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Productivity of Western and Domestic Capital

in Polish Industry

Katherine Terrell

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Center for Economic Research and Graduate Education
Faculty of Social Sciences

Charles University

Táboritská 23, 130 87 Prague 3

Czechoslovakia

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ABSTRACT

The efficiency of western capital in Polish industry during 1961-1981 is estimated within a production function framework using a new time series on western and domestic capital. Analysis of changes in total factor productivity, output elasticities and marginal products suggests Gierek's New Development Strategy failed to raise industrial productivity and that investment in western capital was often wasted. For many industries the strategy's premise of increasing efficiency through western capital imports appears to have been misguided since the marginal product of western capital was lower than that of domestic capital already during the 1960s. Importation of western capital exacerbated these differentials.

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PRODUCTIVITY OF WESTERN AND DOMESTIC CAPITAL IN POLISH INDUSTRY

In January of 1990 the Polish government launched a stabilization and structural adjustment program aimed at reviving the Polish economy. Polish policy makers, including Lech Walesa, as well as officials from western governments, stressed that a substantial infusion of western capital would be a precondition for a successful transition to a market economy. This raises the question of how efficiently western capital would be utilized. In this paper I draw on previous experience and analyze of how efficiently the Poles used the transfer of western capital during their last major experiment, namely Edward Gierek's New Development Strategy of 1971-1976. In many respects the two reforms are very different. Nevertheless, a correct understanding of whether or not western capital was utilized efficiently in the past and what determined the outcome can help in designing sound policies in the current context.

Gierek's team sought to increase the productivity of Polish industry by means of a massive infusion of western capital. This reliance on western capital was not new. During the 1960-71 period, 16 - 23 percent of all imported machinery and equipment originated from non-socialist countries. What was new in Gierek's policy was the magnitude of the inflow, which jumped to 34 - 52 percent of all imported machinery and equipment during the 1972-76 period. Put differently, over the 1970-1976 period the volume of investment grew by 129 percent and the value of machinery and equipment imported from non-socialist countries more than doubled.

Several studies, such as Fallenbuchl (1983), Gomulka (1986), Montias (1982), show that industrial output rose over the 1971-1976 period, but they also point to the inability of the Polish economy to absorb western capital productively, often resulting in idle western machinery and equipment due to shortages of complementary inputs such as buildings, technical personnel, etc.. Other analysts, relying on production function analysis, suggest that total factor productivity may have risen in that period for industry as a whole and for some of those sectors that imported large absolute amounts of western technology (Kemme, 1987; Whitesell, 1985). In addition, Gomulka (1986), using an algebraic methodology based on growth theory, tentatively concluded that an increase in the value of imports of western machinery equivalent to 10 percent of total investment in machinery would lead to a 1 percent increase in the growth of industrial labor productivity. The conclusions of these studies are indirect because they cannot link the growth of total factor productivity to variations in the industry-specific inflows of western capital, and they cannot provide estimates of the productivity of western capital. They therefore cannot assess if similar results could not have been obtained without such a sizable capital infusion or with a greater infusion of Polish (or CMEA-produced) rather than western capital.

This paper presents the first direct estimates of the relative productivity of western and domestic capital in Polish industry.[2] The estimates rely on a new data series of western capital in each of the eight major industrial branches over the 1961-1983 period.

I. Methodology

In this study, I impose no strong a priori restrictions on the form of the production function and on the implied elasticities of substitution among the inputs.[3] For each of the eight industrial branches, I estimate a translog production function of the form:

$$\ell nQ = \ell n\alpha_0 + \alpha_1 t + \alpha_2 t^2 + \alpha_3 D7276 + \sum_{i=1}^{3} \beta_i \ell nX_i + .5\sum_{i=1}^{3}\sum_{j=1}^{3} \gamma_{ij}\ell nX_i \ell nX_j + \mu \qquad (1)$$

where Q = output, the inputs are X_1 = domestic capital (K_d), X_2 = western capital (K_w), X_3 = labor (L), and $\gamma_{ij} = \gamma_{ji}$. In addition to the three inputs, a time trend (t and t^2) is included as well as a dummy variable, D7276, to account for the effect of the New Development Strategy on productivity. While the emphasis of the study is on the relative productivity of western and domestic capital, the production function framework makes it possible to obtain estimates of the evolution of and shifts in total factor productivity of Polish industry during the 1961-1983 period. The t and t^2 variables allow me to test for the possibility of variable technological change, while the inclusion of D7276 permits me to assess if total factor productivity shifted during the New Development Strategy. Since it is likely that there was a one-year lag between the time the policy was announced and the time enterprise managers could change their investment patterns, D7276 was 1 for 1972-76 and 0 otherwise.

The translog function with symmetry imposed ($\gamma_{ij} = \gamma_{ji}$) is a quadratic approximation around the expansion point $X^* = [X_1^* ... X_3^*] = [1,...1]$, to an arbitrary production function of the form $\ell ny = f[\ell nX_1,...\ell nX_3]$, (see Denny and Fuss, 1977, p. 407). Equation 1 was estimated with 1961-1983 data from each of the eight branches of Poland's industrial sector. The data were normalized around the midpoint in each series. Since the error terms are correlated across industries due to common shocks, the efficiency of estimation can be increased by the use of generalized least squares estimates (GLS). As a result, Zellner's (1962) seemingly unrelated regression (SUR) technique was employed for the four light and the four heavy industries, respectively.

Mean values of the three inputs and the output are presented in Table 1. The means have been calculated for three time periods: before, during and after the New Development Strategy. Output is measured as global product in millions of 1961 zloty. Domestic capital (K_d) is fixed assets net of western capital. Western capital (K_w) is estimated from the value of imported machinery, equipment and plants from non-socialist countries. Both types of capital are measured in millions of 1961 zloty and have been adjusted for capacity utilization during the 1979-1983 crisis period. Labor is measured in millions of hours per annum. A detailed explanation of how these variables are constructed is provided in the appendix.

[Table 1 here]

Tests for Appropriate Restrictions

Equation 1 nests a number of widely used production functions. Hence, I test five principal hypotheses about the appropriate form of the production function in each of the eight industrial branches and then re-estimate the production function with the appropriate constraints imposed.

Hypothesis 1: The appropriate form of the production function is one where domestic and western capital (K_d and K_w) can be aggregated into K and weakly separated from labor (L), with the elasticities of substitution between both K_d and K_w and between K and L being freely estimated from the data.

The production function then takes the form:

$$\ell nQ = f[g(\ell nK_d, \ell nK_w), \ell nL], \quad (2)$$

where the aggregate input function g(.) is a translog combination of components K_d and K_w and the production function f is translog in the input aggregates. The test of Hypothesis 1 is a test of the following restriction on the translog function:[4]

$$H1_o: \beta_1/\beta_2 - \gamma_{13}/\gamma_{23} = 0. \quad (3)$$

Hypothesis 2: The appropriate form of the production function is one where K_w and K_d can be aggregated and strongly separated from L such that the production function takes the Cobb-Douglas form in K and L and a translog form between K_w and K_d.

The test for this form of the production function amounts to testing the following two restrictions on equation (1):

$$H2_o: \gamma_{13} = \gamma_{23} = 0. \quad (4)$$

Hypothesis 3: The appropriate production function is a Cobb Douglas in three inputs.

The translog function reverts to a Cobb-Douglas specification when

$$H3_o: \gamma_{11} = \gamma_{22} = \gamma_{33} = \gamma_{12} = \gamma_{13} = \gamma_{23} = 0. \quad (5)$$

Hypothesis 4: The appropriate function is a Cobb-Douglas in the three inputs with constant returns to scale.

This amounts to testing the following restriction in addition to the restrictions in equation (5):

$$H4_o: \Sigma_i\beta_i = 1. \quad (6)$$

Hypothesis 5: The appropriate form of the production function is one where there is a constant elasticity of substitution in the three inputs with constant returns to scale. The test for this specification amounts to testing the following four constraints:

$$H5_o: \quad \alpha_1/\alpha_2 - \gamma_{13}/\gamma_{23} = 0;$$

$$\alpha_1/\alpha_3 - \gamma_{12}/\gamma_{13} = 0;$$

$$\Sigma_{ij}\ \gamma_{ij} = 0;$$

$$\Sigma_i\beta_i = 1. \quad (7)$$

The Wald test was selected as an appropriate test for assessing the validity of the various constraints. The test results are presented in Table 2 below. The findings indicate that weak separability ($H1_o$) could not be rejected in seven of the eight industrial branches.[5] Hence, capital aggregation with a translog function is possible in these six industrial branches. The hypothesis that capital is strongly separable ($H2_o$) is rejected in all but one of the eight industrial branches. For the sake of completeness I report in Table 2 the results of the remaining three more restrictive hypothesis tests that show that these specifications, Cobb-Douglas function, $H3_o$ and $H4_o$, and the CES constant returns to scale production function, $H5_o$, are rejected at conventional significance test levels.[6]

[TABLE 2 HERE]

Based on the statistics presented in Table 2, the most constrained specification of the production function accepted by the industrial branch data at the 5 percent confidence level is selected as the appropriate specification for that branch. The results of this selection are summarized in Table 3. The constraints are imposed and the industry specific production functions re-estimated using Zellner's (1962) SUR. Because this technique is used, the Durbin-Watson statistic is no longer a sufficient test for auto-correlation. Guilkey's (1974) test for serial correlation across each system of four equations was therefore used and the results indicate the joint hypotheses of serial correlation can be rejected.[7]

[TABLE 3 HERE]

II. Findings

Total Factor Productivity

If the New Development Strategy of 1971-1976 had a positive effect on industrial productivity, one might expect to find higher total factor productivity over this period, as compared to the previous period, for all branches. Indeed, Whitesell (1985) found for five Eastern European countries, including Poland, that:

> "factor productivity growth was generally higher than average in the early 1970s and lower than average in the late 1970s. This coincides with a large increase in the rate of growth of Western imports in the early 1970s and a decrease in the growth of imports in the late 1970s." (p. 241)[8]

Moreover, Kemme (1987) found for Polish industry as a whole a small but statistically significant increase in the rate of growth of total factor productivity during the 1973-1977 period as compared with the 1960-1972 period. Like Whitesell, he attributed this result to the import of western capital.

While I can control directly for the effect of western capital, the question remains whether or not the introduction of western technology into the enterprise changed the enterprises' production process, i.e., improved the management and organization of work by managers or the work effort by workers, so that one might witness a shift in total factor productivity captured as a fixed effect in the coefficient on the dummy variable D7276 for the 1972-1976 period. Moreover, I want to test whether the gains in total factor productivity are larger in those industries that acquired more western capital.

The degree to which the industries acquired foreign capital can be measured in either absolute terms measured by total investment or in relative terms as a proportion of the sector's total capital stock. The ranking of the industries using these two measures does not always coincide. Fallenbuchl,(1983, p. 122), indicates that engineering and chemicals were first and second, respectively, among industries ranked by total expenditures on western capital over the 1972-1977 period, each spending over four billion deviza zloty. They were followed by metallurgy, light industry, food and tobacco, power and fuel, which spent two to four billion deviza zloty, and then wood and paper and minerals, which spent less than two billion deviza zloty. The proportions of western capital to total capital stock in each industry, presented in Table 1, indicate other light industry and wood and paper invested more than chemicals or engineering in relative terms during the 1972-1976 period. Over the entire 1960-1985 period, the highest proportions are found in the other light industry, wood and paper, and chemicals industries, 4.0 - 6.6 percent. In the remaining five industries, western capital represented only between 0.5 and 4.2 percent of their respective total capital stocks.

The parameter estimates for D7276 in Table 4 indicate that only four of the eight industries, wood and paper, chemicals, engineering and minerals, experienced a statistically significant increase in total factor productivity during the 1972-1976 period. Note that two of these industries, chemical and engineering, were ranked as the two highest investors and the other two as the lowest investors in absolute terms. Moveover, only two, wood and paper and chemicals, of these four industries invested large amounts in western capital in percentage terms. Metallurgy, whose share of western capital more than tripled, did not register a significant increase in total factor productivity.

[TABLE 4 about here]

These results are consistent with Kemme's (1987) analysis of disaggregated Polish industry. Using CES and CD production functions at the level of industrial branches, Kemme (1987) tested the hypothesis that total factor productivity rose during 1973-77, as compared to 1960-72, in those branches where: a) fixed assets rose and b) relatively more western licenses for technology were acquired.[9] His findings suggest that the growth of factor productivity did not always rise in those sectors in which either fixed assets rose most rapidly or where investment in western technology licenses was the greatest.[10] My direct and Kemme's more indirect estimates hence indicate that it is difficult to link the infusion of western capital to the rate of growth or changes in the level of total factor productivity in Poland in the mid-1970s.

Output Elasticities

In Table 5 the output elasticities of the three inputs are presented for each industrial branch and for each of the three policy periods under study. These elasticities are calculated from the production function estimates of Table 4 and their statistical significance is established by a Wald test.

[TABLE 5 HERE]

The first finding that emerges from these results is that the output elasticities of many of the inputs were low as early as the 1960s and early 1970s. However, while the elasticities of domestic and western capital are zero or negative in six of the eight industries in the 1961-1971 period, the elasticities of domestic capital improve in the remaining two periods, whereas they continue to be negative or zero for western capital in three-quarters of the industries.[11] This suggests that western capital was used wastefully throughout the 22 years in several industries, especially other light industry, wood and paper, chemicals, engineering, and fuels and energy.

A comparison of Tables 1 and 5 also reveals that the elasticity of western capital has tended to be negative in the industries with the highest proportions of western capital and in the two industries that undertook the highest absolute expenditures on western capital in the 1972-77 period. Moreover, those industries that had a high share of western capital and reduced it over time, other light industry and wood and paper, appear not to have cut back sufficiently as there is no increase in their output elasticities of western capital over time.

An examination of the labor elasticities in Table 5 indicates that the extent of labor redundancy, measured by the number of industries with negative output elasticities of labor and hence marginal products, was alleviated as capital intensity increased and hours worked decreased over time. Hence, while three of the eight labor elasticities were significantly negative in the 1962-71 period, none was significantly negative in the 1972-76 and 1977-83 periods.[12]

Marginal Productivity of Western and Domestic Capital Within an Industry

A related way to assess the efficiency of use of western capital is to examine how productive it was on the margin relative to domestic capital within each industry. Since the quantities of both types of capital are expressed in identical cost units, millions of 1961 zloty, the question naturally arises as to whether investment funds were allocated between the two types of capital efficiently or whether reallocation of expenditures between the two types of capital could have increased total product. To address this question, the difference between the marginal products of domestic and western capital was examined by a chi-square test.

The results presented in Table 6 indicate that in each of the three policy periods the difference in marginal products was significant in five to seven of the eight industries, thus pointing to considerable misallocation of investment between the two types of capital on the margin. The striking finding is that the marginal product of domestic capital exceeded that of western capital in three industries, wood and paper, chemicals, and metallurgy, already in the 1961-1971 period. These findings are consistent with the elasticity estimates of Table 5 and they challenge the wisdom of Gierek's New Development

Strategy with respect to these industries. In particular, these results suggest that during 1961-71 a reallocation of investment expenditures toward domestic capital would have been desirable in nearly half of the industries, *ceteris paribus*. The exceptions to this pattern were the food and tobacco and the minerals industries, where the difference of marginal products was negative and significant, and possibly also the engineering industry, where the difference was negative but statistically insignificant. Interestingly, the minerals and food and tobacco industries did not receive priority allocation of western capital during the New Development Strategy while chemicals, which did, displayed low relative marginal productivity of western capital. The results also indicate that it was appropriate to give the engineering industry priority western capital allocation as was done during the New Development Strategy. However, as I show presently, the extent of this priority was excessive.

[TABLE 6 HERE]

With the major inflow of western capital in the 1972-76 period, the number of industries with significantly different marginal products of domestic and foreign capital increased from five to seven and that the number of industries in which the marginal product of domestic capital exceeded that of western capital rose from three to five. Moreover, as could be expected with a sizable western capital inflow, the positive and zero differentials between the marginal product of the domestic and western capital increased in all but one of these industries, chemicals. With the cutback in the inflow of western capital in the 1977-83 period, the number of statistically significant differences between the two marginal products actually declined from seven to five. Moreover the number of significantly positive differences between the domestic and western capitals' marginal products decreased from five to four.

Marginal Productivity of Western and Domestic Capital Across Industries

In addition to misallocating investment funds between domestic and western capital within each industry, the government may have also misallocated western and domestic capital across industries. To investigate this possibility, Tables 7 and 8 provide the relevant significance test statistics for pairwise comparisons of the marginal products across the four industries whose parameters were jointly estimated using the SUR technique. These two groups loosely correspond to light and heavy industries. The table indicates that the marginal products of domestic capital are significantly different from zero in about two-thirds of the 36 cross-industry comparisons. The same is true of foreign capital and hence the overall picture is one of substantial misallocation. However, the inter-temporal pattern varies considerably. For foreign capital, the number of significantly different marginal products decreases in the last period relative to the previous two periods in both groups of industries. The same pattern is found for domestic capital in the four light industries but not in the four heavy industries.

[Tables 7 and 8]

The results suggest that the pattern of the massive importation of western capital in the 1970s was in large part inconsistent with the goal of allocative efficiency and by and large ineffective in achieving allocative efficiency between the two types of capital within an industry and for one type of capital across industries. Efficiency seems to have increased during the crisis. It is possible that the crisis forced managers to economize in ways they did not have to before.

III. Summary and Conclusions

The present study estimated changes in total factor productivity and calculated the output elasticities and marginal products of labor and western and domestic capital from production function estimates based on a new 1961-1983 time series of western and domestic capital in eight Polish industries. The picture that emerges is one of an economy with low marginal productivity of many inputs that went through an unsuccessful attempt to increase total factor productivity and efficiency of resource allocation by importing western capital.

The findings of this paper support the observations of others that Poland experienced considerable difficulty with the absorption of western technology during the 1972-1983 period. This difficulty stemmed in part from the excessive pace of the investment strategy. Buildings meant to house the new machinery were not constructed on time, imported machinery was often underutilized or stood idle, and there were delays in supplying various complementary parts and shortages of experienced managers, technical personnel, etc. The efficiency of the technology transfer was also adversely affected by the inflexibility of the over-centralized and heavily bureaucratic planning and management system. These may be important institutional and systemic reasons for economic inefficiency in the 1960s and for the inability of many sectors to use effectively the large inflows of western capital in 1971-1976.

The 1971-1976 Polish experience has an important lesson for the 1990s, namely that an infusion of western capital into an economic system that is not sufficiently market oriented is likely to be ineffective. The fact that the Polish economy of the 1990s is more decentralized and enterprises face somewhat harder budget constraints should help. Nevertheless, since most enterprises are still state owned and the financial markets are underdeveloped, a rapid infusion of western capital could easily result in a large foreign debt with little improvement in economic efficiency.

Footnotes

1.This research was supported in part by grant from the National Council for Soviet and East European Research. I would like to thank David Kemme, Stanislaw Gomulka and Robert Whitesell for generously sharing their data. I would also like to thank Patricia Beeson, Josef Brada, Saul Estrin, Zbigniew Fallenbuchl, Asatoshi Maeshiro, Jean Francois Richard, Jan Svejnar, Martin Weitzman, and two anonymous referees for their suggestions on earlier drafts. Finally, I am grateful to Robert Moore and Sharad Bhandari for their computational assistance and to Magdalena Okulicz-Kozieren for her help in constructing the new time series on output and inputs for this study. Many thanks to Anita Tilford for her patience in word processing the tables. I am of course responsible for any remaining errors.

2. Throughout the paper, the term domestically produced capital will refer to the combination of capital produced in Poland and capital imported from other CMEA countries. Western capital refers to capital imported from non-socialist countries.

3. Since the estimates of technological parameters are conditioned by the particular form of the production function, it is important to follow a methodology that tests for the appropriateness of different specifications. This fact became evident in the econometric efforts to quantify the productivity effect of western capital in Soviet industry. The first studies, Green and Levine (1976, 1978), assembled data on western and Soviet capital in three Soviet industries: chemicals, petroleum products, and machine building and metallurgy. Their capital data are quite similar to the data I have constructed for this study. Their parameter estimates, based on a Cobb-Douglas (CD) specification, led them to conclude that the marginal product of western capital was higher than that of Soviet capital in the three industrial branches.

Weitzman (1979), questioning the assumption of unitary elasticity of substitution between western and domestic capital, estimated production functions that assume infinite elasticity of substitution between these two factors. Weitzman specified aggregate capital (K) to be: $K_d + \omega K_w$, where K_d is domestic capital and K_w is western capital. Using the Green and Levine data, he estimated two forms of the production function: one which constrained the elasticity of substitution between aggregate capital and labor to be one (Cobb-Douglas) and one which allowed this elasticity to be a freely estimated constant (CES). He concluded that there was no significant difference between the productivity of western and domestic capital.

Toda (1979), critical of Weitzman's assumption of perfect substitutability between foreign and domestic capital, provided yet another set of estimates with the same data. Using a combined CES/CD production function, CES between aggregate capital and labor and CD between domestic and foreign capital, he found no statistical difference between the marginal products of K_w and K_d.

Brada and Hoffman (1985), using a general translog specification, found that the marginal products of western and domestic capital were not significantly different from each other in machine building and metallurgy and in chemicals. However, the marginal product of domestic capital was higher than that of western capital in petroleum products.

4. The parameter restrictions presented in H1 and H2 are from Denny and Fuss (1977). It should be noted that the restrictions are necessary but not sufficient conditions for the relevant hypotheses.

5. There is evidence that for finite samples, changing the form of a nonlinear restriction to a form which is algebraically equivalent under the null hypothesis may change the numerical value of the Wald statistic (Gregory and Veall, 1985). I calculated the Wald statistic for the $H1_o$ restriction in two ways:

$H1a_o$: $\beta_1/\beta 2 - \gamma_{13}/\gamma_{23} = 0$

$H1b_o$: $\beta_1 - \beta_2\gamma_{13}/\gamma_{23} = 0$.

The test result was robust in the alternative specification.

6. Parallel tests for Soviet industry, performed by Brada and Hoffman (1985), yield somewhat similar findings: $H1_o$ (weak separability) could not be rejected in any one of the three industrial branches under study, chemicals, petroleum and machine building. For the petroleum branch, the underlying technology could be represented as one where capital is strongly separated from labor with a unitary elasticity of substitution between capital and labor, $H2_o$. However, the underlying production function for machine building could be specified as a Cobb-Douglas with constant returns to scale, which is far more restrictive than any functional form accepted here.

7. I am grateful to one of the anonymous referees for bringing the need for this test to my attention.

8.Using frontier production function analysis, Brada (1989) shows that the decline in factor productivity growth in the late 1970s was due to a decline in technical efficiency rather than of technological progress.

9. Kemme reasoned that the rate of growth of fixed assets should be correlated with the rate of foreign capital accumulation and that growth of fixed assets would hence be a good proxy. However, these two growth rates may not be so highly correlated. This reasoning assumes foreign capital is a constant proportion of total capital, which is not the case, as seen in Table 1 of this paper. Hence, fixed assets may have grown very slowly in industries that acquired foreign capital very rapidly if the foreign capital component began as a small proportion of the total and the domestic portion grew slowly.

10. Due to the differences in the methodologies that Kemme and I used to estimate change in total factor productivity, it is difficult to compare our findings. He analyzed the rate of growth in each period whereas I analyzed the rate of growth over the entire period and then looked at the shift in the 1972-76 period. Kemme (1987) measures a change in the rate or slope by interacting a 1973-1977 dummy variable with time, whereas I measure shifts in the overall level.

11.To check the robustness of these results, the production functions were estimated with western capital that was constructed from a two-year lag, rather than a one-year lag, of imported western plants, machinery and equipment. Although the basic conclusions remain unchanged, it is notable that the majority of the negative elasticities become not-significantly-different from zero. An explanation for this may lie in that fact it took a long time for western capital to be installed due to structural bottlenecks. Hence, by building this lag into the construction of the variable, its marginal product becomes less negative.

12. With the exception of the food and tobacco industry, the allocation of labor also improved in that one cannot reject the hypothesis that marginal product of labor was identical across industries in the 1972-76 and 1977-83 periods.

REFERENCES

Brada, Josef C., "Technological Progress and Factor Utilization in Eastern European Economic Growth." *Economica*, 56:433-448, 1989.

Brada, Josef C. and Hoffman, Dennis L., "The Productivity Differential Between Soviet and Western Capital and the Benefits of Technology Imports to the Soviet Economy." *Quart. Rev. Econ. Bus.*, 25:7-18, 1985.

Denny, Michael and Fuss, Melvyn, "The Use of Approximation Analysis to Test for Separability and the Existence of Consistent Aggregates." *Amer. Econ. Rev.*, 67(3): 404-418, 1977.

Falenbuchl, Zbigniew, *East-West Technology Transfer, Study of Poland 1971-1980*, Paris: OECD, 1983.

Gomulka, Stanislaw, *Growth, Innovation and Reform in Eastern Europe*, Madison, Wisconsin: University of Wisconsin Press, 1986.

Green, Donald W. and Levine, Herbert S., "Implications of Technology Transfers for the USSR." in NATO, *East-West Technological Co-operation*. Main findings of a colloquium held March 17-19, 1976 in Brussels, Belgium. Brussels: NATO Economic Directorate, 1976.

Green, Donald W., "Technology Transfer to the USSR: A Reply." *J. Comp. Econ.*, 3:178-180, 1979.

Gregory, Allan W. and Veall, Michael R., "Formulating Wald Tests of Nonlinear Restrictions." *Econometrica*, 53(6):1465-1468, 1985.

Guilkey, D.K., "An Alternative Test for First Order Vector Autoregressive Error Specification." *J. Econometrics*. 2:95-104, 1974.

Kemme, David M., "Productivity Growth in Polish Industry." *J. Comp. Econ.*, 11(1):1-20, 1987.

Montias, J. Michael, "Poland Roots of the Economic Crisis." *Amer. Comp. Econ. Stud. Bul.*, 24(3):1-20, 1982.

Toda, Yasushi, "Technology Transfer to the U.S.S.R.: The Marginal-Productivity Differential and the Elasticity of Intra-capital Substitution in the Soviet Industry." *J. Comp. Econ.*, 3(2):181-194, 1979.

Weitzman, Martin L., "Technology Transfer to the USSR: An Economic Analysis."*J. Comp. Econ.*, 3(2):167-177, 1979.

Whitesell, Robert S., "The Influence of Central Planning on the Economic Slowdown in the Soviet Union and Eastern Europe: A Comparative Production Function Analysis." *Economica*, 52:235-2, 1985.

Zellner, Arnold., "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias." *J. Amer. Stat. Assoc.*, 57:348-368, 1962.

APPENDIX

Description of Data

The data used for the present study were collected from Rocznik Statystyczny, Rocznik Statystyczny Handlu Zagranicznego, and the Rocznik Statystyczny Przemyslu.

Unique to this study are the data on the amount of western capital used in Polish industry. The data on western capital is the depreciated sum of the real value in 1961 zloty of machinery, equipment and completed plants imported from non-socialist countries. The construction of this variable required taking the following steps, described below: a) allocating the value of imported western capital to individual Polish industries; b) converting deviza zloty into zloty; c) making assumptions on the rate of capital depreciation; and d) converting the nominal values into 1961 zloty.

The time series on imports were calculated from detailed tables of imports of machinery, equipment and plants by country of origin in the Foreign Trade Yearbook. The methodology for grouping these imports by industrial sector of destination was taken from Fallenbuchl (1983, p. 119) who allocated the four digit level categories of imports to eleven industrial branches.

The western capital stock, K_w, was constructed by adding the previous year's real value of annual imports of machinery, equipment and completed plants to the depreciated sum of all the previous years' imports as follows:

$$K_{w_t} = M_{w_{t-1}} + .85 K_{w_{t-1}}$$

where M_w = real value of annual imports of western machinery, equipment, and plants. The nominal value of imports was deflated to 1961 prices using the official producer price index. A depreciation factor of 15 percent per annum was selected since it depreciates a given capital stock to approximately 4 percent of its original value after 20 years. Green and Levine (1978) use a similar method. Their variable for industrial capital western machinery was calculated as 95 percent of the previous year's KIW, using a 5 percent per annum depreciation rate, plus the real value of the previous year's imports of machinery and equipment.

Finally, in order to disaggregate the available data on total capital stock into its western and domestic components, it was necessary to value western capital in the same units of measurement as that of domestic capital. Imported machinery is valued in deviza zloty, and fixed assets in domestic zloty, The effective exchange rate between these two currencies is not published.

In Poland, I am aware of only one attempt to construct an exchange rate between the deviza zloty and the zloty. A Polish source, G.U.S. Inwestycje, 1979, cited by Fallenbuchl (1983, p.156), supplies data on the industrial sector's total imports of machinery and equipment from 1972 to 1978 in domestic zloty. Although this means an exchange rate must have been calculated for this period, it was not possible to learn how this calculation was carried out and what the actual rate in fact was. I therefore used the information on imports of machinery and equipment in domestic zloty together with data on the industrial sector's total imports of machinery and equipment in deviza zloty over the same period (Fallenbuchl,1983, pp.117-118). Calculating a ratio of these two figures for each of the seven years and taking an average yields a zloty:deviza zloty exchange rate of approximately 1:16 or .063.

To get the industrial sector's imports of machinery and equipment (M & E) in deviza zloty required some manipulation of the Fallenbuchl (1983) data, since data were presented on imports to the entire nation rather than to the industrial sector. Hence, I calculated industry's share of total imports of M & E in zloty (dividing the numbers in the two rows on page 156 of Fallenbuchl, 1983) and applied these shares to the time series on total imports of M & E (to the nation) in deviza zloty. The actual calculations were:

Year	A	B	C	D	E
1972	3,194.6	.682	2,178.7	31,509.6	14.46
1973	4,561.8	.387	1,765.4	26,957.2	15.26
1974	5,506.1	.663	3,650.5	63,884.7	17.50
1975	6,852.9	.677	4,639.4	79,676.4	17.17
1976	7,612.3	.731	5,564.6	87,803.7	15.78
1977	7,548.6	.716	5,404.8	82,607.6	15.28
1978	7,718.2	.711	5,587.6	85,141.2	15.52

Where:

A = Total imports of M & E to the nation in deviza zloty (pp. 117-8);
B = The ratio of industrial imports to total imports in zloty (p. 156);
C = A x B = Total imports of M & E to industry in deviza zloty;
D = Total imports of M & E to industry in zloty (p. 156);
E = D/C = annual zloty:deviza zloty exchange rate.

The average of the seven figures in col. E is 15.9. Hence, a constant exchange rate of 1:16 was used in the paper.

The validity of exchange rate depends on: a) how carefully the authors of Inwestycje made their calculations and b) whether or not the same quantity and types of imported machinery and equipment were used in the zloty vs. deviza zloty calculations. While this measure is not ideal, it should be noted that it was calculated for a rather homogeneous product, machinery and equipment, and hence takes prices into account. It can also be argued that this methodology is comparable, and possibly superior, to that adopted by Green and Levine (1978, p. 113):

> "The coefficient of .0712 for converting foreign trade rubles into domestic rubles for machinery [over the 1960 to 1974 period] was determined by Kostinsky and Treml [1976] from the 1966 Soviet I-O Table."

My methodology improves on theirs by deriving a rate based on several years of data rather than just one year.

The data for domestically produced capital were constructed as follows. Time series data are available for fixed assets, which of course include both domestically produced and all imported capital. The variable representing domestic capital, including capital imported from other eastern countries, was thus created as a residual equal to fixed assets minus western capital. In order to get an indication of the relative magnitude of western capital, its share of total capital was calculated for each of the eight industrial sectors over the 1960-1983 period. The overall proportion is rather small, averaging 3.1 percent and ranging from 1.0 percent to 5.1 percent over the period, (see Table 1 for more detail). It is interesting to note that the ratio of accumulated investment in western capital to total capital in the Soviet Union according to Green and Levine (1978, p. 114) was between 1.4 percent and 5.6 percent for total industry during 1960-1974.

The domestic and western capital series were adjusted for capacity utilization in the 1979-1983 period when the economy suffered a deep recession. This methodology, whose development benefitted from discussions with Jean Francois Richard, assumes that the relationship between the capital stock effectively utilized in each industrial branch, K^*, and energy consumption, E, is stable over time. Hence the following quadratic relationship was estimated using the 1961-1978 years when it is assumed that capital was fully utilized and hence $K = K^*$:

$$K_t = K_t^* = \delta_0 + \delta_1 E_i + \delta_2 + E_i^2 + \mu_i$$

where δ_1 and δ_2 were statistically significant in all eight industries. This corresponds to an increasing capital energy ratio over time. The coefficients $\hat{\delta}_1$ and $\hat{\delta}_2$ were then used to forecast the value of effectively utilized capital, $\hat{K}^*$, in the recession period of 1979-1983.

The methodology hence assumes that any point on the predicted curve reflects the underlying relationship between energy and capital at a given point in time and that deviations from these points reflect the underutilization of capital during the 1979-83 period. In this framework overutilization is also possible, and it was observed for two data points. An index of capital utilization is then given by $\hat{K}^*/K$. This same index was applied to both western and domestic capital. The index of correction factors applied to these capital series is presented in the Table A1 below.

The output measure used for the dependent variable is the value of global product, measured in thousands of 1961 zloty. As in other studies on Poland, the use of global product is necessitated by the absence of data on value added. Since material inputs tend to have a high elasticity of substitution with labor and capital, the other estimated parameters are not likely to be affected. It is notable that the output in the two branches which invested most heavily in western technology, engineering and chemicals, grew at almost twice the average rate. In general, growth of output during the 1972-1977 period was higher than for the 1960-1971 period and all of the sectors experienced a negative rate of growth in their global product during the 1977-1983 period.

Employment was measured as the number of hours worked each year. Plots of this variable indicate that there is a clear downturn in the number of hours worked beginning in 1979 in every industry except engineering which has a slight downturn only in one year, 1979

Table 1. Mean Values of Factor Inputs and Output by Industry

Inputs and Output	IND1	IND2	IND3	IND4	IND5	IND6	IND7	IND8
1961-1971								
Domestic Capital[1]	76350.3	45904.2	26981.5	65024.5	108909.9	197770.3	51597.6	73944.1
Western Capital[1]	922.0	2249.2	1575.2	2980.4	5006.2	7319.4	832.1	413.4
% Western Capital to Total[2]	1.1	4.5	5.2	4.0	4.2	3.6	1.5	0.5
Labor[3]	658.3	1142.2	393.5	384.5	1604.4	710.5	427.4	368.7
Output[1]	148914.9	106762.9	40868.6	83079.1	229228.5	84148.5	31946.9	76909.6
1972-1976								
Domestic Capital	139682.6	82314.4	48926.7	131991.1	256651.2	339164.6	86407.1	144574.9
Western Capital	2584.1	5790.6	2918.4	6946.0	9772.2	10049.1	1624.3	1866.8
% Western Capital to Total	1.80	6.6	5.7	5.0	3.7	2.9	1.84	1.23
Labor	762.8	1297.8	436.7	461.7	2146.7	807.3	451.0	405.0
Output	232334.8	191900.6	71347.3	201922.0	600125.4	142356.1	57811.9	139554.8
1977-1983								
Domestic Capital[4]	189001.3	100650.4	67762.4	150708.2	324756.8	500510.0	104420.6	209207.7
Western Capital[4]	4985.7	5959.5	3379.7	9144.1	10314.6	10373.4	1798.7	3448.6
% Western Capital to Total	2.6	5.6	4.8	5.8	3.1	2.1	1.7	1.7
Labor	575.6	1030.5	350.6	395.5	2041.9	850.9	383.4	365.6
Output	276676.7	233012.3	92393.5	264993.9	891018.3	171327.7	70093.2	167204.9

[1]in millions of 1961 Zloty
[2]calculated as the mean of the annual ratio
[3]in millions of hours
[4]adjusted for capacity utilization in 1979-1983

Note: The industry classification is as follows:

IND1 = Food and Tobacco
IND2 = Other Light Industry
IND3 = Wood and Paper
IND4 = Chemicals
IND5 = Engineering
IND6 = Fuels and Energy
IND7 = Minerals
IND8 = Metallurgy

Table 2: Wald Test Statistics for the Five Hypotheses

Industrial Branch	$H1_0$ $[x^2(1)]$	$H2_0$ $[x^2(2)]$	$H3_0$ $[x^2(6)]$	$H4_0$ $[x^2(7)]$	$H5_0$ $[x^2(4)]$
Food and Tobacco	0.01	22.13[a]	36.01[a]	149.03[a]	117.86[a]
Other Light Industry	0.08	9.55[a]	16.50[b]	158.23[a]	36.20[a]
Wood and Paper	0.33	7.27[b]	44.54[a]	44.64[a]	709.61[a]
Chemicals	5.86[b]	3.21	28.35[a]	29.19[a]	21.55[a]
Engineering	1.40	11.01[a]	48.82[a]	554.06[a]	578.04[a]
Fuels and Energy	0.11	3.82	139.57[a]	140.64[a]	118.88[a]
Minerals	0.50	8.08[b]	41.81[a]	44.90[a]	24.75[a]
Metallurgy	12.57[a]	9.38[a]	44.80[a]	76.40[a]	161.80[a]

[a]H_0 is rejected at the 0.01 confidence level.

[b]H_0 is rejected at the 0.05 confidence level.

Table 3: Selected Specification from Hypothesis Tests

Industrial Branch	Specification
Food and Tobacco	Weak Separability: $f[g(\ell nK_{\ell}, \ell nK_{w}), \ell nL]$
Other Light Industry	Weak Separability: $f[g(\ell nK_{\ell}, \ell nK_{w}, \ell nL]$
Wood and Paper	Weak Separability: $f[g(\ell nK_{\ell}, \ell nK_{w}), \ell nL]$
Chemicals	Strong Separability: $f[g(\ell nK_{\ell}, \ell nK_{w}) + h(\ell nL)]$
Engineering	Weak Separability: $f[g(\ell nK_{\ell}, \ell nK_{w}), \ell nL]$
Fuels and Energy	Strong Separability: $f[g(\ell nK_{\ell}, \ell nK_{w}) + h(\ell nL)]$
Minerals	Weak Separability: $f[\ell nK_{\ell}, \ell nK_{w}, \ell nL]$
Metallurgy	Translog: $f[\ell nK_{\ell}, \ell nK_{w}, \ell nL]$

Table 4: Parameter Estimates for Industry-Specific Production Functions
(Standard Errors In Parentheses)

INPUTS	IND1	IND2	IND3	IND4	IND5	IND6	IND7	IND8
CONSTANT	-0.4446[a]	-1.4744[a]	-0.2471	0.1473	-1.5015[a]	-1.6106[a]	-0.8632[a]	0.0140
	(0.054)	(0.180)	(0.0220)	(0.191)	(0.101)	(0.191)	(0.051)	(0.190)
TIME	0.0430[a]	0.1981[a]	0.0203	-0.0515[c]	0.1851[a]	0.2298[a]	0.1083[a]	-0.0064
	(0.013)	(0.025)	(0.030)	(0.029)	(0.014)	(0.026)	(0.009)	(0.027)
TIME SQUARED	0.0003	-0.0049[a]	0.0002	0.0038[a]	-0.0035[a]	-0.0068[a]	-0.0022[a]	0.0002
	(0.0008)	(0.001)	(0.0008)	(0.001)	(0.0004)	(0.001)	(0.0004)	(0.001)
D7276	-0.0050	0.0021	0.0373[a]	0.0411[a]	0.0303[b]	0.0160	0.0235[b]	-0.0047
	(0.017)	(0.018)	(0.012)	(0.014)	(0.013)	(0.012)	(0.008)	(0.018)
LDOM	-0.2400[a]	0.3024[a]	0.5676[a]	1.1151[a]	0.2509[b]	0.1398	-0.0554	0.5420[b]
	(0.064)	(0.122)	(0.182)	(0.152)	(0.084)	(0.169)	(0.066)	(0.174)
LFORK	0.1854[a]	-0.4653[a]	-0.1278	-0.3305[a]	-0.2998[b]	-1.0875[a]	0.0728	0.1948[a]
	(0.049)	(0.115)	(0.116)	(0.092)	(0.104)	(0.167)	(0.098)	(0.059)
LEMPLY	0.5018[b]	0.2986[c]	-0.0230	0.3851[b]	-0.0537	0.2616[c]	0.0906	-0.4399
	(0.187)	(0.204)	(0.216)	(0.177)	(0.286)	(0.143)	(0.177)	(0.373)
$(LDOM)^2$	0.9731[a]	-0.3937[c]	0.3409[b]	0.2954[b]	-0.2492	-0.1620	-0.3875[b]	0.5345
	(0.345)	(0.259)	(0.186)	(0.134)	(0.158)	(0.222)	(0.140)	(0.486)
$(LFORK)^2$	-0.0509	-0.2620[a]	0.0271	0.0705[a]	0.2730	-2.3871[a]	-0.0159	0.1486
	(0.045)	(0.053)	(0.021)	(0.025)	(0.160)	(0.330)	(0.018)	(0.099)
$(LEMPLY)^2$	3.0635[a]	-0.190	-0.1367	-1.1452[b]	-0.2304	2.0942[c]	-1.0226[b]	0.4447
	(0.600)	(0.246)	(0.274)	(0.580)	(0.727)	(1.001)	(0.446)	(1.238)
LDOM·LFORK	-0.4523[c]	0.9271[b]	-0.4660[a]	-0.7139[a]	0.3698[c]	3.2156[a]	0.9974[a]	-0.7290
	(0.314)	(0.346)	(0.143)	(0.169)	(0.181)	(0.461)	(0.146)	(0.465)
LDOM·LEMPLY	-3.567[a]	-0.9315[b]	0.5606[b]		2.5468[b]		1.7022	-2.4500
	(1.060)	(0.384)	(0.260)		(0.977)		(0.969)	(1.486)
LFORK·LEMPLY	2.7589[a]	1.4333[a]	-0.1262		-3.0439[b]		-2.2376[b]	1.4269[c]
	(0.704)	(0.238)	(0.116)		(1.298)		(0.866)	(0.669)
D.W. Statistic	2.0221	2.3475	2.0927	1.9667	2.0220	1.7997	2.9624	2.9162
ADJ. R-SQUARED	0.9974	0.9991	0.9990	0.9995	0.9997	0.9988	0.9997	0.9988
NO. OF OBSERVATIONS	23	23	23	23	23	23	23	23

[a]Significant at 1% level.
[b]Significant at 5% level.
[c]Significant at 10% level.

LDOM = *ln*(Domestic Capital)
LFORK = *ln*(Western Capital)
LEMPLY = *ln*(Labor)

Note: The industry classification is as follows:

IND 1 = Food and Tobacco
IND 2 = Light Industry
IND 3 = Wood and Paper
IND 4 = Chemicals
IND 5 = Engineering
IND 6 = Fuels and Energy
IND 7 = Minerals
IND 8 = Metallurgy

Table 5: Elasticities of Output with Respect to Inputs
(Standard Errors in Parentheses)

INPUTS	IND1	IND2	IND3	IND4	IND5	IND6	IND7	IND8
1961-1971								
DOMESTIC CAPITAL	-0.134	0.106	0.630^{b}	1.427^{a}	-0.314^{b}	-0.576^{b}	-0.467^{a}	0.820^{a}
	(0.107)	(0.261)	(0.291)	(0.230)	(0.146)	(0.244)	(0.034)	(0.243)
WESTERN CAPITAL	0.048	-0.447^{a}	-0.020	-0.104^{a}	-0.111^{b}	-0.981^{a}	-0.058	0.156^{a}
	(0.032)	(0.860)	(0.781)	(0.043)	(0.047)	(0.130)	(0.073)	(0.042)
LABOR	-0.770^{a}	-0.525^{a}	-0.058	0.820^{a}	0.745^{c}	-0.300	0.929^{a}	-0.464^{c}
	(0.278)	(0.204)	(0.287)	(0.113)	(0.411)	(0.186)	(0.166)	(0.240)
1972-1976								
DOMESTIC CAPITAL	-0.213^{c}	0.256^{a}	0.767^{a}	1.084^{a}	0.315^{a}	0.345^{b}	0.018	0.213^{c}
	(0.113)	(0.097)	(0.093)	(0.135)	(0.079)	(0.137)	(0.074)	(0.118)
WESTERN CAPITAL	0.203^{a}	-0.181	-0.279^{c}	-0.481^{a}	-0.251^{b}	-0.818^{a}	0.312^{a}	0.240^{a}
	(0.070)	(0.138)	(0.148)	(0.123)	(0.127)	(0.162)	(0.092)	(0.052)
LABOR	1.515^{a}	0.422^{b}	0.120	0.156	0.323	0.245^{c}	-0.080	0.100
	(0.280)	(0.186)	(0.195)	(0.283)	(0.250)	(0.137)	(0.212)	(0.269)
1977-1983								
DOMESTIC CAPITAL	-0.020	-0.012	0.901^{a}	0.963^{a}	0.069	0.319	-0.310^{c}	0.355^{b}
	(0.146)	(0.287)	(0.105)	(0.111)	(0.119)	(0.196)	(0.171)	(0.145)
WESTERN CAPITAL	0.082	0.127	-0.421^{b}	-0.537^{a}	0.026	0.282	0.875^{a}	0.032
	(0.110)	(0.243)	(0.178)	(0.137)	(0.144)	(0.193)	(0.126)	(0.113)
LABOR	2.438^{a}	0.078	0.304^{c}	0.065	0.812^{a}	0.463^{b}	0.350	0.103
	(0.425)	(0.171)	(0.158)	(0.327)	(0.142)	(0.225)	(0.219)	(0.281)

^{a}Significant at 1% level.
^{b}Significant at 5% level.
^{c}Significant at 10% level.

Note: The industry classification is as follows:

IND 1 = Food and Tobacco
IND 2 = Other Light Industry
IND 3 = Wood and Paper
IND 4 = Chemicals
IND 5 = Engineering
IND 6 = Fuels and Energy
IND 7 = Minerals
IND 8 = Metallurgy

Table 6: Difference Between the Marginal Products of Domestic and Western Capital in each Industrial Branch, by Policy Period

Industrial Branch	1962-1971	1972-1976	1977-1983
Food and Tobacco	-0.213	-0.350[a]	-0.053
Other Light Industry	0.493[b]	0.397[a]	-0.149
Wood and Paper	0.657[a]	1.072[a]	1.373[a]
Chemicals	1.442[a]	1.748[a]	1.835[a]
Engineering	-0.203	0.566[a]	0.043
Fuels and Energy	0.405	1.163[a]	0.038
Minerals	-0.410[a]	-0.294[c]	-1.185[a]
Metallurgy	0.665[a]	-0.027	0.323

[a]Significant at 1% level.
[b]Significant at 5% level.
[c]Significant at 10% level.

Table 7: Differences in the Marginal Products of Capital Across Light Industries for Three Time Periods
(Column Industry minus Row Industry)

	Domestic Capital			Foreign Capital		
	IND2	IND3	IND4	IND2	IND3	IND4
1961-1971						
IND1	0.115	0.915[a]	1.684[a]	-0.509[a]	-0.144	-0.222[a]
IND2		0.800[b]	1.569[a]		0.365[a]	0.288[a]
IND3			0.770[b]			-0.078
1972-1976						
IND1	0.424[a]	0.868[a]	1.212[a]	-0.381[b]	-0.411[a]	-0.618[a]
IND2		0.444[a]	0.788[a]		-0.030	-0.236
IND3			0.344[b]			-0.207
1977-1983						
IND1	-1.005[a]	-0.631[c]	-0.440	0.581	0.627[c]	0.483
IND2		0.375	0.565[b]		0.046	-0.098
IND3			0.191			-0.144

[a] Significant at the 1% confidence level.
[b] Significant at the 5% confidence level.
[c] Significant at the 10% confidence level.

Note the Industrial Classification is as follows:

IND1 = Food and Tobacco
IND2 = Other Light Industry
IND3 = Wood and Paper
IND4 = Chemicals

Table 8: Differences in the Marginal Products of Capital Across Heavy Industries for Three Time Periods
(Column Industry minus Row Industry)

	Domestic Capital IND6	Domestic Capital IND7	Domestic Capital IND8	Foreign Capital IND6	Foreign Capital IND7	Foreign Capital IND8
1961-1971						
IND5	-0.262	-0.153	1.135[a]	-0.870[a]	0.053	0.266[a]
IND6		0.109	1.397[a]		0.923[a]	1.137[a]
IND7			1.288[a]			0.213[b]
1972-1976						
IND5	0.030	-0.297[a]	-0.102	-0.567[a]	0.563[a]	0.491[a]
IND6		-0.327[b]	-0.132		1.130[a]	1.058[a]
IND7			0.195			-0.072
1977-1983						
IND5	0.250	-0.380[c]	0.286	0.256	0.848[a]	0.006
IND6		-0.630[b]	0.036		0.593[a]	-0.249
IND7			0.666[a]			-0.842[a]

[a] Significant at the 1% confidence level.
[b] Significant at the 5% confidence level.
[c] Significant at the 10% confidence level.

Note the Industrial Classification is as follows:

IND5 = Engineering
IND6 = Fuels and Energy
IND7 = Minerals
IND8 = Metallurgy

Table A1: Correction Factors for Capital Utilization in Polish Industry 1979-1983

Industry	1979	1980	1981	1982	1983
IND1	1.000	0.871	0.805	0.694	0.878
IND2	0.863	0.891	0.626	0.596	0.548
IND3	0.863	0.899	0.829	0.667	0.759
IND4	0.884	0.676	0.532	0.396	0.402
IND5	0.948	0.981	0.882	0.940	1.000
IND6	0.806	0.718	0.643	0.614	0.601
IND7	0.883	0.837	0.659	0.624	0.652
IND8	0.903	0.916	0.594	0.559	0.598

Note: The industry classification is as follows:
IND 1 = Food and Tobacco
IND 2 = Other Light Industry
IND 3 = Wood and Paper
IND 4 = Chemicals
IND 5 = Engineering
IND 6 = Fuels and Energy
IND 7 = Minerals
IND 8 = Metallurgy