LABOR MARKET EFFICIENCY IN POLAND: A STOCHASTIC WAGE FRONTIER ANALYSIS

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ABSTRACT

In this paper, we apply a stochastic frontier approach in order to analyze labor market efficiency in Poland – a transition economy and a new entrant to the European Union. Wage efficiency is defined as the ratio of a worker's actual and potential (maximum) wage, given his or her demographic and socio-economic characteristics. Our findings indicate that, on average, in 2001 the full-time hired Polish workers realized 86 percent of their potential earnings. It implies inefficiency in acquiring and processing job market information. At the same time, an international comparison shows that the degree of wage efficiency in Poland was similar to or higher than that in other developed countries. Our attempt to identify the determinants of wage efficiency in Poland produced mixed results. However, in sum, worker performance in the Polish labor market seems to be rewarded appropriately, with some typical-for-Europe degrees of inefficiency in acquiring information, by a standard of wage efficiency and proximity to the wage frontier.

INTRODUCTION

The transition process to a market economy in the Central and East European countries has included a wide spectrum of adjustments in labor markets. Different aspects of these adjustments – such as unemployment, labor market flows, the wage structure and distribution, etc. – in post-Communist economies have been extensively scrutinized and analyzed in the economics literature. A significant body of research has focused on labor market developments in Poland, which is widely regarded as one of the most successful transition economies in Central and Eastern Europe. In particular, a number of empirical studies have analyzed the dynamics of wage distribution and wage structure in Poland during the pre-transition years, and then the early and mature stages of transition (see Adamchik *et al*., 2003 for an overview). A frequently used approach is the Mincerian earnings function (Mincer, 1974). However, this model assesses the impact of different factors on the *average* level of earnings; it does not identify the potential (maximum) earnings level for a worker with a given set of worker characteristics and how these characteristics contribute to achieving the potential wage.

In this study, we apply a stochastic frontier approach in order to analyze the degree of wage efficiency in the Polish labor market in 2001. To our knowledge, there has been no such research for Poland. Wage efficiency is defined as the ratio of a worker's actual and potential wage, given his or her demographic and socio-economic characteristics. Consequently, wage inefficiency is defined as the gap between a worker's actual and potential wage. Wage inefficiency arises mainly from incomplete labor market information and inefficient job matches, which results in the loss of output. Thus, understanding the causes and extent of wage inefficiency in a country will help to develop more appropriate labor market policies and institutions, ultimately to increase national output. We analyze the factors that affect the potential wage, and focus on the degree of wage (in)efficiency and its determinants. The paper is organized as follows: The Methodology section sketches the key concepts for a framework of stochastic frontier models. The Data section explains the data set that we use for our estimates of the frontier and resulting wage efficiency ratios. In the next two sections, we investigate factors that influence the wage frontier and analyze wage efficiencies at various levels of disaggregation. The International Comparison section provides a perspective from existing study with which to interpret our results for Poland. The final section concludes the paper.

METHODOLOGY

In a labor market, worker i with a given set of demographic and socio-economic characteristics faces a wage-offer distribution varying from the lowest wage ($w_{\min_i}$) to the highest potential wage ($w_{\max_i}$). Workers whose actual wage (w_i) is less than their potential maximum wage are said to be suffering from some kind of "wage inefficiency." Inefficiency may be attributed to different causes, such as imperfect information on the part of both workers and employers, discrimination, the market power of the employer, or a worker's negotiating power. For instance, while searching for a job, workers do not know which firms pay the highest wages for their set of skills. Because search is costly, workers may stop searching and accept lower wages before discovering the highest-paying job. On the other hand, employers have imperfect information about potential hires. Different employers have access to different data about the same worker, leading to different conclusions about this person and different wage offers to him or her.

The earnings frontier approach describes the maximum potential wage for a worker with a specific set of characteristics. All workers are assumed to be located either on this "best available wage," envelope frontier (a fully efficient position when $w_i = w_{\max_i}$) or below this frontier (an inefficient position when $w_i < w_{\max_i}$). Early deterministic frontier models (Greene, 1980) assumed that each deviation from the frontier (i.e., potential wage $w_{\max_i}$) was due to inefficiency:

$$\ln w_i = \ln w_{\max_i} - \varepsilon_i , \tag{1}$$

where $\ln w_i$ and $\ln w_{\max_i}$ are the logarithms of the observed and potential wage of the *i*-th individual; and ε_i is a one-sided non-negative error term, because of the impossibility of $w_i > w_{\max_i}$. Aigner *et al*. (1977) proposed that the frontier itself may be stochastic and split the error term into two parts – a white noise variable $v_i \sim N(0, \sigma_v^2)$ and a non-negative inefficiency term $u_i \geq 0$. The wage frontier is usually modeled with a Mincerian earnings function (Mincer, 1974). Eqn. (1) thus can be rewritten as:

$$\ln w_i = \ln w_{\max_i} + v_i - u_i = \alpha + \boldsymbol{\beta}' \mathbf{x}_i + v_i - u_i , \tag{2}$$

where $\mathbf{x}_i$ is a vector of socio-economic characteristics; and α and β's are parameters to be estimated. In Eqn. (2), $\ln w_{\max_i}$ represents a deterministic wage frontier, $\ln w_{\max_i} + v_i$ represents a stochastic frontier, and $\ln w_{\max_i} + v_i - u_i$ represents the observed wage. The degree of wage inefficiency for each worker is measured by the difference between the actual wage and the stochastic wage frontier (that is, u_i). In this study we assume that wage inefficiency generally results from the imperfect information of employees. However, as mentioned above, wage inefficiency may be attributed to incomplete information of both workers and employers. Polachek and Yoon (1987, 1996) proposed such a model with a two-tiered stochastic wage frontier, in which the error term ε_i is split into three parts: white noise, a non-positive error term representing worker information gaps, and a non-negative error term for employer ignorance. However, as Polachek and Xiang (2005, p.7) later recognized, empirical results suggest that "incomplete employee information varies far more than incomplete employer information" and thus may be ignored without a significant loss of accuracy and generality.

We assume a half-normal distribution for $u_i \sim N^+(0, \sigma_u^2)$ and that u_i and the independent variables are unrelated. Eqn. (2) is estimated using the log-likelihood function (Aigner *et al*., 1977; Meeusen and van

den Broeck, 1977). The conditional expected value of u_i given ε_i is calculated as in Jondrow *et al*. (1982). Finally, we use u_i-values to calculate individual efficiency (EFF) and inefficiency (INEFF) ratios which measure the gap between the actual wage and the stochastic wage frontier:

$$\text{INEFF}_\text{i} = 1 - \text{EFF}_\text{i} = 1 - \frac{\exp(\alpha + \boldsymbol{\beta}'\mathbf{x}_i + v_i - u_i)}{\exp(\alpha + \boldsymbol{\beta}'\mathbf{x}_i + v_i)} = 1 - \exp(-u_i)\,. \tag{3}$$

We then explore whether a set of macroeconomic, demographic, socio-economic, and institutional characteristics can explain the variation of the efficiency estimates.

Data

The Labor Force Survey conducted by the Polish Central Statistical Office in May of 2001 constituted the data source for this paper. We restricted our attention to full-time hired workers because only this category of employees was required to report their net earnings at their main workplace during the preceding month. Part-time hired workers, self-employed individuals, and those assisting in family businesses were not required to report their earnings. We further narrowed our sample by deleting those individuals who were full-time students, or handicapped, or younger than 18, or older than 65 (men) and 60 (women). These age restrictions correspond to the specific retirement ages as well as comply with the Polish Central Statistical Office definition of the working-age population (women 18-59 women; men 18-64). Furthermore, because wages were defined in terms of monthly earnings, for consistency we controlled for an employee who worked 40 and more hours per week on a regular basis. After all these adjustments, we had a sample of 9,380 full-time hired employees, of which 5,208 were males and 4,172 were females.

ESTIMATES OF THE STOCHASTIC WAGE FRONTIER

The maximum likelihood estimates of Eqn. (2) and the means of independent variables are presented in Table 1. In addition to the conventional human capital characteristics (education, potential experience, gender), our wage frontier equation includes other personal characteristics (marital status, head of the household) as well as dummy variables that capture regional labor market conditions (region, city/town size or village). We also include current job characteristics such as tenure, which reflects years of work experience with the current employer, as well as controls for thirteen industries, eight occupational indicators, four firm sizes, and an indicator for the sector of work (public versus private). Similar to other studies in this area, we use potential experience (age minus years of completed education minus 6) as a proxy for actual experience. For the regression model in Table 1, the reference person is a woman who has an elementary or lower education, is not married, does not head the household, lives in a small town or rural area in the Central region, works as a laborer in a small (5 or fewer employees) private manufacturing firm, and has less than a year of both potential experience and tenure at the current workplace.

The results in Table 1 show that the potential wages of Polish workers are closely related to their demographic and socio-economic characteristics. Most variables in Table 1 are significant at the 5-percent level or less and have the anticipated signs. For instance, the coefficients of the gender, education, and potential experience variables are statistically significant and positive and indicate that the potential wages were higher for men, and for workers with more education or potential experience. According to our results, men have a 15.2 percent higher potential wage than women, *ceteris paribus*. University-educated workers experience a 38.0 percent higher potential wage than their counterparts with only elementary education. The impact of potential experience on the wage frontier exhibits a standard

concave shape: each additional year of potential experience increases the potential wage but at a decreasing rate, so that after about 35 years the positive impact of an additional year of experience starts to decline. The impact of tenure is similar to that of potential experience. Being married increases the wage potential by 4.4 percent; however, we should treat this result with caution. It is well documented in the literature that marriage positively affects men's wages, but inversely for women. Thus, the "married" coefficient in Table 1 may be misleading. Further, such factors as living in a more economically developed Central region (including Warsaw), or in a big city, or being a top manager, or working in a firm with more than 100 employees indicate a larger potential wage. Workers in the public sector face a lower potential wage than their similarly endowed counterparts in the private sector. These results are quite consistent with economic theory and with similar studies that have estimated the wage frontier for different countries.

Table 1: Maximum Likelihood Estimates of the Stochastic Wage Frontier

Variable	Coeff.	Std.Err.	Mean	Variable	Coeff.	Std.Err.	Mean
Constant	6.395*	(0.030)		Transportation	0.069*	(0.013)	0.081
Man	0.152*	(0.008)	0.555	Financial interm.	0.190*	(0.024)	0.022
University	0.380*	(0.019)	0.100	Real estate	-0.004	(0.016)	0.038
Post-secondary	0.162*	(0.020)	0.043	Public admin	0.054*	(0.015)	0.077
Secondary vocational	0.144*	(0.014)	0.295	Education	-0.100*	(0.020)	0.041
Secondary general	0.155*	(0.017)	0.075	Health care	-0.153*	(0.016)	0.089
Basic vocational	0.054*	(0.012)	0.384	Social services	-0.018	(0.020)	0.029
Potential exp., years	0.007*	(0.001)	20.750	Top manager	0.471*	(0.019)	0.040
Potential exp. sq.	-0.000*	(0.000)	538.313	Specialist	0.311*	(0.019)	0.066
Married	0.044*	(0.008)	0.747	Technician	0.270*	(0.015)	0.163
Head of household	0.104*	(0.007)	0.508	Office clerk	0.131*	(0.016)	0.106
Region South	-0.038*	(0.011)	0.147	Services	0.070*	(0.017)	0.117
Region East	-0.114*	(0.010)	0.214	Farmer	0.058	(0.044)	0.009
Region North-West	-0.038*	(0.010)	0.188	Industrial worker	0.089*	(0.013)	0.254
Region South-West	-0.035*	(0.012)	0.114	Machinist	0.126*	(0.014)	0.134
Region North	-0.065*	(0.010)	0.186	Public sector	-0.021*	(0.009)	0.429
City (>100 thous.)	0.069*	(0.020)	0.280	Tenure, years	0.008*	(0.001)	10.047
City (50-100 thous)	-0.003	(0.021)	0.101	Tenure sq.	-0.000*	(0.000)	189.053
City (20-50 thous.)	-0.025	(0.021)	0.125	Firm size (6-20)	0.052*	(0.013)	0.195
City (10-20 thous.)	-0.030	(0.021)	0.089	Firm size (21-50)	0.083*	(0.014)	0.156
City (5-10 thous.)	-0.053*	(0.024)	0.036	Firm size (51-100)	0.087*	(0.014)	0.139
Rural	-0.023	(0.020)	0.336	Firm size (>100)	0.129*	(0.013)	0.424
Agriculture	-0.047*	(0.020)	0.026				
Mining	0.226*	(0.023)	0.024	λ	0.701*	(0.047)	
Energy supply	0.096*	(0.022)	0.030	σ	0.332*	(0.003)	
Construction	0.059*	(0.012)	0.082	σ_v^2	0.074		
Trade	0.006	(0.011)	0.137	σ_u^2	0.036		
Hotel & restaurants	0.047	(0.025)	0.018	N obs.	9380		

** Significant at the 5 percent level or less.*

ESTIMATES OF WAGE EFFICIENCY

The degree of asymmetry of the disturbance term is measured by λ, defined in Eqn. (4),

$$\lambda = \sigma_u / \sigma_v \quad . \tag{4}$$

While the estimate of λ in Table 1 is statistically significant, its low magnitude of 0.701 indicates that the inefficiency component in the data is rather small. For comparison, some studies report much higher values of λ: 1.06 for Germany (Lang, 2004), 1.83 for the U.S. and 2.65 for Canada (McClure *et al*., 1998).

We further decompose the variance of the composite error ε_i and calculate the contribution of the variance of u_i to the total variance. As Greene (1993) points out, for the half-normal model

$$\frac{\mathrm{Var}(u_i)}{\mathrm{Var}(\varepsilon_i)} = \frac{[(\pi - 2)/2]\sigma_u^2}{\sigma_v^2 + [(\pi - 2)/2]\sigma_u^2} \quad . \tag{5}$$

Substituting the estimates for each statistic from Table 1 into Eqn. (5), we find that only about 22 percent of the variance of ε_i results from wage inefficiency, and the remaining 78 percent is due to other unexplained variability factors. This finding reinforces our conclusion above that wage inefficiency plays a quite limited role in our estimates. We also note that our result is consistent with the magnitude of the U.S. estimate of 27 percent reported by Hunt-McCool and Warren (1993). In contrast, Lang (2004) reported an estimate of 39 percent for Germany, and Landeau and Contreras (2003) 51 percent for Chile. Although larger, these latter two estimates are within the same order of magnitude as ours for Poland and may indicate a somewhat different operation of those national labor markets, but not a completely different structure.

We now turn to the interpretation of the efficiency ratios. The estimated efficiency ratios, based upon Eqn. (3), for the entire sample and for different socio-demographic groups are presented in Table 2. For the entire sample, the efficiency ratio is 86 percent, that is, on average workers realize 86 percent of their potential earnings and are 14 percent below their potential. It means that an average worker could increase his or her wage by about 16 percent (1/0.86-1=0.16) without any additional investment in his or her human capital endowment. The efficiency ratio of 86 percent for Poland is quite consistent with the reported results for some countries. For example, 86 percent for the U.S. (Hunt-McCool and Warren, 1993), 84 percent for the U.S. and 83 percent for Canada (McClure *et al*., 1998), 83 percent for Chile (Landeau and Contreras, 2003), 80 percent for Germany (Lang, 2004), 80 percent for the UK (Polachek and Xiang, 2005).

Our next step is to determine whether wage efficiency varies among socio-demographic groups. The common rationale is that higher costs of job search, weak labor market attachment, environment with limited public knowledge, etc. lead to less complete information and, consequently, to higher wage inefficiency. Thus, typical expectations are that men, married workers, prime age workers, workers with more education, workers in urban areas, and natives experience less underpayment as compared to women, single workers, young workers, less educated workers, workers in rural areas, and migrants. For instance, the greater market attachment of men is believed to result in their having better labor market information and higher wage efficiency as compared to women (Groot and Oosterbeek, 1994). Residing in rural areas increases information costs and is likely to result in higher wage inefficiency as compared to the areas with dense population. Because migrants in the labor market usually possess less information

than the native population, the former are expected to experience higher wage inefficiency (Polachek and Xiang, 2005). Contrary to these expectations, we fail to detect significant differences in wage efficiency for the above-mentioned and other population groups (see Table 2). While surprising, such results are not unusual. For instance, Lang (2004) does not detect any difference in wage efficiency between natives and immigrants in Germany; Dar (2006) reports no difference in wage efficiency between Canadian men and women and only a slight advantage for the native-born and university-educated Canadians. Possibly, these results occur from only analyzing the marginal effects of single differences, but more complex comparisons of joint pairs of characteristics might yield statistically significant results. Also for Poland, the extreme upheavals of the transition decade may have sensitized all workers in a similar fashion to information about wages.

Table 2: Wage Efficiency (Percent of the Wage Frontier) by Socio-Demographic Groups

Group	Mean	Std. Dev.	Min.-Max.	N obs.	Group	Mean	Std. Dev.	Min.-Max.	N obs.
All sample	86.0	3.8	42.5-95.4	9380	Industrial worker	86.1	3.8	47.6-95.0	2381
Men	86.0	4.0	42.5-95.4	5208	Machinist	86.0	3.9	48.9-95.4	1259
Women	86.1	3.6	42.8-94.9	4172	Manual worker	86.2	3.4	48.7-94.0	1037
University	85.7	4.7	42.8-94.4	941	Public sector	86.1	3.7	42.5-94.4	4023
Post-secondary	86.0	3.7	73.5-93.8	403	Private sector	86.0	3.9	46.7-95.4	5357
Secondary vocat.	86.1	3.6	47.8-94.4	2764	City (>100 thous.)	85.9	4.2	42.8-95.0	2622
Secondary gen.	86.0	4.0	46.7-94.9	704	Town & rural	86.1	3.7	42.5-95.4	6758
Basic vocat.	86.1	3.7	42.5-95.0	3600	Potential exp. <=10yrs	86.0	3.9	46.7-94.6	2063
Elementary	86.1	3.9	48.9-95.4	968	Potential exp. >10 yrs	86.0	3.8	42.5-95.4	7317
Married	86.0	3.8	42.5-95.4	7011	Firm size (>100 empl.)	86.0	3.9	42.5-94.3	3978
Not married	86.0	3.9	46.7-94.6	2369	Firm size (<100 empl.)	86.0	3.8	46.7-95.4	5402
Top manager	85.7	5.2	42.5-93.6	377	Region South	86.1	3.6	68.6-94.0	1378
Specialist	85.7	4.9	42.8-94.4	620	Region East	86.1	3.5	48.9-95.4	2005
Technician	86.0	3.8	58.8-94.9	1532	Region North-West	86.1	3.8	42.5-94.4	1765
Office clerk	86.1	3.6	46.7-94.3	991	Region South-West	86.0	4.1	42.8-94.9	1071
Services	86.2	3.2	52.7-94.6	1100	Region North	86.0	4.0	46.7-95.0	1749
Farmer	86.2	3.1	76.5-93.5	83	Region Central	85.9	4.1	58.8-93.9	1412

We then looked for a set of selected macroeconomic, demographic, socio-economic, and institutional characteristics that would explain the variation of the efficiency measures. We considered the 16 Polish administrative regions (voivodships), each of which had distinctive labor market characteristics. For each of these regions, we collected specific macroeconomic indicators that we believed could affect an individual's incentives to search for a higher wage and influence the acquisition of additional labor market information. Following Polachek and Xiang (2005), we tested population density, rural population, industrial employment, public sector employment, and the inflow of workers (both from other Polish regions and from abroad). We regressed the logarithms of these variables on the logarithm of the average regional wage efficiency ratio (EFF) defined in Eqn. (3). The estimation results are presented in Table 3.

The "population density" and "public sector employment" coefficients are both positive, which is consistent with economic theory. In the former case, a more dense population implies better access to information as well as more concentrated job opportunities (Sandell, 1980). In the latter case, as Groot and Oosterbeek (1994, p. 388) contend, "workers in the public sector possess more market information than workers in the private sector (…) probably due to the fact that wage policies in the private sector are

in general less public knowledge and more individually based." Also, as expected, the "rural population" coefficient is negative because "rural regions are less concentrated with job opportunities, and therefore likely to result in more incomplete information" (Polachek and Xiang, 2005, p. 17). Our estimation results confirm that the two factors - population density and public sector employment - prolong search by lowering its costs, which in turn leads to gathering more information and increasing wage efficiency; and residing in rural areas has exactly the opposite effect on wage efficiency. While the signs of these three coefficients are in accord with job search theory, their statistical significance is weak, possibly due to a relatively high pairwise multicollinearity among industrial, public and rural employment variables. On the other hand, the "industrial employment" and "inflow of workers" coefficients are statistically significant, but their signs are opposite those expected from other countries' explanations of efficiency relationships. According to Freeman (1980), Polachek and Yoon (1987), Polachek (2004), and Polachek and Xiang (2005), the expected sign is positive for the "industrial employment" coefficient and negative for the "inflow of workers" coefficient. Industrial workers are assumed to be more strongly unionized, leading to more current information on wages and jobs, compressed wage distributions, and an increase in the degree of workers' wage efficiency; and migrants (both internal and from abroad) are assumed to have less knowledge than natives about the distribution of wages in the new region, with consequent higher wage inefficiency. However, this reasoning may not apply to our case because Poland has experienced a dramatic drop in unionization over the 1990s, along with major redistribution of former industrial workers, leaving "survivors" in industry less able to bargain for higher wages. Furthermore, a large portion of migrants in Poland is internal and may be highly sensitized to the opportunities opened by transition processes – they are simply following their new incentives with better labor mobility. Overall, using voivodship characteristics as the basis to explain regional wage efficiencies provides some empirically sensible (although statistically weak) results.

Table 3: Impact of Regional Macroeconomic Variables on the Average Regional Wage Efficiency Ratio [a]

Variable	Coef.	Std.Err.	Mean**
Constant	4.490	(0.096)	
Ln (Population density, persons per sq. km)	0.005	(0.004)	129.6
Ln (Rural population, % of total population)	-0.002	(0.010)	40.1
Ln (Industrial employment, % of total employment)	-0.021*	(0.011)	24.9
Ln (Public sector employment, % of total employment)	0.006	(0.021)	25.2
Ln (Inflow of workers, % of total employment)	0.013*	(0.007)	0.7
R-squared, %	37		
N obs.	16		

** Significant at the 7-8 percent level.*
*** Means of the original variables, not their logarithms.*
[a] *The estimation method is OLS. The dependent variable is LnEFF; the EFF ratio is defined in Eqn. (3).*

INTERNATIONAL COMPARISONS

In this section we provide a more detailed cross-country analysis of wage efficiency. We assess how Poland fits into a group of eleven countries (ten OECD countries and Israel) for which a recent study by Polachek and Xiang (2005) is available. We estimated a wage frontier specification similar to that of Polachek and Xiang, which has a much smaller set of independent variables: years of education, potential experience, potential experience squared, and a dummy for gender (woman). The definitions of these variables in our study are identical to those in Polachek and Xiang's paper, and we can make some qualitative evaluations. Our estimates for Poland appear below theirs in Table 4.

As shown at the bottom of Table 4, the mean number of years of schooling for our Polish sample is 11.985, which is very similar to the means reported for most OECD countries (with the maximum of

13.288 for Canada, and the minimum of 9.492 for Ireland). The average potential experience for Poland is 20.750 years, which again is well within the OECD range – between the maximum of 29.905 (Ireland) and the minimum of 18.450 (Canada). On average, the proportion of women in our sample is 44.5 percent, which is only slightly lower than the 46-52 percent range for OECD countries. The estimated frontier coefficients for Poland are all significant at quite robust *p*-value levels and in strong agreement with those reported in Polachek and Xiang (2005). *Ceteris paribus*, one additional year of education increases the wage frontier by 8.5 percent in Poland and by 6.5-16.1 percent in OECD countries. Polish women face a 23.1 percent lower potential wage than men do with the same characteristics. In Polachek and Xiang's sample, the Netherlands has the lowest female disadvantage (5.8 percent) and Israel has the largest one (51.4 percent). Finally, potential experience exhibits a common concave shape: the positive impact of each additional year of experience on the wage frontier is initially increasing (but at a decreasing rate) and then decreases. One additional year of experience shifts the wage frontier up by 1.8 percent in Poland and by 1.8-4.3 percent in OECD countries. While the estimated wage frontier for Poland is very similar to those reported for OECD countries, the average efficiency ratios differ quite a bit. For Poland, the EFF ratio is 89.1 percent (this estimate is for the parsimonious specification of the wage frontier in Table 4; for our extended specification in Table 1, the EFF ratio is 86.0 percent). For OECD countries the EFF ratio ranges from 43.7 percent (Finland) to 79.6 (UK). Consequently, the INEFF ratio is 10.9 percent for Poland, lower than those for OECD countries.

Table 4: Maximum Likelihood Estimates of the Wage Frontier Coefficients: International Comparison, Polachek and Xiang (2005) Specification [a]

Country	Year	Years of schooling	Potential experience, years	Potential experience squared	Woman	Wage efficiency, %
Canada	2000	0.098	-0.006	0.0002	-0.314	66.0
Czech R.	1996	0.093	0.020	-0.0003	-0.321	72.6
Finland	2000	0.065	0.043	-0.0005	-0.421	43.7
Germany	2000	0.105	0.020	-0.0002	-0.187	64.3
Ireland	1996	0.091	0.038	-0.0004	-0.110	64.7
Israel	1997	0.128	0.042	-0.0005	-0.514	65.9
Netherlands	1999	0.065	0.026	-0.0003	-0.058	70.3
Norway	2000	0.073	0.046	-0.0008	-0.460	51.6
Sweden	2000	0.092	0.036	-0.0005	-0.392	52.9
UK	1995	0.161	0.018	-0.0001	-0.368	79.6
US	2000	0.116	0.027	-0.0003	-0.307	61.6
Poland:	2001					89.1
coefficient		0.085*	0.018*	-0.0002*	-0.231*	
std. error		(0.002)	(0.001)	(0.0000)	(0.007)	
means		11.985	20.750	538.313	0.445	

λ = 0.464* (std.err. 0.080); σ = 0.345* (std.err. 0.005); σ_v^2 = 0.098; σ_u^2 = 0.021; N obs.= 9380

** Significant at a less than 1 percent level.*

[a] *Authors' computations for Poland. For other countries - Polachek and Xiang (2005), Table 2. Polachek and Xiang estimated wage frontier equations for 10 OECD countries and Israel over a number of years. We are using the most recent year for each country from their study.*

Our last step was to repeat the graphical analysis of Polachek and Xiang (2005), not presented here, in order to see where our 2001 Polish results would fit in their scatter diagrams thereby indicating how close Poland was to the typical measure of wage inefficiency in OECD countries. We combined our estimate of wage inefficiency (about 11 percent) with Polish Central Statistical Office measures of population density, rural population, industrial employment, and inflow of foreign workers (both in absolute and relative values). The resulting pairs of numbers were plotted within Polachek and Xiang's Figures 2 to 6. Given that the estimated wage inefficiency ratio for Poland is lower than those for OECD countries, it was not a surprise that in all five cases Poland appears to be an outlier, quite similar to the UK and the Czech Republic that exhibit the lowest inefficiency ratios of Polachek and Xiang's estimates (2005, pp.

24, 29-31). This leads us to speculate that these countries have some unique characteristics that could be the subject of productive future research with regard to wage efficiency. At the same time, we should treat Polachek and Xiang's low wage efficiency results with caution, because they are rather at the low end of the reported wage efficiencies. Many other studies find much higher wage efficiencies – about 80-85 percent, which are more consistent with our findings.

CONCLUSIONS

In this paper, we have applied a stochastic frontier approach in order to analyze the degree of wage efficiency in the Polish labor market in 2001, that is, after more than a decade of transition adjustments and three years prior to joining the European Union. Our findings indicate that full-time hired Polish workers realized 86 percent, on average, of their potential earnings. An international comparison shows that the degree of wage efficiency in Poland is high and quite similar to other developed countries. Our attempt to identify the determinants of wage efficiency in Poland produced mixed results for our specific choice of explanatory variables. However, in sum, the transformed labor market structure in Poland appears to value a sensible relationship between worker skills or attributes and wages paid, similar to other developed economies. Worker performance seems to be rewarded appropriately, with some typical-for-Europe degrees of inefficiency in acquiring information, by a standard of wage efficiency and proximity to the wage frontier.

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