The Impact of International Trade and Foreign Competition on Labour Earnings in Poland

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Introduction

International trade and foreign direct investment play a crucial role in economies of almost all countries in the world. Globalisation and growing interdependence of markets force governments to sign preferential trade and investment agreements. In May 2004 Poland, as one of the 10 new countries, became the member of the European Union (EU)—one of the most developed regional trade blocks in the world. However, for some Polish politicians, joining this block was a controversial step and they tried to point out at its disadvantages. The most important arguments against joining this block were connected to rising prices of commodities, mass bankruptcies of Polish enterprises and a decline in wages of workers. Especially, the last from the aforementioned statements required further empirical verification.

The impact of foreign trade and international competition on labour earnings has been analysed by many researchers and for different countries (e.g. Golub and Hsieh [2000] for the United States, Trefler and Gaston [1994] for the United States as well, Gorg and Strobl [2002] for Ghana, Gonzaga, Filho and Terra [2006] for Brazil or Onaran and Stockhammer [2006] for Central and Eastern European countries). However, in the past the conducted studies were mostly focused on developed countries[1] while the evidence for other countries is still scarce. Trade and investment liberalisation, which take place in developing and transition countries, are still the controversial issues as their impact on host country especially in the long run is still unknown. Moreover, empirical studies both for the rich and the poor nations are often country specific and inconclusive. For instance, the relations of trade and the wage gap between skilled and unskilled labour are tested empirically by Hanson and Harrison (1999). They examine data on Mexican manufacturing plants and Mexican Industrial Census data to assess whether Mexico's sweeping trade reform affected wage inequality in the 1980s. The authors find that the reduction in tariff protection in 1985 affected low-skilled industries disproportionately. It occurred that Mexico trade protection of sectors demanding low-skilled workers was relatively high so the reform affected

[1] Most empirical studies refer to North America.

them the most. Their results were consistent with the intuition and the Stolper-Samuelson theorem. As Mexico has an intermediate abundance of skilled workers, the exposure of this country to competition from countries with a lot of unskilled labour like China, causes lower relative wages of unskilled workers.

On the other hand, using as a theoretical background Heckscher-Ohlin theory, Edin, Fredriksson and Lundborg (2004) study the effect of increased trade on earnings of workers in the manufacturing sector in Sweden. Their research confirms that earnings respond to alterations in industry sales not only created by domestic market but also by international trade. The results indicate that the higher Swedish export the higher annual earnings but the relationship between import and earnings is negative: an increase in import means lower earnings. Moreover, the researchers are not able to reject the hypothesis that changes in domestic market and changes in trade are alike. They do not find any evidence that trade with non-OECD is more harmful for less-skilled labour than with the OECD members. Also their research does not confirm that there are systematic differences in the trade impact across the skill distribution.

Because empirical findings are often inconsistent with the initial expectations and predictions of neoclassical models in many cases, this raises the need to depart from them and to provide new empirical evidence.

Poland is considered as a country relatively abundant in unskilled labour compared to the EU member countries, so the traditional trade models of international trade would predict that the wage of unskilled workers used in the production process should increase after the removal of trade barriers with respect to the EU trading partners that are relatively abundant in skilled labour.

The main goal of this paper is to examine whether the impact of increased foreign competition resulting from the removal of trade and investment barriers on the earnings of skilled workers in Poland, is positive. In contrast to the predictions of Heckscher-Ohlin neoclassical framework and other classical and neo-classical models, following Neary (2002) and skill-bias technological change models, the increase in salaries of the best educated workers (i.e. skilled labour) is expected. This work extends the framework presented by Neary by allowing for international capital flows and then tests it empirically.

Using both aggregated and disaggregated datasets for the labour income in the years 1999 and 2004, it studies the influence of increased goods inflow and foreign direct investment flows in pricing skilled labour in Poland, controlling for time effects and individual characteristics. To evaluate their impact it uses the following estimation methods: ordinary and robust least squares and instrumental variables inference.

The first section of this paper describes the analytical framework used to study the impact of trade and investment liberalisation on labour earnings in Poland. It combines elements of various theoretical approaches and leads to

the final estimating equation. The empirical study is based on the inference derived from this hybrid theoretical framework. Data and methodology used to conduct this research are described in the second section that explains the way of collecting the data obtained from labour force surveys. Descriptive statistics of the sample and definitions of explanatory variables are also presented in this section. The third section provides a description of estimation results. The results of two estimation methods are presented and discussed. First, using robust ordinary least squares method, the averaged and individual data evidence is provided. Second, the sensitivity analysis with the use of instrumental variables method is conducted.

The last section of the paper summarises and concludes the findings of earlier sections. It also points out at some topics, which would benefit from closer attention in further studies.

1. Analytical Framework

The theoretical framework used to study the impact of international trade and investment on labour earnings in Poland brings together three different approaches: the extended model of international trade based on Heckscher-Ohlin-Samuelson, the human capital theory which is associated with the model of Jacob Mincer, and the more recent model of the general oligopolistic equilibrium (GOLE) developed by J.P Neary (2002). The first two models allow to distinguish between different types of demographic characteristics of individuals and to find the source of income inequalities of workers. The third model describes how an increase in foreign competition may influence the choice of technology by the company and skill differentials among workers after removing trade barriers between integrating countries.

1.1. Foreign competition, trade and wages among skilled workers

The basic Heckscher-Ohlin-Samuelson (H-O-S) model is a $2 \times 2 \times 2$ model: two countries, two goods and two factors. The initial model assumed the homogeneity of labour but due to its inconsistency with reality, researchers implemented various modifications to this simple framework (Johnson, Stafford, 1999, p. 2240). The very popular and commonly used approach divides labour into two categories: unskilled and skilled workers, which are used to called human capital.

Regardless of the extension of the H-O-S framework, the main conclusions and implications for the production factors' market hold. Moreover, this model is still used to explain the pattern of trade between developed and developing countries as the factor endowments may differ across them (Masse, 2001, p. 213).

The analytical framework presented here starts with this traditional framework as the classical H-O-S model was first extended by disaggregating the labour force into its particular categories and these extensions provide a linkage between the micro and the macro approach to trade models.

To study the impact of various factors on wages, many researchers use a microeconomic model developed by Jacob Mincer (1974). The accounting-identity model is based on the assumption that earnings depend on the stage of the life cycle. It also underlines the relations between potential and observed earnings as well as the role of investments in human capital. These investments consist of formal school education and knowledge collected during job trainings. It allows for heterogeneity of individuals contrary to his earlier model (Mincer, 1958).

Modern specifications of the Mincerian equations have their sources mostly in the empirical evidence. The specification, which is going to be used in this study, is based on the Murphy and Welch (1990) extension of the Mincer model. They find that the most widely accepted in economics empirical specification of the human capital earnings function, in which earnings are expressed as a quadratic in potential experience cannot be appropriate in every case because it provides a poor approximation. The results of this approximation may be biased. They propose alternative specifications that fit the data such as cubic, nested quadratic and quartic specification. These alternatives are mainly consistent with the Mincer's idea, however the basic assumption about the constant rate of return and linearly declining investment are not fulfilled. Based on the results of their empirical analysis, they notice that the quartic form eliminates nearly all of the bias generated by the quadratic and fits the data well. The estimated equation for a quartic specification looks as follows:

$$\ln Y_{ixt} = \beta_0 + \beta_1 x + \beta_2 x^2 + \beta_3 x^3 + \beta_4 x^4 + v \tag{1}$$

where Y_{ixt} denotes wage for a schooling group i in a year t, x is defined as work experience, and v is an error term.

This specification is consistent with intuition that due to gaining new experience wages grow faster at the beginning, next they stabilize at some level for some period after which they increase once again due to tenure. But because it is impossible for wages to grow to infinity so the specification takes into account the fact of retirement and ageing of the workers and earnings fall again (Murphy, Welch, 1990, p. 204).

The model of the general oligopolistic equilibrium (GOLE) developed by Neary (2002) tries to explain how increased foreign competition may influence the choice of technology and skill differentials among workers in the case of reduction in trade barriers between countries.

The starting point is a closed economy with an industry consisting of n firms. Each of them produces an output that is symmetrically differentiated. It is assumed that firms behave in line with the Cournot two-stage oligopolistic competition. At the beginning they decide about the amount of investment and after that they choose their outputs. The decision about the level of investment is made on the predictions of future competition as the equilib-

rium is subgame perfect. The incentive to invest is the higher, the greater competition in a sector. The optimal level of investment k in terms of output x is the following:

$$\gamma k_i = \mu_n \theta x_i \tag{2}$$

and: θ is a technological component of marginal return to investment per unit output, while μ_n is a strategic component of the marginal return on investment per unit output.

The more companies enter the market the greater incentive to engage in strategic overinvestment. This is because firms want to improve their outputs from the game. The similar situation takes place when products become closer substitutes: it also results in intensified investment's spending (Neary, 2002, p. 683).

To illustrate how foreign trade can affect the behaviour of domestic companies, it is assumed that there is only one firm active in the domestic and one in the foreign market. At the beginning, the level of costs of a foreign company does not allow it to sell its products on home market and for this reason the domestic producer is a monopolist. Thus, there is no need to introduce the strategic investment.

Presume that removing trade barriers[2] makes it possible to the foreign firm to compete in the domestic market because of the cost reduction. If this reduction is sufficiently large, there is an incentive for the incumbent firm to invest strategically. When the investment is insufficient to blockade the entry, the decrease in costs allows the foreign company to compete at home market. In this case, the home company loses its monopoly status, import occurs and the equilibrium is a duopoly in which both firms invest strategically.

Allowing for many firms in this model, the starting point is $n-1$ companies which operate in the domestic market and differ only in their competitiveness. It is possible to say that there is a nonempty range of relative competitiveness of the foreign company within each trial of entering the home market is blockaded by the other players on the market and no import occurs. However, it must be noticed that in this situation incumbent firms engage more in strategic investment than in case of uncompetitive potential entrant (Neary, 2002, p. 686).

From the earlier analysis it can be said that there is a level of relative competitiveness at which the foreign company can enter the home country and export its products to the domestic market. Contrary to Neary (2002), in this work, it is assumed, that the trade barriers removal is sufficient for some foreign companies but for some not. For this reason the domestic companies invest strategically but at the same time import occurs.

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[2] Neary allows also for technological progress instead of fall in trade barriers similarly as it is in skill-biased technological change models.

Considering the home country consisting of the continuum of sectors identical to this specified above it is possible to claim, that companies are not big enough to have a significant impact on prices in other sectors, so they take them as given. Similarly, aggregate income and factor prices are exogenous. All sectors are identical, and there are only two factors: unskilled and skilled labour. The crucial assumption made by Neary is that investment demands only skilled workers (human capital) while production only unskilled. This restrictive assumption does not change the findings when it is relaxed and assumed that production uses both types of workers. However, to simplify further analysis it is better to consider this extreme case.

Although Neary in his work excludes foreign direct investments (*FDI*) from the analysis and assumes that firms cannot relocate their production facilities, this assumption is relaxed and companies are allowed to serve both home and foreign markets. Following Bedi and Cieślik (2002) *FDI* is introduced into production function, which can be perceived as the flow of capital and other advantages (e.g. modern technologies) to a host country. They may increase productivity of the home workers. As they are not financed by the home companies, they are not introduced to the investment function in the equation.

$$x_i = F_i(L, FDI) \tag{3}$$

Assuming that labour L is homogenous and each unit supplies the same amount of labour, the above function can be rewritten in the following way:

$$x_i = F(L_i)T(FDI_i) \tag{4}$$

According to theoretical considerations of Neary (2002) the investment is a function of skilled labour (human capital) H. Because firms made their decisions on the basis of the situation on a market they operate greater competition and import M induced by removing trade barriers affect the strategic motive for investments. Thus, the investment is a function of imports and human capital:

$$k_i = G_i(H, M) \tag{5}$$

Rewriting this function in a similar way to the production function, allowing human capital to be homogenous and that each unit of skilled labour supplies one unit of human capital and substituting both functions into our equilibrium equation, the following expression is received:

$$\gamma G(H_i)Z(M_i) = \mu_n \theta F(L_i)T(FDI_i) \tag{6}$$

where *FDI*, *M*, *H*, and *L* are respectively total foreign direct investment, total imports, total human capital and total labour supplies.

In order to obtain empirical specification of the equation, let the function of knowledge capital be an expotential function of foreign direct investments $e^{\alpha FDI}$ (Bedi, Cieślik, 2002, p. 6). A similar assumption is made in the case of imports. $H(v) = v^{\alpha}$ and $L(w) = w^{\alpha}$ represent human capital and unskilled labour markets supplies respectively. Given all these assumptions, the log form of (6) is:

$$\ln\gamma + \alpha_1 \ln v + \alpha_3 import = \ln\mu_n\theta + \alpha_2 \ln w + \alpha_4 FDI \tag{7}$$

After transformation, the obtained reduced form gives the following specification of the estimating equation:

$$\ln v_i = \beta_0 + \beta_1 \ln w_i + \beta_2 FDI_i + \beta_3 import_i + \varepsilon_i \tag{8}$$

The conclusions from the model drawn by Neary (2002) are the following: if an exogenous reduction in trade barriers in both directions takes place, bilateral trade among countries occurs with an additional assumption that foreign firms are competitive on a home market and companies do not change their behaviour. However, domestic entrepreneurs decide for an extra strategic investment, which as a result should blockade the entry of a company (companies) from abroad. This is often called a "defensive innovation". Thus, the relative demand for skilled labour goes up as home firms increase their investment-output ratio. This higher demand causes an increase in the economy-wide skill premium, which is the incentive for people to acquire new skills and higher education. This results in the increased relative supply of skilled labour (i.e. human capital). Despite to supply response, the increase in relative demand is not fully eliminated.

The introduction of foreign direct investment into the model can be modelled in a simple way as the operation of the company in two markets: home and foreign. This increases competition among firms in a sector so positive flows of capital or/and knowledge result in higher defensive innovation of other firms.

1.2. Model implementation and research hypothesis

Having given the specification (8) of the estimation equation, in order to examine the impact of trade liberalisation and foreign competition on earnings in Poland with the use of disaggregated data, following the Mincerian framework and further extensions of his original models described earlier, it is necessary to control for individual characteristics which may differentiate the income of workers. Assuming that the quality of human capital *H* supplied by worker *l* in industry sector/firm *i* is dependent on individual charac-

teristics of this person X and $h_{il} = e^{\beta_4 X_{il} + e_{il}}$, the final version of the estimating equation is obtained:

$$\ln v_{il} = \alpha_0 + \beta_1 \ln w_i + \beta_2 FDI_i + \beta_3 import_i + \vartheta X_{il} + u_i \tag{9}$$

Here, the vector of individual characteristics[3] takes the following form:

$$X_l = m_0 + m_1 \exp_l + m_2 \exp_l^2 + m_3 \exp_l^3 + m_4 \exp_l^4 + m_5 gender + \\ + m_6 occupation_z + m_7 area_p + \tau_l \tag{10}$$

where:

exp —denotes work experience measured in years

gender —is a dummy variable indicating gender of the individual (1 if female, 0 otherwise)

$occupation_z$ —indicates the profession z of the person (dummy variable)

$area_p$ —indicates the place of living p in a country (voivodoship)

τ_l —is an error term.

Of course, to control for a company characteristics, while analysing disaggregated data, it is necessary to include a variable which control for the company size (logarithm of the number of employees)[4] *size* and a dummy variable for the type of sector ownership the person works (public or private sector) *public*.

This work analyses therefore two cases: first, where strategic investment is defined at the industry level and the dependent variable is the average salary of a skilled worker in particular industry group and second, where strategic investment is made at the firm level and the firm decides in case of each particular worker about the salary given wages of unskilled workers (input into the production process). The first regression equation is then:

$$\ln v_i = \beta_0 + \beta_1 \ln w_i + \beta_2 FDI_i + \beta_3 import_i + \beta_4 \exp_i + \beta_5 \exp_i^2 + \\ + \beta_6 gender_i + \beta_7 area_i + \beta_8 public_i + \varsigma_i \tag{11}$$

where ς_i is an error term. In this case, independent variables of individual characteristics take the form of shares: for example variable *gender* represents a ratio of women employed in industry i and *exp* is the average total work experience of the workers in industry i.

The second equation is given as:

$$\ln v_{nl} = \gamma_0 + \gamma_1 \ln w_n + \gamma_2 FDI_i + \gamma_3 import_i + \gamma_4 \exp_l + \\ + \gamma_5 \exp_l^2 + \gamma_6 \exp_l^3 + \gamma_7 \exp_l^4 + \gamma_8 gender_l + \gamma_9 size_n + \\ + \gamma_{10} area_l + \gamma_{11} public_l + \gamma_{12} occupation_l + \xi_l \tag{12}$$

[3] Limited by the used dataset described in the next section.

[4] See: Brown, Medoff, 1989.

where w_n is the average wage level of unskilled workers in the company n and ξ_l is an error term.

Using the framework presented here, the next part of the paper examines whether the impact of increased foreign competition resulting from the removal of trade and investment barriers on the earnings of skilled workers in Poland is positive.

2. Data and Methodology

2.1. Data sources and definitions

The empirical analysis is based on the Z-12 survey conducted by the Polish Central Statistical Office (GUS)[5] every second year in Poland. This survey gathers data on profession, sex, education level, age, place of living, monthly and annual wages, and total hours spent at work. The data is collected directly from firms and restricted only to those firms, which employ at least 9 persons. The Z-12 Survey includes only the employed and covers 20% of all firms from the indicated group. Companies are divided and coded in line with the PKD[6] classification (Polish Classification of Activities) at 3-digit level. The differences between the year 1999 and 2004 in the code description are negligible. The professions are grouped consistent with the KZS[7] classification of occupations.

The original dataset consists of 740,622 and 609,764 observations in the years 1999 and 2004, respectively. As the limitation of the data forces to study the impact of trade only in goods, all individuals working at services industries are dropped from the initial sample. So after restricting the sample to manufacturing, a sample of 265,260 individuals was received for the year 1999 and 202,812 for 2004. Narrowing the dataset only to manufacturing and excluding other sectors for which trade data is not available—either because of missing trade data or because of no data for individuals, leads to 213,849 workers in 1999 and 165,989 in 2004 and 20 sectors.

Data related to international trade (imports and exports) come also from the GUS[8]. They are expressed in the CN (Combined Nomenclature)[9] classification at 8-digit level (denoted as CN8). To combine this dataset with the labour data from the Z-12 survey, the correspondence table between the CN8 and the PKD classifications is required. It is possible to merge them via the

[5] Główny Urząd Statystyczny.

[6] PKD (Polska Klasyfikacja Działalności) corresponds with the classification NACE Rev. 1.1—Nomenclature Statistical Classification of Economic Activities in the European Community.

[7] KZS (Klasyfikacja Zawodów i Specjalności) is based on the classification ISCO-88—International Standard Classification of Occupations approved by International Labour Organisation.

[8] HANZA database.

[9] CN is used in statistics and records of the foreign trade.

PKWiU[10] classification (The Polish Classification of Products and Services) where linkages to the PKD at 4-digit level and the CN8 are clearly specified. Applying this concordance table and grouping imported products by the PKD at 2-digit and 3-digit levels enable to examine the impact of international trade and investment on labour earnings.

Information about foreign direct investments (FDI) flows by the PKD sectors (2-digit numbers) is gathered by the National Bank of Poland (NBP)[11]. Other macroeconomic data such as unemployment, gross national product (GDP) and consumer price index (CPI) come from the Central Statistical Office[12].

To implement the instrumental variables (IV) method and to obtain an instrument for FDI inflows, data for labour costs and industry sales in the Netherlands[13] is necessary. These statistics are taken directly from the EUROSTAT database. All calculations were performed using the statistical package STATA ver. 9.2.

The variables taken into account in this empirical analysis are presented below:

ln_v —logarithm of skilled worker hourly real salary
ln_w —logarithm of unskilled worker hourly real wage
imports —share of import from old EU countries (15 countries) to Poland in Polish industry sales
FDI —share of FDI flows in industry sales in Poland
time —dummy for the year where 1 denotes 2004
labour cost in the Netherlands—share of labour costs to industry sales in the Netherlands
exper —work experience in years
exper2 —work experience in years to the second power
exper3 —work experience in years to the third power
exper4 —work experience in years to the fourth power
size —logarithm of the number of employees in a company
female —dummy variable for being a woman
public —dummy variable for working in public sector
executives—dummy variable for being an executive versus other professions
managers in support departments—dummy variable for being a manager in support department versus other professions
mechanical engineers—dummy variable for being a mechanical engineer versus other professions
voivoidships—set of 16 dummy variables to control for place of working and living

[10] The structure of PKWiU (Polska Klasyfikacja Wyrobów i Usług) is based on NACE classification, the Classification of Products by Activity (CPA) and the PRODCOM List (PRODCOM).
[11] Obtained on request.
[12] Collected from the website: www.stat.gov.pl.
[13] The reason of using in this study statistics for this particular country is explained further.

The first set of regressions that was run is based on the aggregated data for manufacturing at the 2-digit level of the PKD classification. Cumulating the data, results in receiving the means for explanatory variables. The average level of wages for skilled and unskilled workers, the ratio of particular genders and the mean values of total work experience for an employee in each industry are the explanatory variables. Also the variable used to control for a place of living is the share: it is the ratio of people living in the region and working in a particular industry.

The second group of models exploits the individual properties of the dataset. Descriptive statistics for main explanatory variables are presented in Table 1.

Table 1.

Descriptive statistics for main dependent and explanatory variables

Variable	Mean	Std. Dev	Mean	Std. Dev
	1999		2004	
university	7.57%	26.45%	11.95%	32.44%
post secondary	2.16%	14.55%	3.48%	18.33%
secondary vocational	24.86%	43.22%	26.04%	43.89%
secondary general	5.29%	22.39%	6.69%	24.99%
vocational	42.96%	49.50%	41.31%	49.24%
elementary and less	17.15%	37.69%	10.52%	30.68%
exper	17.63	10.37	17.25	10.79
age	38.22	10.09	38.46	10.14
female	37.68%	48.46%	34.08%	47.40%
FDI[14]	–2.07%	12.77%	–6.53%	32.56%
imports	9.41%	13.99%	9.48%	12.51%
hourly real earnings (total)	9.54	6.97	10.45	10.06
hourly real wage	10.66	4.12	10.22	3.26
hourly real salary	19.81	16.21	20.83	21.68
unemployment rate	11.99		19.51	
No. Obs.	213,849		165,989	

Source: Own calculations.

What is clearly seen from the Table 1., is that the number of people with tertiary education (having a university degree) in Poland increased from 7.57% in 1999 to almost 12% in 2004. At the same time the proportion of work-

[14] FDI flows for most industries are greater than zero. The negative value is a result of big lower than zero values for five PKD sections.

ers without any or with elementary education dropped from 17.15% to 10.52%. The average work experience in years and age of employees is similar in both years. The mean of earnings for all people and for the best educated (skilled workers) in the analysed sample increased by about 1 PLN (corrected by inflation—CPI) but the standard deviation is greater. The average unskilled labour income per employee dropped only by 0.44 PLN but the standard deviation is smaller in this case. The differentiation of wages in this group is much smaller than in group of high educated people. For this reason *skilled* workers (non-manual workers) were defined as workers with a university degree (who completed higher education) and *unskilled* (manual) as all other employees.[15] The registered unemployment rate increased from 12% in 1999 to 19.5% in 2004.

Despite the fact, that there are some discrepancies in the KZS occupations' coding between two periods of the sample, descriptions of professions remain constant. In the situation of a completely new occupation it was decided to retain the original group code for a particular year. Into account were taken groups for which the number of employees exceeds 2% of total number of observations and is not classified as "others". The other groups are the basis for this analysis of the impact of the particular occupation on labour earnings.

2.2. Empirical methodology

Researchers use several methods to examine the effect of foreign trade and investment on the income of production factors. To estimate the impact of international trade on labour earnings with the use of disaggregated data this work follows two methods: robust ordinary least squares (OLS)[16] to control for unobserved heterogeneity and instrumental variables to control for possible endogeneity.

The possible difficulties, which may arise in the empirical studies, are connected with probable endogeneity and heteroscedasticity. This second problem that may arise is related to unobserved heterogeneity in the sample. These unobserved effects may affect the standard errors, which are unobservable. The heteroscedasticity-robust standard errors are associated with the names of econometricians including Eicker, Huber, and White. They discovered the variance-matrix estimator, which is valid even in the absence of homoscedasticity (Wooldridge, 2001, pp. 56–57). One of the tests which detects whether the mentioned problem occurs or not is the Breusch-Pagan Lagrange multiplier test. The null hypothesis is homoscedasticity of the variance. An advantage of this test is that it can be applied for various models.[17]

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[15] Workers with a university degree are treated as skilled labour also in the work of Goh, Smarzynska Javorcik, 2005.

[16] For instance in the paper of Dostie (2006) the wage equation is estimated with OLS method.

[17] For further details see Greene (2003, pp. 223–225).

An important problem, which may arise, is that one or more explanatory variables in the regressed equation can be endogenous. The solution to this problem is to use an instrumental variable as the alternative to the variable considered as endogenous.

It is also possible to obtain the heteroscedasticity-robust inference for this estimation method. The most popular is the Two-Stage Least Squared Estimation, which was also used in this paper.

The Hausman specification test is commonly used in order to indicate whether IV is preferred over OLS estimation. Under null hypothesis that the Ordinary Least Squares is not subject to specification error, after conducting such test, it is possible to choose the proper method.[18]

3. Estimation Results

In this section two sets of empirical results are presented and discussed. The first set of estimates is based on the averaged dataset of sectors of the economy at the 2-digit level of PKD classification while the second controls for individual worker.

The dependent variable in the first set of results is the logarithm of the average real hourly salary level of workers with tertiary education in the industry. The sample encompasses PKD divisions. The coefficient standing on the wage level of an unskilled worker is interpreted as elasticity.

3.1. Averaged data evidence

The estimation results on the averaged dataset obtained via the OLS technique are reported in Table 2.

The estimates obtained from the simplest specification of the regression equation that assumes relationship only between the salaries of skilled labour (price of investment in human capital) working at the home country and wages of unskilled labour as well as international flows of products (import) and capital (foreign direct investments) from abroad are presented in the column (1). The estimation results show the expected positive nexus between imports and salaries of skilled workers. Greater imports of manufactured goods in an industry by one percent increases salaries by 26.4%. However, surprisingly, the impact (5.8%) of capital flows is not statistically significant.

The next step is to include in the regression worker characteristics. First, average experience as well as its second power to control for potential non-linearities as in the simple Mincer[19] framework were added. The estimation results obtained from the specification that controls for work experience are displayed in column (2). These results are consistent with the predictions of the theory and both experience variables are statistically significant. The impact of the work experience on salaries is positive and amounts to about

[18] Instrumental variables estimation is discussed in Wooldridge (2001, pp. 83–115).
[19] See: Mincer (1974).

12%. The increase in imports causes an increase in salaries by 28.4%. The model with two additional experience variables yields about 23% greater R^2 than the base case model. This indicates that work experience is an important factor in pricing the skilled labour.

Table 2.

OLS estimates on aggregated data (standard errors in parentheses)

Variable	(1) Baseline Model	(2) Model II	(3) Model III	(4) Model IV	(5) Model V
ln_w	0.4886*** (0.115)	0.7143*** (0.0944)	0.6721*** (0.1182)	0.6734*** (0.1185)	0.6887*** (0.144)
imports	0.2641*** (0.083)	0.2838*** (0.0742)	0.2657*** (0.0806)	0.2911*** (0.0856)	0.2893*** (0.0874)
FDI	0.0576 (0.0521)	0.0382 (0.0389)	0.0425 (0.04)	0.0392 (0.0402)	0.0394 (0.0409)
exper		0.1246** (0.0509)	0.1089* (0.0576)	0.1032* (0.0581)	0.1009 (0.0602)
exper2		–0.0045*** (0.0015)	–0.004** (0.0017)	–0.0037** (0.0018)	–0.0036* (0.0018)
female					0.0234 (0.1206)
mazowieckie			0.0928 (0.1534)	0.1246 (0.1578)	0.1119 (0.173)
public				–0.1437 (0.159)	–0.1388 (0.1634)
constant	1.8877*** (0.2555)	0.6181 (0.5107)	0.8157 (0.6103)	0.8291 (0.6121)	0.8102 (0.6291)
R-squared	0.5150	0.7476	0.7503	0.7566	0.7569
Adj R-squared	0.4745	0.7105	0.7050	0.7033	0.6941
F statistics	12.74	20.14	16.53	14.21	12.06
Reset F (Prob > F)	0.0511	0.4061	0.1354	0.2073	0.2176
Number of obs.	40	40	40	40	40

Dependent variable is a logarithm of real average hourly salary in the industry (1999 prices).
***, **,* significant at 1%, 5%, 10% level.
Source: Own calculations.

Specifications in columns (3) and (4) control for the place of work (i.e. *mazowieckie* region) and the share of public sector across industries, respectively. However, both variables are not statistically significant.

The effect of other worker characteristics on salaries that include gender is shown in column (5). It is, however, not statistically significant and do not affect the level of average salaries of people with a higher degree.

Summing up, in all specifications imports from the European Union countries is statistically significant and displays a strong positive impact (26%–29%) on the salaries of skilled workers in Poland. However, the precision of estimates is not satisfactory enough. Foreign direct investment inflows do not seem to be important in determining salaries in industries into which such inflows take place. Worker characteristics are difficult to interpret as they represent the average values. Besides, they are not significant in the more general specification (5) and are important only in the simplest version of the model. However, the Ramsey RESET test indicates that all the functional forms of the model are correct. Nevertheless, as it can be seen from the Table 2., the small number of observations (40) limits the amount of explanatory variables[20]—there is a risk of overfitting (Greene, 2003, p. 159) the model (number of degrees of freedom is quite low in some regressions).

3.2. Individual data evidence

As the results obtained on the averaged data cannot be regarded as satisfactory, it is needed to use the more disaggregated dataset that allows controlling for individual worker characteristics. The estimation results based on this dataset are presented in Table 3.

Table 3.

Robust OLS and pooled OLS estimates on individual data (standard errors in parentheses)

Variable	(1) Baseline Model	(2) Model II	(3) Model III	(4) Model IV	(5) Model V	(6) Final Regression
ln_w	0.8495*** (0.0094)	0.8497*** (0.0087)	0.842*** (0.009)	0.792*** (0.0095)	0.8219*** (0.0088)	0.8218*** (0.0088)
imports	0.0557** (0.0234)	0.0248 (0.0228)	0.0463** (0.0227)	0.0643*** (0.0231)	0.0884*** (0.0217)	0.0894*** (0.0215)
FDI	–0.0093 (0.0127)	–0.0085 (0.0116)	–0.021* (0.0116)	–0.0045 (0.0116)	–0.0043 (0.0104)	–0.0032 (0.0104)
time		0.0414*** (0.0058)	0.0291*** (0.0058)	0.0318*** (0.0058)	0.0214*** (0.0053)	0.0395*** (0.0054)
exper		0.0937*** (0.0034)	0.0934*** (0.0034)	0.0907*** (0.0034)	0.0911*** (0.0033)	0.0885*** (0.0033)
exper2		–0.0054*** (0.0003)	–0.0053*** (0.0003)	–0.005*** (0.0003)	–0.0056*** (0.0003)	–0.0054*** (0.0003)
exper3		0.0001*** (0)	0.0001*** (0)	0.0001*** (0)	0.0001*** (0)	0.0001*** (0)
exper4		–0*** (0)	–0*** (0)	–0*** (0)	–0*** (0)	–0*** (0)

[20] For this reason these regressions do not use experience to the third and fourth power as explanatory variables.

Variable	(1) Baseline Model	(2) Model II	(3) Model III	(4) Model IV	(5) Model V	(6) Final Regression
female		–0.1956*** (0.0058)	–0.1959*** (0.0057)	–0.2036*** (0.0057)	–0.1499*** (0.0054)	–0.1644*** (0.0055)
size			0.0139*** (0.002)	0.0197*** (0.0021)	0.0419*** (0.002)	0.0405*** (0.002)
public			–0.1554*** (0.0068)	–0.1482*** (0.0068)	–0.1344*** (0.0062)	–0.1289*** (0.0061)
voivoidship				+/–	+/–	+/–
executives					0.8867*** (0.0149)	0.8859*** (0.015)
managers in support departments						0.2511*** (0.0103)
mechanical engineers						–0.1508*** (0.0074)
constant	0.8263*** (0.0219)	0.4191*** (0.022)	0.3793*** (0.023)	0.5594*** (0.0259)	0.3273*** (0.0242)	0.3374*** (0.024)
R-squared	0.1871	0.2926	0.3013	0.3146	0.4148	0.4271
F statistics	2,765.63	1,907.65	1,603.87	719.26	923.24	910.56
Reset F (Prob > F)	0.0000	0.0003	0.0000	0.0000	0.1386	0.0592
Number of obs.	36,012	36,012	36,012	36,012	36,012	36,012

Dependent variable is a logarithm of real hourly salary (1999 prices).
***, **,* significant at 1%, 5%, 10% level.
Source: Own calculations.

In all cases it was necessary to use the robust regression because of unobserved individual effects[21] as the Breusch-Pagan Lagrange multiplier test[22] indicates clearly the presence of heteroskedasticity.

It can be noticed that the results presented in Table 3. are mostly consistent with the predictions of the theory. The baseline specification of the model presented in column (1) indicates that the higher imports influence positively the income of the best educated workers (one percentage change in plus increases the wage of skilled labour by about 5.6 percent). This finding is consistent with the predictions of the presented analytical framework and supports the view that increased competition forces domestic firms to rise the salaries of skilled workers in order to keep their production at least at the same level as before and to remain competitive at the labour market. In this case the flows of foreign direct investment do not matter for salary determination. However, it can be expected that not only these three variables are important when firms are setting the salary for their workers. Indeed, R-

[21] This problem was discussed in previous section.
[22] See: Greene (2003, pp. 223–225).

-squared in this case is quite low and equals 18.71 percent and the Ramsey RESET test shows that functional form of the model is incorrect.

According to the Mincerian theory of human capital discussed earlier in order to improve the fit of the model worker characteristics such as work experience and gender were added. Moreover, the time dimension of the dataset is taken into account[23] and in the estimating equation a year dummy is included[24]. The estimation results are presented in column (2) of Table 3. First, the model is better fitted but the specification of it is still unsatisfactory. Second, all additional variables turn out to be statistically significant and consistent with the theory prediction and other empirical studies. In particular, a gender pay gap is clearly seen in Poland[25]. Being a female decreases the salary by about 19.6%. One additional year of work experience increases income of an educated person by about 8%–9%. However, our attention should turn to the estimates of the coefficients on the share of imports and the share of FDI in sales of the industry. As before, the impact of foreign capital inflows remains statistically not significant. This time the coefficient on imports is also not statistically significant and imports does not seem to affect the salaries in Poland.

Third specification of the model controls for public vs. private ownership and the size of enterprise. It becomes clear that skilled workers in a public sector earn less by 15.5% than those employed in the private sector. Controlling for ownership and number of employees in a company shows that one percentage change in plus in the ratio of import to the output causes an increase in the individual salary by 4.6%. This result displays how a threat of being driven out of the market can motivate domestic firms to invest in technology upgrading and consequently the price of skilled labour increases.

In column (3) the coefficient on FDI turns out to be statistically significant. However, the negative sign means that the greater flows of foreign direct investment in the industry the person works, the lower the salary. This result is inconsistent with the results obtained by Bedi and Cieślik (2002) but may be the consequence of some omitted variables as the Ramsey RESET test again points out that the functional form of the model is incorrect.

Differences in earnings among particular regions in Poland are considered in column (4). The *mazowieckie* region is treated as a benchmark for regional salary premium comparisons. In all the regions except of *lubuskie* and *wielkopolskie,* where coefficients are not statistically significant, skilled labour is paid less than in *mazowieckie* region. Therefore, it can be presumed that the cost of importing commodities is lower here and firms must invest strategically to maintain the level of output. The greater Poland's imports

[23] The dimension of datasets is discussed in Wooldridge (2001, pp. 128–129).

[24] While using a year dummy, local labour market characteristics (e.g. unemployment rate) can be neglect.

[25] Gender pay gap problem is discussed for instance in paper of Myck and Paull (2004).

from the European Union causes a 6.4 percentage rise in salaries of skilled workers. Unfortunately, the specification of the estimated equation is still unsatisfactory.

Finally, similarly to the study by Bedi and Cieślik (2002) the labour force was differentiated by the occupation. The intuition suggests that the price of managerial labour should be the highest. Certainly, the salaries of directors and presidents of corporations are on average, ceteris paribus, greater by about 89% in comparison to other occupations. Taking this factor into account results in the increase of the estimated impact of imports on salaries. Moreover, the specification of the model seems to be right.

Further disaggregating the skilled labour confirms the findings concerning the executives, shows slightly greater coefficient standing by import shares (8.9%) but indicates that FDI does not matter. Managers' positions in support departments are better paid by about 25% in comparison to other occupations not highlighted in this research. Surprisingly, mechanical engineers earn less than other non-manual workers. The loss in salary caused by doing this job is approximately 15%.

To sum up, these results show, that liberalisation of international trade in Poland with the European Union plays an important role in the pricing of labour. Regression results for specifications presented in columns (5)–(6) confirm the fact that with rising foreign competition through increasing imports, domestic firms must invest strategically in technology upgrading and the salaries of skilled labour are now higher than under the closed economy. Presented estimates also document influence of other factors such as individual characteristics of workers and sectors in the economy. However, it must be noted that the impact of foreign direct investment and FDI is sensitive to the specification of the estimating equations. The ratio of investments flows to the output level in a particular sector has a significant and negative impact on the skilled workers income only in one specification which functional form is incorrect. This may be due to data imperfections and time limitation of the dataset to only two years. Moreover, it would be probably more useful to analyse the impact of foreign investment stocks rather than flows in particular years. It is also worth noting, that the sign of the coefficient on average wages in a company of unskilled workers is consistent with the predictions of neoclassical trade theory that postulates that wages in the labour abundant country, such as Poland should rise after its opening to international trade.

3.3. Sensitivity analysis

Earlier empirical studies suggest that, there might exist the possibility of endogeneity problem in the model. The variable, which may cause the inconsistency of the estimates, is the ratio of foreign direct investment to the industry output. The problem may arise due to measurements errors and multicolinearity. In order to examine if the regression results are consistent, it is useful to conduct the sensitivity analysis using the instrumental variables

method. The instrument should be correlated with FDI inflows but uncorrelated with our dependent variable. One of the options suggested by Bedi and Cieślik (2002) is to use the labour costs share in the country from which most of the FDI comes. The explanation behind this is that foreign companies probably prefer to invest abroad as the labour costs in their own country are too high. This variable seems to fit well to the assumptions about the properties of instrumental variable. Thus, in this work the instrument for the ratio of FDI to the industry output is the share of labour costs in industry output in the Netherlands[26]. The first stage regression of foreign direct investment flows on the instrument yields R^2 equal to 42.7. The correlation between *FDI* and our new variable is approximately 70%. The results of the IV regression are presented in Table 4.[27]

Table 4.

IV estimates (standard errors in parentheses)

Variable	IV Coef. (Std. Err.)	OLS Coef. (Std. Err.)
FDI	0.0392* (0.0215)	–0.0032 (0.0104)
ln_w	0.8133*** (0.0096)	0.8218*** (0.0088)
imports	0.072*** (0.0237)	0.0894*** (0.0215)
time	0.0571*** (0.0058)	0.0395*** (0.0054)
exper	0.0873*** (0.0035)	0.0885*** (0.0033)
exper2	–0.0052*** (0.0004)	–0.0054*** (0.0003)
exper3	0.0001*** (0)	0.0001*** (0)
exper4	–0*** (0)	–0*** (0)
female	–0.1613*** (0.0058)	–0.1644*** (0.0055)
size	0.0386*** (0.0021)	0.0405*** (0.002)
public	–0.1306*** (0.0064)	–0.1289*** (0.0061)
voivoidship	+/–	+/–
executives	0.8914*** (0.0159)	0.8859*** (0.015)

[26] Most of the FDI flows in 2004 come from the Netherlands.

[27] For two groups without specified of the ratio of labour costs in the Netherlands, 0 was assumed. Similarly, in two other cases where data was available only for one year.

Variable	IV Coef. (Std. Err.)	OLS Coef. (Std. Err.)
managers in support departments	0.2499*** (0.0112)	0.2511*** (0.0103)
mechanical engineers	–0.1465*** (0.0077)	–0.1508*** (0.0074)
constant	0.3476*** (0.0259)	0.3374*** (0.024)

Dependent variable is logarithm of real hourly salary (1999 prices)
***, **,* significant at 1%, 5%, 10% level
Source: Own calculations.

Comparing IV and OLS estimates important differences in the value of estimates on *FDI* variable can be noted. IV estimates show that FDI is more important that OLS method would predict. The estimated coefficient is positive not negative as previously and equal to about 3.9%. However, it is not clear, which specification is better. The Hausman specification test points out at the endogeneity problem: it rejects the null hypothesis about consistency of OLS estimates with *p-value* = 0.000. For this reason while formulating the final conclusions, the results received by IV method will be used.

Conclusions

The goal of this paper was to show that trade and investment liberalisation which took place in Poland several years ago, had a positive impact not only on wages of the least educated workers but also on those with university degrees. The obtained empirical results are consistent with the expectations based on new trade theory models.

First, ordinary least squares estimation with the use of the aggregated dataset was conducted. It showed the strong positive impact (26%–29%) of increased imports from the European Union on earnings of skilled workers in Poland. It turned out that foreign direct investment do not play any role in pricing this kind of labour. The stable effects of socio-demographic and sectoral characteristics of the economy were difficult to observe as they were sensitive to the specification of the model.

Second, individual workers data was used in the analysis and both robust OLS and instrumental variables (two-stage least squares) regressions were run that confirmed the influence of foreign competition on the salaries of people with university degrees. This indicates an increasing strategic investment undertaken by foreign and domestic companies what is in line with *skill-biased technological change* models and the results obtained by Abrache, Dickerson and Green[28] for Brasil. Moreover, instrumental variable inference indicates that foreign direct investment is also an important factor in determining the salaries. Its impact is equal to about 4% and is statistically signifi-

[28] See: Abrache, Dickerson, Green (2004, pp. 73–96).

cant. This IV regression also confirms the presence of a gender pay gap in Poland what is consistent with the results obtained by other researchers. The Hausman specification test points out that outcome of IV inference is better than that of OLS. Controlling for individual worker characteristics also turned out to be important. The findings are mostly consistent with the initial expectations derived from the theory, seem to describe the reality quite well and confirm the evidence obtained for Poland in studies conducted by Goh and Smarzynska Javorcik, and Bedi and Cieślik. However, it must be noticed that the results presented here are sensitive to the number of explanatory variables in the regression.

Finally, although the estimation cannot be regarded as fully satisfactory due to possible measurement errors and the dependence of the estimated coefficients on the specification of the model[29], this work showed that international trade and foreign direct investment liberalisation with European Union affected positively the level of earnings in Poland. Analysis of data gathered after 2004 could provide further insight into the subject. Flows of all production factors (not only the capital and skills) should be taken into account while considering rising foreign competition. In particular, incorporating international migrations into the analysis could yield interesting results. Currently however, the data for flows of workers between Poland and other countries are not precise enough and are mainly based on approximate values and estimates. Therefore further research should address these interesting and important issues.

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[29] Similar estimates were done for men and women only, and for public and private sectors. However, in all cases, the functional form of the model occurred to be incorrect.

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Abstract

The Impact of International Trade and Foreign Competition on Labour Earnings in Poland

This paper investigates the influence of international trade and increasing foreign competition on earnings in Poland. Using disaggregated income data for skilled labour in the years 1999 and 2004, and OLS and IV estimation methods it examines the impact of liberalisation of international trade and foreign direct investment flows between Poland and the European Union. The conducted analysis suggests that increased competition forces domestic firms to raise the salaries of the best educated workers.