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Productivity dispersion and misallocation of resources: evidence from Polish industries

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Abstract

Differences in GDP per capita across countries are large and to a large extent accounted by differences in total factor productivity. We analyze role the misallocation of resources plays in helping us understand productivity differences. In theory, the extent of misallocation is worse when there is a greater productivity dispersion between firms in the same industry. We find significant differences in productivity dispersions within Polish industries but also compared to the same two-digit German industries. It provides evidence that misallocation of resources is important source of low level of total factor productivity.

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1. Introduction

Large differences in output per worker between rich and poor countries have been attributed mostly to differences in total factor productivity (TFP). At cross-country level, Klenow and Rodríguez-Clare (1997) and Prescott (1998) argue that it is TFP rather than capital that determines the levels and changes in international income differences even if the concept of capital is expanded to include intangible capital such as human capital and organization capital.

However the identification of the sources of the TFP level, was very difficult research task since the beginning of economic growth studies. The basis of the existing empirical studies is the neoclassical growth model built on an aggregate production function with exogenous technical change. This aggregate construct is a powerful tool for measuring the size of TFP but perhaps not for identifying its sources. The technical change can be, as Solow (1957) himself emphasized, any kinds of change in the production function at aggregate level. When an economy is goes through structural transformation, compositional changes among and within sectors, across which productivity levels differ on the extensive margins, would contribute not only to output growth but also to productivity growth without any true technical change.. As Kehoe and Prescott (2002) conclude, in the absence of careful micro studies at firm and industry levels, we can only conjecture as to what are the causes of different Total Factor Productivity levels between countries, calling for much more micro evidence. Research on this question has largely focused on differences in technology within representative firms.

One of the most important developments in growth studies in recent years was enhanced appreciation of problem of efficiency of resource allocation to explain differences in Total Factor Productivity between countries. How misallocation of resources can help us understand Total Factor Productivity level and income differences across countries?

According to misallocation hypothesis, poor countries are poor not only because they have different levels of factors accumulation, but also how these factors are allocated across heterogeneous production units. That is, it is not only the level of factor accumulation that matters, but also how these factors are allocated across heterogeneous production units. Instead of focusing on the efficiency of a representative firm, it suggests that misallocation of resources across firms can have important effects on aggregate TFP. Hsieh and Klenow (2009) present empirical evidence that misallocation across plants within 4-digit industries may reduce TFP in manufacturing by a factor of two to three in China and India. It is growing interest in the view that underdevelopment may not be just a matter of lack of resources, such as capital, skilled labor, entrepreneurship, or ideas, but also a consequence of the misallocation or misuse of available resources.

The literature thus developed a consensus saying that productivity is determined by two factors - technology, representing the knowledge of how to use the available resources in the production process, and efficiency of their use. There are, therefore, two main channels of productivity growth. The first is technological change, the second - the change in the allocation of resources, or better use of production factors in the absence of changes in available technology. There is no doubt that the relationship between the determinants of productivity is multiplicative. But there is no consensus as to which factor, efficiency or technology, is more important. Further studies, therefore will follow the question what is the role of technology and efficient allocation of resources within the economy in explaining differences in productivity between countries, as well as to consider the problem of the determinants of the efficiency of allocation.

2. Misallocation of resources

Misallocation of resources across firms reduces economic efficiency and welfare. Given an economy's stock of physical capital, labor, human capital, and knowledge, the way in which those aggregate quantities of inputs are allocated across firms and industries — and even potentially within firms — determines the economy's overall level of production (Ch.Jones 2011). Misallocation at the micro level typically reduces total factor productivity at the macro level. The best allocation will maximize welfare and output itself in the long run. Other allocations result in lower levels of output and therefore show up in the aggregate as a lower level of Total Factor Productivity.

In theory misallocation maintains when marginal products of firms are not equalized because some firms' are constrained in their input choices (P.Klenow, ChT.Hsieh 2009) . Assuming that marginal products, contrary to what efficiency would require, are not equalized across firms, we are going to see that some firms have very high marginal products, but many other firms do not. Intuitively, the extent of misallocation is worse when there is greater dispersion of marginal products. Therefore allocation of resources across firms depends not only on firm TFP levels, but also on the output and capital/labor distortions they face. To the extent resource allocation is driven by distortions rather than firm TFP, this results in differences in the marginal revenue products of labor and capital across firms.

Misallocation is based on theory that high plant TFPR is a sign that the plant confronts barriers that raise the plant's marginal products of capital and labor, rendering the plant smaller than optimal. Those establishments that are efficient and should operate at a higher scale are unable to do so. For example, imagine an economy with two firms that have identical technologies but in which the firm with political connections benefits from subsidized credit (say from a state-owned bank) and the other firm (without political connections) can only borrow at high interest rates from informal financial markets (P.Klenow, ChT.Hsieh 2009). Assuming that both firms equate the marginal product of capital with the interest rate, the marginal product of capital of the firm with access to subsidized credit will be lower than the marginal product of the firm that only has access to informal financial markets. Aggregate output would be higher if capital was reallocated from the firm with a low marginal product to the firm with a high marginal product. The misallocation of capital results in low aggregate output per worker and TFP.

Efficient resource allocation is not directly observable variable. Economic theory provides, however, indications that it is higher, the differences in productivity between the firm's most and least productive in the industry are lower. This means that in an economy, with the same technology at the same cost of capital and labor, firms are not characterized by large differences in marginal product of capital and labor.

However, recent empirical research using firm-level data from several countries has substantiated the existence of large productivity differences among establishments in the same narrowly defined industries. These research contradict many standard assumptions of classical growth theory and give foundations for misallocation hypothesis. In that case from theoretical point of view, one must conclude that the extent of misallocation is worse when there is a greater productivity dispersion between firms in the same industry.

Modelling misallocation is to show how distortions that drive wedges between the marginal products of capital and labor across firms will lower aggregate TFP. Parente and Prescott (2000) examine some of the many factors that affect TFP at the firm level, such as disembodied TFP, work rules, government ownership, and corruption. Caselli and Nicola Gennaioli (2003) model misallocation of capital due to capital market imperfections. Nezih Guner, Gustavo Ventura, and Yi Xu (2008) analyze the consequences for TFP of size-dependent policies. Restuccia and Rogerson (2008) explicitly analyze a model of misallocation among heterogeneous plants to quantify the effect on aggregate TFP. Banerjee and Duflo (2005) argue that the marginal product of capital differs widely among firms in India, potentially reducing overall output because of differences in rental price of capital in formal and informal credit markets. Jones (2009) demonstrates that complementarities across industries can allow modest industry-level distortions to have larger effects on aggregate TFP.

We can distinguish between two types of causes affecting the degree of efficiency of resource allocation. These factors are: internal (work organization, management methods) and external (regulatory environment, tax system, labor market, industrial policy, credit market frictions, differences in non-market access to production factors, or preferential policies, where taxes or the allocation of production licenses are based on firm-specific idiosyncrasies like family ties or political conviction. etc.). While these factors emphasize very different mechanisms that causes misallocation (and have of course very different policy implications), their consequences for identifying constrained firms in the data are similar. As the marginal product of constrained producers will exceed to one of their unconstrained competitors, high measured productivity will be a sign of the firm facing some binding barrier to expand.

In Hsieh and Klenow (2009) authors assume that there is a single final good Y produced by a representative firm in a monopolistic competitive final output market. This firm combines the output Y of S manufacturing industries using a Cobb-Douglas production technology.

Research framework in which misallocation is studied are based on standard general equilibrium models of monopolistic competition with heterogonous firms, in the spirit of work by Melitz (2003) and Hsieh and Klenow (2009).

Assuming firms combines output of S industries using a Cobb-Douglas production technology:

(1)
$$Y = \prod_{s=1}^{S} Y_s^{\theta} where \sum_{s=1}^{S} \theta_s = 1$$

Cost minimization implies:

(2)
$$P_s Y_s = \theta_s P Y$$

Here P_s refers to the price of industry output Y_s and $P \equiv \prod_{s=1}^{S} \left(P_S / \theta_S\right)^{\theta_s}$ represents the price of the final good. Industry output Y_S is itself a CES aggregate of M_S differentiated products:

(3)
$$Y_s = \left(\sum_{i=1}^{M} Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma-1}{\sigma}}$$

The production function for each differentiated product is given by a Cobb-Douglas function of firm TFP, capital and labor:

(4)
$$Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}$$

Production function in (4) describes the steady-state competitive equilibrium of the model.

In a steady state equilibrium the rental prices for labor and capital services will be constant, and we denote them by *w* and *r* respectively.

In the steady state of this model there is a non-degenerate distribution of plant-level productivity and the distribution of resources across these plants is a key element of the equilibrium resource allocation. The aggregate capital stock will be constant and there will also be a stationary distribution of plants across types.

To differing firms in their efficiency levels, firms potentially face different labor and capital distortions. Because there are two factors of production, we separately identify distortions that affect both capital and labor from distortions that change the marginal product of one of the factors relative to the other factor of production. Let denote distortions that increase the marginal products of capital and labor by the same proportion as an output distortion *τY*.

Profits are given by:

(5) $$\pi_{si} = (1-\tau_{Ysi})P_{si}Y_{si} - wL_{si} - (1+\tau_{Ksi})RK_{si}$$

The capital labor ratio, labor allocation, and output are given by:

(6) $$\frac{K_{si}}{L_{si}} = \frac{\alpha_s}{1-\alpha_s} * \frac{w}{R} * \frac{1}{1+\tau_{Ksi}}$$

(7) $$L_{si} \alpha \frac{A_{si}^{\sigma-1}(1-\tau_{Ysi})^{\sigma}}{(1+\tau_{Ksi})^{\alpha_s(\sigma-1)}}$$

(8) $$Y_{si} \alpha \frac{A_{si}^{\sigma}(1-\tau_{Ysi})^{\sigma}}{(1+\tau_{Ksi})^{\alpha_s\sigma}}$$

The marginal revenue product of labor is proportional to revenue per worker:

(9) $$MRPL_{si} \stackrel{\Delta}{=} (1-\alpha_S)\frac{\sigma-1}{\sigma}\frac{P_{si}Y_{si}}{L_{si}} = w\frac{1}{1-\tau_{Ysi}}$$

The marginal revenue product of capital is proportional to revenue-capital ratio:

(10) $$MRPK_{si} \stackrel{\Delta}{=} \alpha_S \frac{\sigma-1}{\sigma}\frac{P_{si}Y_{si}}{K_{si}} = R\frac{1+\tau_{Ksi}}{1-\tau_{Ysi}}$$

In Hsieh and Klenow (2009), TFP does not vary across plants within an industry unless plants face capital and/or labor distortions. In the absence of distortions, more capital and labor should be allocated to plants with higher TFP to the point where their higher output results in a lower price and the exact same TFP as at smaller plants. The distribution of distortions therefore provides one microfoundations for the distribution of "misallocation". Furthermore, model identify industry-specific distortions as a "wedge" but then uses the empirical analysis to test for specific properties of distribution, which are implied by the theory.

The strategy is to draw quantitative implications from misallocation policies to first restrict model parameters, in the absence of any distortion, in order to reproduce aggregate and cross-sectional observations. It allows to estimate the magnitude of resource misallocation, i.e estimating TFP losses from TFP dispersion compare with actual, observed TFP differences on macro level.

Having that, model allow us to study a class of distortions that lead to no changes in aggregate prices and no changes in aggregate factor accumulation. Specifically, we could analyze the consequences of an aggregate tax on output, regulatory restrictions "wedge" etc. One can extend the model with distortions parameters such as tax rate, transportation cost, quality of labor skills costs, regulatory restrictions in industries and other policy distortions that are found in literature to be important factor of productivity. In general we can here analyze empirically impact of distortions to plant-level decision making. Finally, one could also perform welfare computation and find non-trivial welfare effects from policies releasing firms in their input choices.

3. Productivity dispersion

The standard economic analysis postulates that the marginal products of a production factors such as labor and capital are all equal across firms, industries, and sectors in equilibrium. Otherwise, there remains a profit opportunity, and this contradicts the notion of equilibrium. However, we have some evidences suggesting that there is always productivity dispersion in the economy.

For example, Syverson (2004b) documents productivity dispersion in the ready-mix concrete industry using data from the U.S. Census Bureau. Syverson (2004b) finds that within four- digit SIC concrete industry in the U.S. manufacturing sector, the average difference in logged total factor productivity (TFP) between an industry's 90th and 10th percentile plants is 0.651. This corresponds to a TFP ratio of e0.651 = 1.92. To emphasize just what this number implies, it says that the plant at the 90th percentile of the productivity distribution makes almost twice as much output with the same measured inputs as the 10th percentile plant. Chang-Tai Hsieh and Peter J. Klenow (2009), for example, find even larger productivity differences in China and India, with average 90–10 TFP ratios over 5:1.

Productivity differences are puzzling, since selection by exit should drive out inefficient plants from the market. That large and common differences in productivity levels across industries implicate that there are distortions to efficient allocation mechanism.

By decomposing aggregate TFP into the average of firm-level TFPs, and the efficiency of input allocation across firms, one can conclude that greater productivity dispersion leads to lower aggregate TFP, and accordingly is sign of greater misallocation of resources. If marginal products were equalized across plants in a given industry, then industry TFP would be higher than actual and also country aggregate TFP.

A lot of studies shows huge differences in industry productivity levels both between and within countries. Comparing labor productivity, on average Western European countries are almost twice as productive (73,04% of German productivity) as their Eastern Europe counterparts (38,36%), with two remarkable exceptions - Portugal and Greece. Considering TFP, average productivity of Eastern European countries is only 53,82% of German productivity and average Western countries productivity is 81,06%.

Polish industry labor productivity level is on average 39% of German labor productivity level. Considering TFP, average productivity of Polish industries are 55% German industries' productivity[1].

To sum up, there are significant differences in productivity levels between the same industries among countries even with similar total factor productivity levels.

This raises a question about causes of that variations in productivity. In the light of that results, theory provides hypothesis that there must be some deeper determinants of industry-level productivity than just the level of technology. We assume in our study that according to recent developments in growth theory, there must be role for misallocation of resources to play in helping us understand industry productivity level differences between countries. We plan to present estimation of productivity

[1] Author's own calculations, see Lewandowska – Kalina (2012)

dispersion in Polish industries, that could shed light on impact of misallocation of resources on productivity differences.

3.1 Production function

In theory, productivity is simple question of how much output is obtained from a given set of inputs. It is typically expressed as an output–input ratio. The literature distinguishes many different measures and concepts of productivity, each of which has its particular meaning and use. Broadly, productivity measures can be classified into single-factor productivity measures (relating a measure of output to a single measure of input) and multi-factor productivity measures (relating a measure of output to a bundle of inputs). Another distinction is between productivity measures that relate gross output to one or several inputs and those that use a value-added concept to capture movements of output.

Single-factor productivity measures reflect units of output produced per unit of a particular input. Single- factor productivity levels are affected by the intensity of use of the excluded inputs. Two producers may have quite different labor productivity levels even though they have the same production technology if one happens to use capital much more intensively, say because they face different factor prices (Ch.Syverson 2004a). Because of this, researchers often use a productivity concept that is invariant to the intensity of use of observable factor inputs. This measure is called total factor productivity (TFP). Conceptually, TFP differences reflect shifts in the isoquants of a production function: variation in output produced from a fixed set of inputs. Higher-TFP producers will produce greater amounts of output with the same set of observable inputs than lower-TFP businesses and, hence, have isoquants that are shifted up and to the right. Factor price variation that drives factor intensity differences does not affect TFP because it induces shifts along isoquants rather than shifts in isoquants.

Great amount of measurement issues arise when constructing productivity measures from actual production data. While research with micro production data greatly expands the set of answerable questions and moves the level of analysis closer to where economic decisions are made than aggregate data does, it also raises measurement and data quality issues more frequently**.** The first set of issues regards the output measure. Even detailed producer micro data do not typically contain measures of output quantities. Revenues are typically observed instead. Given this limitation of the data, the standard approach has been to use revenues (deflated to a common year's real values using price deflator series) to measure output. While this may be acceptable, and even desirable, if product quality differences are fully reflected in prices, it can be problematic whenever price variation instead embodies differences in market power across producers. In that case, producers' measured productivity levels may reflect less about how efficient they are and more about the state of their local output market. Next problem is whether to use number of employees, employee-hours, or some quality-adjusted labor measure (the wage bill is often used in this last role, based on the notion that wages capture marginal products of heterogeneous labor units). Capital is typically measured using the establishment or firm's book value of its capital stock (Syverson, 2010).

3.2 Data

There is substantial problem with estimation of levels of productivity of individual firms is gathering relevant database of inputs and outputs (costs of capital and labor, financial results etc.) of Eastern Europe countries unlike their Western counterparts. Lack of high quality data is the greatest obstacle for studies of misallocation problem in Eastern Europe.

For our estimation we used AMADEUS Database. AMADEUS is a comprehensive, pan-European database containing financial information on 11 million public and private companies in 41 European countries. It combines data from over 30 specialist regional information providers (IPs). The accounts are in a standardized format (for up to 10 years), consolidated and unconsolidated, financial ratios, activities and ownership for approximately 11 million companies throughout Europe, including Eastern Europe. A standard company report includes: 24 balance sheet items, 25 profit and loss account items and 26 ratios, descriptive information including trade description and activity codes (NACE 2, NAICS or US SIC can be used across the database). National accountants have identified a need for two standard aggregations of NACE categories to be used for reporting SNA data from a wide range of countries. The first, known as "high-level aggregation", aggregates the NACE sections into 21 categories; the second, called "intermediate aggregation", aggregates divisions and is composed of 88 categories. We estimate productivity dispersion at second level of aggregation, omitting categories and divisions for which there were no sufficient number of observations. The variables that we use are the plant's industry (two-digit NACE), labor compensation, value-added, and book value of the fixed capital stock. Measure of labor compensation have to be the sum of wages, bonuses, and benefits. Measure of capital take the average of the net book value of fixed capital at the beginning and end of the fiscal year as our measure of the plant's capital. After filtering our data contains information about 30,000 Polish companies and 20000 German companies.

3.3 Estimation

Differences in output across firms can be decomposed into differences in measured inputs, differences in residuals and differences in production technologies. The measure of productivity is the residual from the log-linear production function OLS regression. Using data from a single industry and assuming a common technology for all firms, the we specify the Cobb-Douglas production function:

$$\log y = \alpha_0 + \alpha_1 \log l + \alpha_2 \log k + \varepsilon$$

where y is value added, l is labor compensation, k is the monetary value of physical capital, and ε is the residual. α_1 and α_2 are the input elasticities of labor and capital. Between two firms with the same inputs l and k, the firm with the higher output y is said to have a higher measured total factor productivity (TFP), which is exp($\alpha_0 + \varepsilon$) above.

We focus on ε the productivity residual. α_0, the intercept captures plant technology level. We assume that within the industry all firms share the same technology. We call ε productivity.

3.4 Results

We measure magnitude of productivity dispersion as deviations of log(ε) from industry means. Then we calculate the difference between the 75th and 25th percentiles, and 90th and 10th percentiles.

Table 1.

2007

NACE code		Poland		
		S.D.	**75-25**	**90-10**
SECTION A — AGRICULTURE, FORESTRYAND FISHING				
01	Crop and animal production, hunting and related service activities	1.32	1.46	2.57
02	Forestry and logging	nd	nd	nd
03	Fishing	1.31	1.51	2.63
SECTION B — MINING AND QUARRYING				
05	Mining of coal and lignite	nd	nd	nd
06	Extraction of crude petroleum and natural gas	nd	nd	nd
07	Mining of metal ores	nd	nd	nd
08	Other mining and quarrying	0.96	1.35	2.60
09	Mining support service activities	nd	nd	nd
SECTION C — MANUFACTURING				
10	Manufacture of food products	1.53	1.31	2.76
11	Manufacture of beverages	1.49	1.26	2.52
12	Manufacture of tobacco products	nd	nd	nd
13	Manufacture of textiles	1.54	1.35	2.79
14	Manufacture of wearing apparel	1.39	1.28	2.46
15	Manufacture of leather and related products	1.30	1.48	2.61
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	1.56	1.32	2.59
17	Manufacture of paper and paper products	1.29	1.33	2.71
18	Printing and reproduction of recorded media	nd	nd	nd
19	Manufacture of coke and refined petroleum products	nd	nd	nd
20	Manufacture of chemicals and chemical products	1.55	1.27	2.84
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	1.52	1.41	2.56
22	Manufacture of rubber and plastic products	1.64	1.98	3.01
23	Manufacture of other non-metallic mineral products	nd	nd	nd
24	Manufacture of basic metals	1.49	1.34	2.70
25	Manufacture of fabricated metal products, except machinery and equipment	1.61	1.42	2.81
26	Manufacture of computer, electronic and optical products	nd	nd	nd
27	Manufacture of electrical equipment	nd	nd	nd
28	Manufacture of machineryand equipment n.e.c.	1.44	1.29	2.68
29	Manufacture of motor vehicles, trailers and semi-trailers	1.57	1.30	2.50

30	Manufacture of other transport equipment	nd	nd	nd
31	Manufacture of furniture	1.65	1.43	2.97
32	Other manufacturing	nd	nd	nd
33	Repair and installation of machinery and equipment	nd	nd	nd
SECTION D — ELECTRICIT Y, GAS, STEAM AND AIR CONDITIONING SUPPLY				
35	Electricity, gas, steam and air conditioning supply	2.00	1.53	3.48
SECTION E — WATER SUPPLY;SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES				
36	Water collection, treatment and supply	nd	nd	nd
37	Sewerage	nd	nd	nd
38	Waste collection, treatment and disposal activities; materials recovery	1.55	1.39	2.56
39	Remediation activities and other waste management services	nd	nd	nd
SECTION F — CONSTRUCTION				
40	Construction of buildings	nd	nd	nd
41	Civil engineering	1.89	1.32	2.66
42	Specialised construction activities	nd	nd	nd
SECTION G — WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES				
45	Wholesale and retail trade and repair of motor vehicles and motorcycles	1.97	1.47	2.73
46	Wholesale trade, except of motor vehicles and motorcycles	2.28	1.3	2.61
47	Retail trade, except of motor vehicles and motorcycles	2.57	1.35	2.42
SECTION H — TRANSPORTATION AND STORAGE				
49	Land transport and transport via pipelines	1.73	1.44	3.05
50	Water transport	nd	nd	nd
51	Air transport	nd	nd	nd
52	Warehousing and support activities for transportation	1.59	1.32	2.79
53	Postal and courier activities	nd	nd	nd
SECTION I — ACCOMMODATION AND FOOD SERVICE ACTIVITIES				
55	Accommodation	1.26	1.61	2.53
56	Food and beverage service activities	nd	nd	nd
SECTION J — INFORMATION AND COMMUNICATION				
58	Publishing activities	2.69	1.53	2.21

59	Motion picture, video and television programme production, sound recording and music publishing activities	nd	nd	nd
60	Programming and broadcasting activities	nd	nd	nd
61	Telecommunications	2.73	1.13	2.28
62	Computer programming, consultancy and related activities	2.42	1.25	2.43
63	Information service activities	2.21	1.11	2.34
SECTION K — FINANCIAL AND INSURANCE ACTIVITIES				
64	Financial service activities, except insurance and pension funding	1.52	1.5	2.99
65	Insurance, reinsurance and pension funding, except compulsorysocial security	1.49	1.51	2.89
66	Activities auxiliary to financial services and insurance activities	1.51	1.46	2.71
SECTION L — REAL ESTATE ACTIVITIES				
68	Real estate activities	2.29	1.24	3.62
SECTION M — PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES				
69	Legal and accounting activities	1.46	1.18	2.72
70	Activities of head offices; management consultancy activities	1.41	1.16	2.68
71	Architectural and engineering activities; technical testing and analysis	1.34	1.21	2.58
72	Scientific research and development	nd	nd	nd
73	Advertising and market research	1.32	1.17	2.46
74	Other professional, scientific and technical activities	nd	nd	nd
75	Veterinary activities	nd	nd	nd
SECTION N — ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES				
77	Rental and leasing activities	2.20	1.37	2.63
78	Employment activities	nd	nd	nd
79	Travel agency, tour operator reservation service and related activities	2.12	1.26	2.53
80	Security and investigation activities	nd	nd	nd
81	Services to buildings and landscape activities	nd	nd	nd
82	Office administrative, office support and other business support activities	nd	nd	nd
SECTION P — EDUCATION				
85	Education	1.32	1.84	3.30

S.D. = standard deviation, 75 – 25 is the difference between the 75th and 25th percentiles, and 90 – 10 the 90th vs. 10th percentiles

Source: own estimations

Table 2.

2007 Manufacturing	Poland	Germany
S.D.	1.53	0.96
75-25	1.31	1.12
90-10	2.76	2.10

Source: own estimations

4. Conclusions

Our study shows that there are significant differences in productivity dispersions between Polish industries. The 90^{th}-10^{th} distribution ranges from 2,21 in publishing industry to 3,62 in real estate activities.

These results implies that in Polish industries, plants at the 90th percentile of the productivity distribution makes from two and half to three and half as much output with the same measured inputs as the 10th percentile plant.

One can conclude that it is not just level of technology but also inefficient allocation of resources that is the cause of low level of total factor productivity.

Our study also shows larger productivity dispersion in Polish (two-digit NACE) manufacturing industries than in Germany. According to theory it provides evidence that there is greater misallocation of resources in Polish industries than in their Germany counterparts. This result is consistent with observable lower level of total factor productivity between Polish and German manufacturing industry and on shallow layer it suggests that dispersion of productivity is important mechanism that drives differences in TFP levels.

Survey of literature shows that there is substantial gap in studies of misallocation in transition countries. Primary cause is likely the fact that this is new problem in economic literature, but secondary cause is lack of high quality data that is necessary to provide reliable international comparisons of misallocation in Eastern European countries. We assume that problem should be overcome in next years and that is why we presented in this paper assumptions of models and methods of measuring misallocation that are applied in literature for studying misallocation problem. In general, it should provide deeper insights to misallocation from theoretical point of view. To sum up, modelling misallocation in Eastern European countries seem to be fruitful directions of research, that could bring deeper insights in structural characteristics of former post-socialist countries and can have non-trivial policy making implications.

Bibliography:

Alfaro Laura, Andrew Charlton, Fabio Kanczuk. "*Plant-Size Distribution and Cross-Country Income Differences*." (2008) National Bureau of Economic Research Working Paper Series No. 14060 2008.

Bartelsman, E.J., J. Haltiwanger, and S. Scarpetta, "*Cross-Country Differences in Productivity: The Role of Allocation and Selection*," NBER Working Paper 15490, 2009.

Bartelsman, E. J., J. Haltiwanger, and S. Scarpetta. "*Distributed analysis of firm-level data from industrial and developing countries*". (2004) Mimeograph.

Caselli, Francesco *"Accounting for Income Differences Across Countries*," (2005) chapter 9 in *the Handbook of Economic Growth Vol. 1A*, P. Aghion and S. Durlauf, eds., North Holland.

Foster, Lucia, John C. Haltiwanger, and C.J. Krizan. "*Aggregate Productivity Growth: Lessons from Microeconomic Evidence.*" (2001) in *New Developments in Productivity Analysis*, Chicago: University of Chicago Press. 2001

Hall, Robert E. and Charles I. Jones "*Why Do Some Countries Produce So Much More Output Per Worker Than Others*?*"* (1999), Quarterly Journal of Economics 114: 83-116.

Gradzewicz M., Hagemejer J., *Marże monopolistyczne i przychody skali w gospodarce polskiej – Analiza mikroekonometryczna*, „Ekonomista*",* 1/(2007)

Jones Charles "*Misallocation, Economic Growth, and Input-Output Economics*" (2011) National Bureau of Economic Research Working Papers 16742

Klenow, Peter J. and Andrés Rodríguez-Clare *"The Neoclassical Revival in Growth Economics: Has It Gone Too Far?*" (1997), in B. Bernanke and J. Rotemberg, eds., NBER Macroeconomics Annual (MIT Press, Cambridge) 73-103.

Klenow, Peter J. and Chang-Tai Hsieh "Misallocation and Manufacturing TFP in China and India" , Quarterly Journal of Economics 124, November 2009, 1403

Lewandowska – Kalina M., *"International differences in industry level productivity in Eastern Europe"*, (2012) SSRN working paper 2152768

Lucas, Robert E. *"On the Size Distribution of Business Firms."* (1978) The Bell Journal of Economics 9(2):508- 523.

Melitz, Marc "*The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity*" (2003) Econometrica, Vol. 71, No. 6. (Nov., 2003), pp. 1695-1725

Midrigan, Virgiliu and Daniel Y. Xu, "*Finance and Misallocation: Evidence from Plant-Level Data*," (2010) NBER Working Paper 15647

Mankiw, N. Gregory, David Romer, and David Weil, *"A Contribution to the Empirics of Economic Growth,"* (1992) Quarterly Journal of Economics, *107* (2), 407–438.

Parente, Stephen L. and Edward C. Prescott, *"Monopoly Rights: A Barrier to Riches*," (1999) American Economic Review, *89* (5), 1216–1233.

Joe Peek, Eric S. Rosengren "Unnatural Selection: Perverse Incentives and the Misallocation of Credit in Japan", American Economic Review 2005, vol. 95(4), pages 1144-1166, September.

Syverson, Chad. "*Market Structure and Productivity: A Concrete Example*." (2004) Journal of Political Economy 112(6):1181-1222.

Syverson, Chad. *"Product Substitutability and Productivity Dispersion*." (2004) Review of Economics and Statistics 86(2):534-550

Syverson Chad *„What Determines Productivity?"*(2012) Journal of Economic Literature, Forthcoming van Ark, B., M. O'Mahony and M. P. Timmer (2008), '*The Productivity Gap between Europe and the U.S.: Trends and Causes'*, Journal of Economic Perspectives, 22(1), pp. 25–44.