction of a fixed effect for sector j with a fixed effect for time t; in other words, s(j, t) is a set of dummy variables specific to sector j (i.e., common to all three-digit industries belonging to sector j) and time t. The term m(t) is a fixed time effect, that is, m(t)

is a set of dummy variables specific to time t but common to all industries. Finally, u(i, j, t) is an idiosyncratic disturbance to industry i in sector j at time t.

The model in (1) is unidentified because some of the dummy variables are perfectly collinear. One possible way to identify the model is to impose the following restrictions on the parameters:

$$\Sigma c(i) = \Sigma s(j, t) = \Sigma m(t) = 0. \qquad (2)$$

These restrictions enable μ to be regarded as the overall mean, whereas c(i), s(j, t) and m(t) are differences between industry and time-specific effects (and their interactions) and the overall mean.[10]

The economic interpretation of the model in equation (1) is as follows. The term m(t) captures aggregate, cyclical factors, which affect all industries (and sectors) at a given time. This term is intended to capture, in particular, real aggregate demand shocks. These shocks have a strong positive effect on measured productivity, because of labor adjustment costs and labor hoarding, even in the absence of structural adjustment and efficiency gains. This is typically the case for market economies (see for example Bernanke and Parkinson, 1991), and even more so for former planned economies which have inherited from the past considerable amounts of idle resources. In principle, the term m(t) also captures aggregate supply shocks. In a transition economy, these can be expected to play a significant role. Typical candidates for such shocks include realignment of prices of intermediate inputs, institutional changes, the access to free trade and imported technologies, better management practices, etc. However, it is reasonable to assume that the impact of such factors has been highly differentiated across sectors, being much stronger in sectors favored by the new system of microeconomic incentives set up by the reforms, and weaker in the other sectors. As such, a large part of the impact of aggregate supply shocks is presumably captured by

[10] The time effects m(t) and the interactions between two-digit industry effects and time effects s(j, t) are correlated. In order to disentangle the fraction of sectoral output variation due to aggregate factors from the fraction due to industry-specific factors, this paper reports the fraction accounted for by the orthogonal components of m(t) and s(j, t).

industry-specific dummies, and the term m(t) can be interpreted as representing mainly real aggregate demand shocks.

On the other hand, all terms specific to a given industry i or sector j - either alone, such as c(i), or interacting with a fixed time effect, such as s(j, t) - capture industry-specific factors, on both the demand and the supply side. Sectoral supply include all those mentioned above (change of input prices, institutional reforms, access to foreign technology, better management, etc.), that the transition reforms were intended to spur or strengthen. As to sectoral demand shocks, they are presumably linked to the new structure of relative prices, and to availability and development of new goods and services, some of which imported. That is, they are too closely related to the Economic Transformation Program. We therefore interpret sectoral shocks - regardless of their origin, on the supply or the demand side - as structural shocks, spurred by the reforms, directly or indirectly.[11]

Productivity growth due to aggregate demand factors is expected to be generalized over sectors. For the reasons explained above, productivity growth stimulated by (or related to) structural change, on the other hand, could be expected to be highly differentiated across industries. The decomposition of sectoral productivity growth into cyclical, economy-wide determinants and industry-specific determinants will therefore give us a measure of the extent of structural adjustment which has taken place in the recent output recovery.

Since one of the main purposes of this paper is to test the effects of ownership change on structural adjustment, we estimated model (1) separately for the state and the

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[11] This is clearly an oversimplification. To the extent that single two-digit industries have non-coincident cycles, the terms s(j, t) also capture components of sectoral demand cycles which are unrelated to structural change and would occur even in its absence. In order to disentangle such components from those related to structural change, one should compare the variance decomposition reported in Table 5 with that relative to the pre-reforms years, which would provide a counterfactual. Unfortunately, such exercise is impossible since the three-digit data used in this paper are available from 1992 onwards only.

Whereas the framework of model (1) has been inspired by Stockman's (1988) pioneering work, the difference between his approach and that described here should now be clear. That is, Stockman used a cross-industry, cross-country model. Industry- specific effects, in this model, are time-specific effects common to all countries for a given industry. In this model, industry- specific effects are time-specific effects common to all three-digit industries belonging to the same two-digit industry. Another difference is that Stockman used output data. His model was applied to a number of transition economies by Borensztein et al. (1993).

private sector, and proceeded to test for the existence of statistically different behaviors of the two subsamples.

The results of the estimation of model (1) are reported in Table 5. For both public and private enterprises the model explains almost 50 percent of sectoral productivity change in the period considered. This is a satisfactory result, given the simplicity of the model and the wide range of industries involved. The F-statistics show that all terms in the model are significant, with the noticeable exception of industry-specific intercepts at three-digit level, i.e. the c(i) terms. This may be due to the fact that three-digit industry effects are very homogeneous within two-digit sectors, and are therefore captured by the s(j, t) dummies.

The most interesting result comes from the relative contribution of the different variables to the explanatory power of the model. With respect to SOEs, the model explains 45 percent of the variation of sectoral productivity around its mean.[12] The variance decomposition gives the following results. Three-digit industry-specific effects c(i) account for 17 percent of the explained productivity change. The remaining 83 percent is accounted for by s(j, t) and m(t). Since they are correlated, Table 5 shows the fraction of explained variation accounted for by the orthogonal components of s(j, t) and m(t), which is, respectively, 62 and 11 percent. The covariation of s(j, t) and m(t) accounts for the remaining 10 percent of explained sum of squares. In sum, effects specific to a given industry - either at three or two-digit level, and either alone or interacting with a time effect - account for 79 percent of the explained sum of squares, and time effects for 11 percent. The covariation of industry and time effects accounts for the residual 10 percent.

The results from the estimation of model (1) with data for private enterprises are very similar. The overall fit of the model is somewhat better, with the model explaining 48 percent of the variation of productivity around its mean. All variables are significant, with the exception of the terms c(i). The fraction of explained sum of squares accounted for by

[12] That is, explained sums of squares is 11.28, whereas total sum of squares (corrected for the mean) is 25.08.

time effects m(t) is larger than before - 13 percent - but still negligible compared with the fraction explained by industry-specific effects c(i) and s(j,t) - 75 per cent.

These figures confirm that both aggregate and sectoral factors played a role in the 1992-93 output recovery of Polish manufacturing. However, the results suggest that structural, sector-specific factors largely outweighed aggregate, cyclical ones, in the period considered. We interpret our results as evidence that the transition reforms have started a significant process of structural adjustment, in both SOEs and private enterprises, and the strong output recovery has not simply been an across-the-board response of the economy to the new, favorable demand conditions, but has also reflected a permanent process of restructuring and resource reallocation[13].

The data allows us to address a further issue, i.e. the differential in performance between public and private enterprises. In order to gain insights into the extent of structural adjustment that has taken place in state enterprises, we compare the sectoral and temporal pattern of the productivity response of public enterprises with that of private ones. Our *a priori* assessment, based on anecdotal evidence, aggregate data and the disaggregate statistics reported in Table 4, is that the private sector has been very responsive to the new system of microeconomic incentives brought by the reforms. Presumably, better management, easier availability of new technologies and capital inputs and the more flexible use of labor inputs have put private firms, by average, not too far from the production possibility frontier of Polish manufacturing. If this is true, we can use the private sector and its productive behavior as a benchmark. The closer is the observed pattern of productivity response of public enterprises to that of private ones, the greater the extent of structural adjustment and restructuring that we can infer is taking place in the public sector.

We therefore pooled public and private enterprises data, and tested if the same statistical model of equation (1) applied to both data sets. We tested for heteroschedasticity,

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[13] Even allowing for some underestimation of cyclical effects deriving from our identification approach -- that we cannot avoid because of lack of data (see footnote 12) -- the substance of our results does not change.

and could not reject its presence. The results of the standard F-test are therefore biased, and we used the procedure suggested by Honda and Ohtani (1986) and Honda (1988). The resulting Generalized Covariance (Chow) test is based on a Chi-square statistic (Table 5, bottom panel) which rejects the null hypothesis. This indicates that the data of public and private enterprises fit different models, as the basic statistics reported in Table 4 suggest. Our formal statistical analysis therefore suggests that the productivity response of public enterprises after the reforms has been significantly different from that of private firms. A plausible interpretation of this result, following the reasoning reported above, is that state-owned enterprises lag significantly behind in the adjustment process compared to private firms. The successful case-studies reported by Pinto et al. (1993) seem therefore to provide a partial picture of the productive performance of public enterprises, as recognized by the same authors and suggested by the data collected by Estrin et al. (1994).

Table 5

$\Delta Y(j,i,t) = \mu + c(j) + s(i,t) + m(t) + u(j,i,t)$

88 three-digit industries, 1616 obs.

Public Enterprises

	Sum of Squares	Percentage of explained SS	F-stat	p-value
Total SS	25.28			
(Model SS)	11.48			
(R-square)	0.45			
Mean	0.2			
Total SS (corrected)	25.08			
Explain SS (MSS-Mean)	11.28			
Expl. SS/TSS(corr.)	0.45			
c(j)	1.9	0.17	0.64	0.99
m(t) + s(i.t)	9.38	0.83	2.41	0.00
m(t) orthogonal	1.28	0.11	6.26	0.00
s(i,t) orthogonal	6.99	0.62	1.90	0.00
u(j,i,t)	13.8			

Private Enterprises

	Sum of Squares	Percentage of explained SS	F-stat.	P-value
Total SS	57.6			
(Model SS)	28.59			
(R-square)	0.50			
Mean	1.87			
Total SS (corrected)	5.73			
Explain SS (MSS-Mean)	26.72			
Expl. SS/TSS(corr.)	0.48			
c(j)	4.03	0.15	0.64	0.99
m(t) +s(i.t)	22.69	0.85	2.76	0.00
m(i,t) orthogonal	3.38	0.13	7.83	0.00
s(i,t) orthogonal	16.05	0.60	2.06	0.00
u(j,i,t)	29.01			

Ho: the same model (variance & coefficient) applies to both public and private enterprises

	F-statistic	p-value
Chow test (Covariance analysis)	1.2	8.47
Variance Ratio test	1.8	0.00
	Chi-stat	
Generalized Chow test	136.76	8.13

Note: Quarterly data. Outliers exceeding mean +/- 3 standard deviations have been removed.

Section IV - Size, Ownership and Productivity

In this section we further analyze the extent of enterprise adjustment and, in terms of their labor productivity growth, the response of public and private firms to the reforms implemented in the 1990s. For this purpose we employ a different data set, with data covering 9 industrial sectors at one-digit level over the period 1990-1993.[14] Compared to the data used in section III, this data set allows to control for the size of enterprises. In addition, we kept cooperative enterprises as a separate entity. Specifically, we can identify 5 different groups: (1) enterprises with 6-20 employees; (2) enterprises with 21-50 employees; (3) enterprises with 51-300 employees; (4) enterprises with 301-500 employees and (5) enterprises with more than 500 employees It is also worth noting that in this new setting we are able to include in the analysis small firms with 6-20 workers whereas in the previous data set these where excluded. Basic statistics have been already shown in table 3.

Consistent with the previous section, we decompose sectoral productivity growth into aggregate cyclical components, structural industry-specific components and size specific ones (Eq. (1)). Given the results discussed in the previous section concerning the heterogeneous behavior of private and public firms with respect to the adjustment process, we initially controlled for model homogeneity across the different ownership groups. In order to do so, we fitted the following model[15]:

$$\Delta Y(k,i,t,o) = \mu + n(k) + s(i,t) + m(t) + z(o) + z(o)*n(k) + z(o)*s(j,t) + z(o)*m(t) + u(k,i,t,o) \quad (3)$$

where ΔY is labor productivity growth, t is time and i is the one-digit sector, z(o) is a dummy variable with levels 0 for public enterprises data and 1 for private and cooperative ones; n(k) is a dummy variable representing the class size. By testing the significant regressors which include z(o) -- alone or interacting with the other variables -- we can

[14] The sectors are: metallurgy, electro-engineering, chemical, mineral, wood and paper, light industry, food industry, other industries (i.e. animal feed and utilization industry, polygraphy and other like toy industry, music instruments and rub materials production). For a description of the data set, see Jackson et al (1995).

[15] See for example Draper N.R. and Smith S. (1981).

then detect if private and cooperative firms present a different behavioral pattern with respect to public ones.[16]

Table 6. Tests of overall model and specific variables homogeneity between public and private/cooperative enterprises

345 observations
$R^2 = .21$
MSE = .311

Variable	Test statistic (1)	p-value
z(o)	$\Updownarrow^2(1) = 1.23$	.90
z(o)*n(k)	$\Updownarrow^2(4) = 13.84$	.01
z(o)*s(i,t)	$\Updownarrow^2(16) = 25.76$	.07
z(o)*m(t)	$\Updownarrow^2(2) = 7.34$	.05
All the above	$\Updownarrow^2(23) = 77.05$	.01

(1) The estimation procedure is heteroschedasticity consistent. Thus, $\Updownarrow^2$ statistics are used (see Huber, 1967, and White, 1980).
Yearly data

Results are reported in Table 6. They show that, with respect to public firms, private and cooperative enterprises belong to a different population, thus confirming the robustness of the results reported in the previous section. The overall significance of the variables including z(o) is in fact quite high, i.e. 1 per cent. Furthermore, the tests relative to the specific variables show a significantly different response with respect to each one of them -- particularly size -- the only exception being the variable z(o) alone, which is not significantly different from zero.

By using the same methodology we have also investigated the possibility that cooperative and private firms did not conform to the same model; the results obtained have led us to reject such hypothesis.[17]

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[16] Given the structure of the data set, we first attempted to develop a panel data random effects model. The results of the Breush Pagan Lagrangian multiplier test for random effects over the presence of a statistically significant variance in the unit specific random variable have rejected such assumption; thus showing the reliability of standard OLS techniques, which we applied in the regression of (4).

[17] The test was performed in accordance with the same methodology discussed above. The related F statistic was F(21, 174)=1.05. Model heterogeneity was then significant only at the 40 percent level of confidence. We have also performed the following diagnostic tests: (1) Ramsey RESET test for omitted

We then proceeded to estimate separate models for public firms and for private and cooperative ones. The results are reported in table 7.

Table 7 Labor productivity growth in private and cooperative enterprises regression results.		
Number of observations	216	
F(21, 194)	2.74	.1%
R2	.23	
Root MSE	.264	
Model SS	4.023	
Residual SS	13.556	
Total SS	17.580	
Variable	Test statistic	Level of sign
Constant	t=-2.35	2%
n(i)	F(3,194)=3.38	2%
s(j,t)	F(16,194)=2.43	.2%
m(t)	F(2,194)=3.15	4.5%

The estimates were obtained using standard OLS and the diagnostic tests were all satisfactory.[18] All the variables are significant at the 5 percent level of confidence. It is not surprising that R^2 is lower than in the regressions presented in section III because data are more aggregate, both across time and industries. With respect to size -- the main variable of interest in this section -- we fitted the model using a dummy variable equal to 1 in the first 3 size groups (6-20, 21-50, 51-300 employees) and a zero in for the last two (301-500 and over 500 employees).

Overall size is highly significant in explaining labor productivity growth. We have also performed an ANOVA analysis; the variance decomposition shows that size accounts for 17 percent of the explained productivity change, while the remaining 83

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variable bias: F(3,176)=.84, P>F=.475, the model has no omitted variable bias;(2) Cook-Weisberg test for heteroschedasticity c2(1)=3.14 P>c2=.589, the presence of heteroschedasticity is rejected.

[18] We have performed the following tests: (1) Ramsey RESET test for omitted variable bias: F(3,197)=1.50, P>F=.216, the model has no omitted variable bias; (2) Durbin-Watson statistic=2.02; (3) Cook-Weisberg test for heteroschedasticity $\Updownarrow^2(1)=3.14$ p-value=7.6% , the presence of heteroschedasticity is therefore rejected at the 5% level of confidence. Given that we could accept the presence of it at the 10% level we ran regressions controlling for heteroschedasticity. The results obtained (not reported) confirm and actually strengthen those reported in table 4.3.

percent is attributable to s(j,t) + m(t). The individual coefficients reported in table 8 enable us to gain further insight over the role of this variable.

Table 8. Size coefficients and significance levels in private and cooperative enterprises

Size	Beta	t	P>t
21-50	.016	.299	.765
51-300	.152	2.794	.006
>300	.089	1.814	.071

Source: Authors' calculations

Given the regression implementation technique, these coefficients represent, other things being equal, the differential contribution of each category to productivity growth compared with that of the group size 6-20. Only the last two coefficients are statistically significant. In medium enterprises (51-300 employees), productivity growth has been clearly higher than in small ones (6-20). This is true for large enterprises (over 300 employees) as well. We interpret this result as suggestive of increasing returns. However, the coefficients also reveal a relatively worse performance of large enterprises compared to medium ones. We can therefore argue that the private Polish industrial system still suffers from the presence of inefficiently oversized large firms.

The regression results of equation (3) for public enterprises, reported in Table 9, are quite different.[19] The interaction of industry and time effects s(i,t) is still highly significant, and the overall fit of the model is quite similar to that obtained with private sector data. However, size has no significant explanatory power (also time effects are not significant, but this is less interesting for our purposes).[20]

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[19] Results are heteroskedasticity consistent, thus we report χ^2 statistics. Other test results: (1) Ramsey RESET test $\chi^2(3)=.42$ p-value=.90, the model has no omitted variable bias; (2) Durbin-Watson statistic= 2.28.

[20] The ANOVA analysis shows that its contribution to the explained variance of the model is 12.5 percent.

Table 9. Labor productivity growth in public enterprises regression results.		
Number of observations	124	
$\chi^2(21)$	246.75	
R2	.23	
Root MSE	.277	
Model SS	2.373	
Residual S	7.784	
Total SS	10.158	
Variable	Test statistic	p-value
n(i)	$\chi^2(3) = 3.42$	50%
s(j,t)	$\chi^2(16) = 193.6$	1%
m(t)	$\chi^2(2) = 2.66$	26%

Further inspection of the single coefficients associated with the size dummies confirms their statistical insignificance (table 10).

Table 10. Size coefficients and their level of significance in public ent.			
Size (employees)	beta	t	P>t
21-50	.001	.012	.99
51-300	-.125	-1.4	.16
over 301	-078	-.92	.35

We have therefore a clearcut result which needs to be explained: size matters among Polish private enterprises, but it does not matter among public ones.

A possible interpretation of this outcomes is related to two broad phenomena common to many Eastern European countries in the first years of the transition and adjustment process: the birth of new private firms and the privatization of public ones. Since the beginning of the 1990s, the Polish economy has been subject to a significant inflow of new private firms, especially small and medium size ones. Recently-established firms have had the opportunity to choose more modern technologies and to take advantage of better managerial skills, thus being better able to exploit the potential technological and organizational economies of scale present in the Polish industrial system, unlike most public firms. Furthermore, the first wave of privatization has in all likelihood taken place among those more profitable and efficient firms. The pattern of privatization has then left in public hands those enterprises that, given the technology,

were more heavily penalized by the problem of excessive employment levels. The implication of this is a differential effect of size on labor productivity levels depending on the ownership status of the firm.

Finally, the ease of restructuring is presumably inversely related to the size of the firms, both in terms of its economic and political costs. To the extent that large private firms are mainly former state enterprises which have been privatized, this can be viewed as partially responsible for the worse performance of large firms with respect to medium ones, in the private ones.

Conclusions

The empirical results discussed in sections III and IV suggest a number of conclusions with respect to the economic recovery that began in Poland in 1992.

First, there is unmistakable evidence that 1990 reforms brought a significant process of structural change. We confirm Berg's (1994) claim and provide broad evidence on resource reallocation. Furthermore, with the use of a statistical model applied to labor productivity growth, we attempt to disentangle structural vs. cyclical determinants of the recovery, and suggest that the former have outweighed the latter.

Second, the detail of our two data sets has allowed us to formally investigate the performance of public versus private enterprises. We found that the productivity response of state enterprises has been significantly different from that of private firms (with the latter largely outperforming the former). Our statistical model has therefore confirmed the anecdotal evidence available to observers of the Polish economy. The successful case-studies of state enterprises reported by Pinto et al. (1993) and Pinto and van Wijnbergen (1995), therefore, seem to provide only a partial picture of the performance of the public sector -- as the same authors also suggested. However, we too found signs of adjustment among public enterprises.

Third, size matters, at least among private enterprises. Overall, there seem to be increasing returns to scale, with the exception of very large enterprises (possibly because relatively many of them were previously state-owned, and need further restructuring). On the other hand, the fact that size is not significant among public enterprises can be interpreted as evidence that several of them do not adopt yet optimal technologies and production processes.

Our results have been confirmed with the use of two different data sets.

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