Regional Wage Differentials in Poland

by

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Prepared for the 2016 Meeting
Association for Comparative Economic Studies
Allied Social Science Associations
San Francisco CA
January 5, 2016

Abstract. The study provides a comprehensive examination of regional wage differentials in Poland over 1994-2007 by utilizing both micro- and macro-data. Our analysis reveals that significant wage disparities between the Polish voivodships remain even after controlling for a number of observed socio-demographic characteristics of workers. The estimated relative regional wage differentials (both nominal and real) are in line with the hypotheses drawn from NEG models: they are correlated with historical patterns of agglomeration, market access, regional amenities as well as internal and external migration. Noticeable and persistent wage differences imply that Poland's regional policy was ineffective in reducing regional disparities. However, whether regional inequalities can be and should be eliminated remains an issue for debate.

1. Introduction

After the collapse of the Soviet bloc in the early 1990s, a fundamental process of transition from a centrally planned to a market economy took place in Central and East European (CEE) countries. The main elements of this fast and radical reform process included privatization, deregulation, liberalization, and structural reforms. The transition process was further reinforced in the early 2000s when ten CEE countries joined the European Union, and the remnants of socialism were largely eliminated. Both transition and accession to the EU profoundly transformed the economies in the CEE region. One aspect of this transformation concerns regional geography, namely how transition and European integration affected the spatial distribution of activities, prices and incomes within and between countries and regions. For academic and policy-oriented economists, the ex-communist countries "present an interesting 'laboratory case'", and "it is somewhat surprising, given the vibrancy of the research field and the importance of the issue, that relatively little analysis has been conducted on the transforming economic geographies of CEE countries" (Brülhart and Koenig, 2006, p. 246).

In this study, we focus on Poland, the biggest new EU member state with the total area of approximately 313 thousand km^2 comprising of sixteen sizeable administrative regions, 9-35 thousand km^2 each (see Figure 1). Since the 14^{th} century, a 'voivodship' ('województwo' in Polish) has been the major territorial division in Poland. At the outset of the transition, in the early 1990s there were 49 small and economically weak voivodships. The 1999 Polish local government reform reduced the number of territorial units to 16. The aim of the reform was to create fewer but stronger regions, capable of implementing their local independent policies according to their own needs and priorities. Polish voivodships are equivalent to provinces and correspond to the NUTS 2 level according to the EU Nomenclature of Territorial Units for Statistics.

Regional diversity in Poland manifests itself in various political, economic and socio-cultural forms. For instance, the Polish Central Statistical Office (GUS, 2008, pp. 45, 48, 69; 2009, pp. 73, 89, 91; 2010, p. 627) reported the following ranges for the main regional macroeconomic indicators in 2007[1,2]: 20,829-49,415 zlotys for nominal GDP per capita [30,873 zlotys], 14,995-24,856 zlotys for nominal disposable income per capita [19,477 zlotys], 36.7-87.1% for GDP per capita in PPP as % of the EU-27 average [54.4%], 7.8-18.7% for the registered unemployment rate [11.2%], 1.8-11.3% for the number of persons in households below the extreme poverty line [5.6%], 6.8-18.0% for the number of persons in households below the legal poverty line [10.6%], 149-335 for the number of registered legal business entities per 10,000 population [236] [3], 2,799-8,023 zlotys for business investment per capita [5,030 zlotys], 2,259.70-3,418.86 zlotys for average gross monthly earnings [2,672.58 zlotys]. These statistics suggest that after fifteen years of transition and several years in the EU, Poland still exhibited pronounced spatial differences. A distinctive feature of the Polish regional pattern is that significant regional disparities are not a recent phenomenon associated with the difficulties of the transformation period but have their

[1] For comparison, the value in square brackets shows the national average.
[2] We report the data for 2007 because the period under consideration in this study is 1994-2007. See Section 3 for explanations.
[3] Not including physical persons conducting economic activity.

roots in the eighteenth-century partitions (Hryniewicz, 2007, p. 35; Zientara, 2009, pp. 118-120).[4] Hence, Poland presents a well-suited 'laboratory' case for a formal analysis of the evolution of regional disparities over the past two decades. In the spirit of Brülhart and Koenig, (2006, p. 246), the questions to address would be: Is the old geographic organization in Poland unravelling and giving way to a different spatial distribution of activities, prices and incomes, shaped by market forces? If so, what is the nature of these forces, and what new spatial equilibrium is likely to emerge?

Empirical studies on regional differences in transition economies (and particularly Poland) are rather scant. Those available generally focus on the distribution of output, income, employment and unemployment. Only a small number of researchers consider price effects, in terms of regional wages. The analysis of inter-regional disparities in wages have been typically in conjunction with the distribution of other macroeconomic indicators, but rarely as the main subject of research. We found only a few papers for Poland: Góra and Sztanderska (1998), Duffy and Walsh (2000, 2002), Sibley and Walsh (2002), Egger *et al*. (2005), Rogut (2007), Adamczyk *et al*. (2009), Bogumil (2009), Cieślik and Rokicki (2013a and b, 2015) and Rokicki (2007, 2015). While the empirical evidence is far from conclusive (estimates of regional wage differentials vary considerably because of variations in methodologies used as well as data sources), the majority of studies find that significant inter-regional pay differentials do exist. However, disentangling the sources of differentials in order to explain their persistence and stability over time has proven difficult.

In this paper, we provide a comprehensive examination of regional wage differentials in Poland over the period from 1994, when the country was recovering from its initial transition shock, to 2007 when Poland was a full member of the EU in the mature phase of its transition to a market economy. The evolution of regional earnings is an interesting topic in its own right because the average pay is an indicator of regional well-being along with the commonly used per capita GDP and disposable income. Furthermore, if the wage curve holds for Poland, persistent regional wage differentials may further exacerbate existing unemployment disparities.[5]

What does economic theory tell us about inter-regional wage disparities? [6] The neoclassical paradigm hypothesizes that nominal wages will equalize across regions. Most of the empirical evidence, however, refutes this assertion. Numerous alternative theories have been put forward, including the amenity theory, the efficiency wage hypothesis, the new economic geography

[4] Zientara writes, "The symbolic border between a better-off Poland and a worse-off Poland is the Wisła river. The areas situated to the east of the river, informally called 'Poland B', are commonly associated with agriculture, backwardness and underdevelopment, whereas those located to the west – 'Poland A' – are seen as industrialised, (relatively) modern and developed (with the notable exception of the north-western part)."

[5] Empirical studies generally confirm the existence of the wage curve in Poland with the following overall unemployment elasticities: -0.12 in 1991-1996 (Duffy and Walsh, 2000), -0.11 in 1994-1996 (Duffy and Walsh, 2002), -0.07 in 1995-1998 (Iara and Traistaru, 2004), -0.06 in 1995-2002 (Yamaguchi, 2008), -0.12 in 1995-2005 (Rogut, 2007), -0.06 in 1999-2010 (Baltagi and Rokicki, 2013).

[6] Section 2 provides a brief overview of some major theories of inter-regional wage differentials.

(NEG) theory, the bargaining theory of wages, *etc*. It is worth noting that most theories provide a rationale for equilibrium regional differentials in *nominal* wages but not real wages. Yet, it is clear that nominal earnings may be quite misleading if there are significant differences in regional costs of living. In recent years, alternative frameworks have appeared that incorporate costs of living into the standard NEG approach. The models predict that the clustering of population that leads to agglomeration effects on nominal wages likely adds to the relative cost of living in an area (commuting costs and/or land rents) and may in fact lead to less pronounced regional differences in real wages and to their gradual equalization. While spatial disparities in nominal earnings are reasonably well understood and documented in empirical analyses (especially for developed countries), there is still a shortage of studies about regional real wages due to the fact that data on regional costs of living are typically not collected by government agencies and, hence, unavailable.

The paper contributes to the area of labor economics and transition economics in several ways. First, the predominant majority of previous studies on regional wages in Poland employed macroeconomic data publicly available on the Polish Central Statistical Office website. Due to a high degree of aggregation, such data may not adequately reflect regional differences at the micro level. For this reason, Duranton and Monastiriotis (2002, p. 223) conclude, "aggregate approaches barely say anything about the "how" and even less about the "why" of regional inequalities." Instead, they call for a disaggregated approach (*i.e.*, use of micro data) in the analyses of regional dynamics because measures of regional disparities that take into account regional heterogeneity may be quite different to measures that ignore it. In this analysis, we use *both* micro *and* macro data. Using microdata on individual workers from Polish Labor Force Surveys, we estimate annual regional wage differentials and carefully examine various measures for evidence of convergence or divergence over time. Then we utilize regional macro data in our examination of the determinants of wage differentials across Polish regions over time.

Second, as compared to all other studies for Poland, we consider the longest time span – from 1994 to 2007. Although the number of voivodships in Poland changed from 49 to 16 in 1999, the Polish Central Statistical Office provided us with the 1994-1999 Labor Force Survey data adjusted for the new territorial classification. Such a long time span allows us to extend our gaze over the early and mature phases of transition in Poland as well as the country's early membership in the European Union.

Third, instead of using OLS regression, which has been standard for estimating the Mincerian wage equation, we apply the restricted least squares estimation procedure (Haisken-DeNew and Schmidt, 1997). The advantage of this technique is that the results (*i.e.*, the coefficients on the regional dummy variables, which measure relative regional wage differentials) are independent of the choice of the reference group.

Fourth, our analysis reveals that significant wage disparities between the Polish regions remain even after controlling for a number of observed socio-demographic characteristics of workers. In the study, we try to disentangle what forces cause persistent regional wage disparity in Poland. To our knowledge, so far no study analyzed the relative contribution of different region-specific factors (such as, amenity, agglomeration economies, trade openness, migration, *etc*.) to the remaining (*i.e.*, unexplained by the worker characteristics) portion of the regional wage gaps.

Fifth, the majority of papers analyzing the evolution of regional wage differentials fail to consider differences in the cost of living among regions within the country. Empirical examination of this issue is limited by the general lack of cross-region relative price indices. In this study, we construct a measure of regional cost-of-living conditions (Relative Regional Price Indices) and augment our analysis of regional disparities in nominal wages with the analysis of regional disparities in real wages. We find that the conclusions about the determinants of nominal differentials also hold with regard to real differentials.

Sixth, our study finds evidence for persistent wage (nominal and real) differentials that reflect regional differences in the historical pattern of agglomeration, geographical proximity to external and internal markets and potential for internal and external migration. In this regard, the study may provide an important contribution to the current debate on efficiency and effectiveness of EU regional policy. Regional disparities have been a major concern for European policy-makers since the inception of the European Union (EU) in the 1950s. Attention to this issue intensified after the latest enlargements when several new member countries with relatively low levels of economic development joined the Union. Financial resources for cohesion policy increased significantly and now constitute the second largest outlay in the EU budget after the Common Agricultural Policy. However, research suggests that, while this policy focus may have narrowed disparities between the EU countries, regional differences within member countries – particularly the new ones – have remained stable or even widened (see Busillo *et al.*, 2010 for an overview; also Monfort, 2008, pp. 5-6; EC, 2010a, pp. 13-14; EC, 2010b, pp. 57-58). Our study confirms the presence of this phenomenon in Poland. Growing spatial inequalities pose a key challenge for EU regional cohesion policy. Therefore, it is important for scientists, politicians and society as a whole to understand the determinants of regional disparities and potential reinforcement mechanisms.

The paper is organized as follows. Section 2 provides a brief overview of some major theories of regional wage differentials. Section 3 describes our micro data (Polish Labor Force Surveys), estimation techniques, and the estimated inter-regional wage differentials from the cross-sectional Mincerian wage equations. Section 4 attempts to disentangle the macroeconomic forces causing persistent regional wage disparity in Poland. Section 5 speculates on why European regional policy in Poland was not successful in mitigating large regional inequalities. The final section summarizes our findings and concludes.

2. Theoretical background: An overview

The basic neoclassical model predicts that if information is perfect, transportation costs are moderate, and labor and capital can move freely, then wages of workers with similar human capital characteristics will be equalized across regions (Goldfarb and Yezer, 1976). The empirical evidence, however, suggests that regional pay differentials persist even in highly mobile developed economies. In order to explain equilibrium wage disparities, the simple neoclassical model was extended by bringing into the fold a variety of non-wage factors affecting the location decision of workers (suppliers of labor) and firms (demanders of labor).

For workers, it is hypothesized that they consider both wage and non-wage factors and maximize their overall utility rather than their wages (Roback, 1982, 1988; Rosen, 1986; Gyourko and Tracy, 1989). These unique features are collectively referred to as 'amenities' and may include topography, climate and environment, fiscal conditions, family considerations, availability and quality of public services, *etc*. If workers place a high value on regional amenities, they will tend to move to high-amenity areas, the supply of labor in those areas will increase leading to lower wages. On the other hand, the supply of labor in the areas with severe climate conditions, air pollution, poor public services and other negative regional attributes will decrease leading to higher wages. For firms, the neoclassical approach asserts that they act as profit maximizers and will pay a wage equal to the marginal productivity of labor; hence, wages are assumed to be determined by labor productivity. If the regional characteristics – such as skilled labor, proximity to major markets, good transportation networks, favorable local economic conditions, *etc*. – increase productivity, the demand for labor in those areas will increase leading to higher wages. Conversely, the low productivity-enhancing regional characteristics will decrease the demand for labor and thereby decrease wages in those regions (Beeson and Eberts, 1989). Overall, neoclassical theory contends that if workers and firms take into account regional non-wage factors when making location decisions, wages will not necessarily be equalized across regions even in the competitive market.

A competing model – the efficiency wage hypothesis – offers a further understanding of persistent regional earnings disparities. Unlike neoclassical theory, the efficiency wage model hypothesizes that workers with identical productive characteristics may receive different wages if firms pay premiums in order to minimize turnover, shirking and adverse selection and increase worker loyalty (Katz, 1986). Farber and Newman (1989) show that efficiency wage models may be appropriate for explaining inter-regional wage differentials if the relationship between wages and productivity differs across regions and if inter-regional conditions necessitate regional efficiency premiums. According to this view, regional efficiency wage premiums may also be a source of persistent gaps in regional wages in addition to the productivity and amenity components.

Most recently, the neoclassical theory of wage determination was augmented with the new economic geography approach pioneered by Krugman (1991a,b). As mentioned above, the standard neoclassical model asserts that each region has a specific set of site characteristics which determine its high or low productivity value to firms. In other words, the region-specific productivity factors are taken as given (*i.e.*, exogenous). In contrast, the new approach posits that productivity differences across regional markets are endogenously determined by the level of economic activity (*i.e.*, agglomeration economies) in that region. Moretti (2010, p. 1286) identifies the three most relevant explanations for the agglomeration of economic activity: "(1) advantages deriving from thick labor markets; (2) advantages deriving from proximity to providers of intermediate non-tradable goods and services; (3) localized knowledge spillovers." He explains how the existence of agglomeration economies can generate multiple regional equilibria, some with low economic activity and low nominal wages, and some with high economic activity and high nominal wages. For instance, a thicker labor market in a particular region may produce higher quality worker-firm matches resulting in higher productivity and higher wages in that region. When many firms locate in a dense region, they share a larger and wider regional supply of inputs, which may cause an increase in productivity as well as wages.

The agglomeration of human capital creates regional clusters of high-skilled workers and may generate important knowledge spillovers that increase productivity and efficiency and allow for higher wages. Furthermore, economic agglomeration may create congestion costs, and firms in agglomerated regions must pay workers higher nominal wages.

Institutional factors and regulatory restrictions on labor and firm mobility offer additional explanations for persisting regional pay differentials. Institutional factors typically include such non-competitive forces of wage determination as unionization levels, collective bargaining, contract duration, wage discrimination, market concentration (monopoly or monopsony power), *etc*. For instance, the studies on the effects of unionization and bargaining on wage inequality show that weak unions as well as more decentralized and uncoordinated collective bargaining typically coincide with more pronounced regional wage differences (OECD, 2004; Dell'Aringa and Pagani, 2007; Vamvakidis, 2008). Restrictions on geographic labor mobility also represent a source of persistent inter-regional pay disparities (Topel, 1986; Dickie and Gerking, 1998).

Finally, it is worth noting that in the original core-periphery NEG model of Krugman (1991a), agglomeration equilibria implied regional differences in both nominal and real wages. His model predicted that higher nominal wages along with lower consumer prices would raise real wages in the densely populated industrialized central (*i.e.*, core) region. The assertion of lower costs of living in the core area stemmed from the fact that the model used the price index for manufacturing goods as a proxy for the cost-of-living index, and neglected land scarcity and higher prices for housing, utilities, and public services. In reality, however, these factors appear to be the main reason why dense urban areas are more expensive. When costs of living are incorporated into the standard NEG framework, the model predicts that regional differences in real wages may be less pronounced (than those in nominal wages) or may even dissipate.

Hence economic theory does not provide us with an unambiguous answer to the question whether regional differences in wages should be viewed as a "problem" or simply as a complex phenomenon shaped by a variety of underlying socio-economic forces. Empirical work is needed to validate and evaluate theoretical hypotheses and predictions and to provide insights for policy implications.

3. Estimation of regional wage differentials: data, methodology and results

Labor Force Surveys conducted by the Polish Central Statistical Office in May of 1994-2007 constitute the data source for the estimation of regional wage differentials.[7] We restrict our attention to full-time hired employees because only this category reported their earnings in the survey. We further narrowed our sample of full-time hired workers by deleting those individuals who did not report their earnings, who were full-time students, or handicapped, or younger than

[7] We end our examination of regional wage differentials estimated from LFS data at 2007 for two reasons. First, we consider the early and mature transition periods in Poland up to the start of the global financial crisis. Second, for several years after 2007 the LFS stopped reporting individual actual earnings, but instead reported individual wage data only for relatively wide predefined wage ranges. Furthermore, the Central Statistical Office allowed respondents to opt not to answer this question, and the non-response rate was high in some surveys.

18, or older than 60 (the retirement age for women) or 65 (the retirement age for men). Furthermore, for consistency we controlled if an employee worked 40 and more hours per week on a regular basis. After all these adjustments, we had samples of about 8,000-15,000 full-time hired employees for each year in 1994-2007.[8]

We use two different measures to assess the overall dispersion of regional wages – the weighted average absolute regional wage differential and the standard deviation of regional wage differentials. We first calculate the overall "raw" regional wage differentials (*deltas*) using current wages in Zlotys:

$$\delta_r = \frac{\sum_{i=1}^{n_r} \frac{w_{ir}}{\overline{w}}}{n_r} - 1, \qquad (1)$$

where $r = 1,...,R$; R is the number of regions (*i.e.*, 16 voivodships); $i = 1,...,n_r$; n_r is the number of workers in region r; w_{ir} is the wage of worker i in region r; $\overline{w}$ is the average wage in the national economy. We use two different measures to measure the overall dispersion of regional wages:

the weighted average absolute regional wage differential

$$AVG|\delta| = \sum_r |\omega_r \delta_r| \quad \text{and} \qquad (2)$$

the standard deviation of regional wage differentials

$$SD(\delta) = \sqrt{\sum_r \omega_r \delta_r^2}, \qquad (3)$$

where $\omega_r = \frac{n_r}{N}$ is the share of each region in the total number of workers (N).

As expected, the Mazowieckie voivodship (with the capital city of Warsaw) exhibits the largest positive deviations from the national average: 11% in 1994 and 18% in 2007. As expected, the regions in the Eastern part of Poland typically exhibit the largest negative deviations from the national average wage: Podkarpackie (-13%) and Podlaskie (-15%) in 1994, and Podkarpackie (-13%) and Świętokrzyskie (-15%) in 2007. Our dispersion measures drawn from these average wage data are summarized in Columns (c) and (f) in Table 1. Over all 16 regions, the AVG|*delta*| measure was about 7% and the SD(*delta*) measure was about 9% in both 1994 and 2007. The dynamic pattern of these two measures, however, suggests a decline in regional wage dispersion in 1994-1999, a subsequent increase in 2000-2001, another decline in 2002-2004, and another

[8] Table 1 shows the number of observations in our data sets for each year. A noticeable reduction in the number of observations after 1999 is caused by a significant decrease in the total number of people surveyed in the LFS's. If in 1994-1999 the total number of the surveyed individuals were 65,000-75,000, then in 2000-2007 the total number of the surveyed individuals were 55,000-60,000.

increase in 2005-2007. Of course, these statistics do not control for differences across regions in the characteristics of workers.

To control for observed heterogeneity of workers, we use the Mincerian 'human capital earnings function' (Mincer, 1974) and apply the restricted least squares (RLS) estimation procedure developed by Haisken-DeNew and Schmidt (1997). The advantage of the RLS procedure is that the results are independent of the choice of the reference group, and all dummy coefficients and standard errors are estimated. In our regression, we include 16 regional dummy variables, that is, one dummy variable for *each* of the 16 Polish regions. Hence, there is no reference group for this category; and the estimated regional coefficients are interpreted as percentage-point deviations from the country's average wage (*i.e.*, the regions' weighted average wage).

The Mincerian earnings function is in its traditional semi-log form:

$$\ln W_i = \alpha + X_i\beta + \sum_{r=1}^{R} \delta_r D_{ri} + \varepsilon_i \qquad (4)$$

where $\ln W_i$ is the natural logarithm of monthly earnings of a full-time hired employee i; X_i is a vector of observed characteristics other than the region of residence; D_{ri} is a regional dummy which assumes the value of 1 if worker i resides in region r and 0 otherwise, $r = 1,...,R$, $R = 16$; α, β, δ_r are the coefficients to be estimated; and ε_i is an error term assumed to be $N(0, \sigma_\varepsilon)$. Equation (4) assumes that β's do not vary by region. While not beyond reproach, this assumption is quite common in empirical regional studies (see, for example, Maier and Weiss, 1986; Azzoni and Servo, 2002; Combes *et al*., 2007; Beenstock and Felsenstein, 2008).

Compared to other papers on the Polish wage structure, the specification of the earnings equation in our study is one of the most comprehensive with 65 individual socio-economic characteristics. In addition to the 16 regional dummies, we include: 5 city/town/rural dummies, 5 educational dummies, marital status (married or divorced/separated/widowed vs single as a reference group), whether the worker heads a household, private sector (vs public sector as a reference group), 13 industry dummies, potential experience and potential experience squared, tenure at the current workplace and tenure squared, 8 occupational dummies, permanent job (vs temporary job as a reference group), recent (within the past 12 months) graduate, whether the worker holds a second job, whether the worker is looking for another job in accordance with his/her qualifications, and whether the worker has an additional non-wage source of income.

The wage regression (4) was estimated for each of the 14 years within the 1994-2007 period. The estimated coefficients on the regional dummy variables ($\hat{\delta}_r$) are interpreted as the regional differences in wages that still exist after controlling for the compositional mix of the work force as well as different socio-economic characteristics. Table 2 shows the wage equation results for 2007[9], and Figures 2 and 3 depict the estimated RLS regional wage coefficients for the entire period of 1994-2007.

[9] The results for 1994-2006 are available from the authors upon request.

Figure 3 is the Salter graph, which allows for a visual examination of the dynamics of regional wage premia. To construct it, we first rank all regions according to their wage coefficients in the base year (1994) and place them in this order along the horizontal axis. Keeping the rank positions of regions in the base year constant on the horizontal axis, we show the estimated RLS wage coefficients for 1994 and all subsequent years on the vertical axis. The Salter graph helps us visualize any significant changes in the regional disparity of wages as well as identify low-wage and high-wage regions. Similar to the findings reported for the "raw" wage differentials, the Mazowieckie voivodship (with the capital city of Warsaw) shows the largest positive deviations of wages from the national average, and the eastern regions show the largest negative deviations of wages from the national average. In particular, there is a significantly negative *delta* for the four eastern regions of Podlaskie, Lubelskie, Świętokrzyskie and Podkarpackie. Western regions like Pomorskie, Wielkopolskie, Zachodiopomorskie along with Mazowieckie, which contains Warsaw, and Malopolskie, which contains Krakow, have large positive regional wage *deltas*. Our next observation from the Salter graph is that rapid movements did take place within the distribution over 1994-2007. Finally, there seems to be some tendency towards the horizontality of the series, which implies that there was a general decrease (or, at least, no increase) in regional wage disparities. In other words, we observe some sort of a "catching up" process when low-wage regions (in the low end of the graph) move upward, and high-wage regions (in the high end of the graph) move downward.

While visual inspection of the regional wage distribution can certainly uncover particular evolutions and patterns, it does not provide specific statistical measures of the distribution and its dynamics. Researchers hence turn to Markov chain analysis in order to assess individual inter-class movements within the distribution, mobility speed, and convergence patterns. Table 3 represents a Markovian transition probability matrix. We choose five classes and select the following class limits: less than -0.06, from -0.06 to -0.02, from -0.02 to 0.02, from 0.02 to 0.06, 0.06 and above.[10] Unlike the majority of studies that typically compare the distribution in the initial and final years of the period under examination and fail to capture movements within the period, we incorporate information from *all* years in the estimation period and compute the transition probabilities for all the 13 pairs of adjacent years, *i.e.*, 1994-1995, 1995-1996… 2005-2006, 2006-2007. This approach exploits the panel dimension of the data and gives a more precise estimation of the true transition probabilities (Monfort, 2008, p. 13). Hence, Table 3 represents the evolution of the regional wage premia by a transition probability matrix, in which each element (i, j) shows the probability that a region that was in class i at time t ends up in class j in the following period. For instance, during the 1994-2007 period, there were 17 instances of a Polish voivodship having its regional wage higher than 6 percent of the national average. The majority of these voivodships (88.2%) remained in that size class at the end of the year, while 11.8% moved down one class by the end of the year. On the other hand, there were 14 instances of a region having its regional wage lower than 6 percent of the national average.

[10] It is worth noting that discretization (*i.e.*, the discrete approximation of the range of values into non-overlapping classes as well as the number of classes) uniquely determines the transition probability matrix and hence may have a heavy impact on the results. We have tried several different discretization methods, and can conclude that the results reported in this paper are quite robust.

The majority of these voivodships (64.3%) moved up one class by the end of the year, and only 35.7% remained in the same size class at the end of the year.

The probabilities on the diagonal in Table 3 show a moderate inter-class mobility. Following Pellegrini (2002), we compute a stability index:

$$S = \frac{Tr(P)}{d} \tag{5}$$

where $Tr(P)$ is the trace of the transition matrix P, *i.e.*, the sum of the elements of the main diagonal, and d is the matrix dimension. The value of the stability index is quite high (0.62) suggesting a moderate probability of remaining in the same class of regional wage premia.

Assuming a time-homogeneous Markov chain[11], we can analyze its ergodic properties. An ergodic (also called limiting, long run, equilibrium, or steady state) distribution describes the future distribution of regional wage premia towards which the current distribution will converge in time, given the transition process described by the transition matrix. In our case, the second eigenvalue (λ_2) of the transition matrix is 0.897 < 1, implying ergodicity and the existence of a stationary distribution. The estimated ergodic distribution is shown in Table 3. Concentration of the frequencies in the middle class implies an overall tendency towards the mean; however, the distribution seems to evolve towards one with higher frequencies in the tails (7.2% vs 6.7% and 8.7% vs 8.2%) implying greater dispersion. The speed of convergence to the steady-state distribution can be evaluated by the half-life indicator showing the amount of time periods it will take to cover half of the distance between the current and stationary distributions (Shorrocks, 1978):

$$HL = \frac{-\ln 2}{\ln |\lambda_2|}. \tag{6}$$

An estimated half-life of 6.4 indicates that convergence towards the stationary distribution is extremely slow, *i.e.*, 6.4 periods of 14 years.

We next compute the summary measures of regional wage dispersion using the estimated coefficients on the regional dummy variables from the RLS regressions. We use Eqs. (2) and (3); the latter equation, however, needed to be augmented:

$$SD(\delta) = \sqrt{\sum_r \omega_r \hat{\delta}_r^2 - \sum_r \omega_r \sigma_r^2}\ , \tag{7}$$

[11] A time-homogeneous Markov chain assumes that transition probabilities are time-invariant (*i.e.*, stationary) and that the future transitions depend only on the present class and not on the history. It is clear that the dynamics of the transition is not necessarily constant in time: different periods may exhibit more or less rapid movements within the distribution. In this paper, however, we follow the traditional approach widely used in empirical research on intra-distribution dynamics and assume time homogeneity of the Markov chain.

where σ_r^2 is the variance of $\hat{\delta}_r$. The results are summarized in Columns (d) and (g) in Table 1. Looking at the time series of data on AVG|*delta*| we see that there was a downward trend in measured regional dispersion from 1994 to 1997 followed by a sharp increase in 1998-2001, a sharp decrease in 2002-2005, and a sharp increase in the last two years (2006-2007). The dynamics of SD(*delta*) shows a similar pattern. When we compare 1994 and 2007, we see that AVG|*delta*| increased from 4.1% to 5.2%, and SD(*delta*) increased from 4.9% to 6.2%. The T2 statistic proposed by Carree and Klomp (1997) rejected equality of the variances in 1994 and 2007.

Columns (e) and (h) of Table 1 indicate that controlling for observed worker heterogeneity reduced measured inter-regional wage disparity by 25-50%. For instance, in the Mazowieckie voivodship (with the capital city of Warsaw) in 2007 *deltas* reduce from 18% ("raw") to 12% (RLS). Our further comparison of the two approaches to measuring regional wage disparity, *i.e.*, actual wages vs RLS coefficients, produces an interesting result. Regional wage dispersion as measured by AVG|*delta*| slightly decreased by 3.3% (from 7.5% in 1994 to 7.2% in 2007) when using actual wages, but increased by 25.3% (from 4.1% to 5.2%) when using RLS coefficients. The pattern is similar for SD(*delta*): a decrease by 2.1% (from 8.9% to 8.7%) when using actual wages, but an increase by 26.2% (from 4.9% to 6.2%) when using RLS coefficients. We conclude that controlling for observed worker heterogeneity does reduce regional wage disparity in Poland, but wage differentials still exist, albeit smaller. Moreover, not only do these remaining wage differentials persist, but they seem to intensify over time. These findings are in line with those reported above that the regional wage distribution seems to evolve towards one with greater dispersion.

Our results are consistent with the studies that have reported regional wage differentials for Poland. Generally, the studies found important inter-regional wage differentials with a persistent gap between western and eastern Poland and between the Mazowieckie voivodship (with the fast-growing capital city of Warsaw) and the rest of the country. Some researchers believe that these disparities is a sign of the lack of mechanisms for spatial coordination when growth is not regionally balanced. Growth was (and still is) disproportionately concentrated in a few regions, particularly in the Mazowieckie voivodship (with the capital city of Warsaw), which is the richest region in Poland, and in the western regions. This east-west divide, often referred to as Poland A and Poland B, is a result of long-term inherited trends in institutional development, sectoral specializations, and educational attainment (Gorzelak, 2006; Piasecki, 2006). Some researchers argue that the usual mechanisms of regional equalization (such as migration) in Poland are ineffective, and labor-market adjustments typically take place through changes in the labor force participation rather than through wage flexibility (Bogumil, 2009). In the next section we will attempt to disentangle the relative contribution of different region-specific factors (such as, amenity, agglomeration economies, trade openness, migration, *etc*.) to this remaining portion of the regional wage gaps in Poland.

4. The impact of region-specific factors on regional wage differentials

4.1. Nominal wage differentials

We turn to an examination of the cross-region correlates of the wage differentials identified in the previous section. As explained in Section 3, the cross-section Mincerian wage regression (Eq. 4) was estimated for each year within the 1994-2007 period. Thus, for each region we have 14 estimated coefficients $\hat{\delta}_r$. In order to indicate the year of observation, in the following discussion we introduce the subscript "t". The RLS coefficient estimates for each region and each year ($\hat{\delta}_{rt}$) identify the positive or negative percentage difference between the regional wage and the average wage across all regions. We transform those coefficients in two ways. First by adding one to each of the coefficient estimates, we convert them into relative nominal wage ratios. We then take the logarithm of the relative nominal wage ratio and use this variable, $\ln(\hat{\delta}_{rt}+1)$, as the dependent variable in regressions focused on determinants of nominal wage differentials across Polish regions.

The NEG concept of wage-augmenting agglomeration economies and Hanson's (2005) derivation of an equilibrium wage relationship from NEG theory guide our approach. In his formulation, the nominal wage level in region r depends on its market potential, measured by economic activity in neighboring regions weighted by their distance from r, the size of the local housing stock, which captures the ability of region r to accommodate in-migration, and wages in other regions. Cieślik and Rokicki (2013a and b) examine the relevance of this approach to regional wage determination in Poland. They find a positive correlation between internal market potential, measured by proximity to Warsaw or by GDP in surrounding regions weighted by inverse distance, and regional wage levels. However, they find little evidence to support the idea that external market potential, measured by proximity to the German border, affected regional average wages in the period from 1995-2009.

We measure regional agglomeration and market potential with six variables. Agglomeration is captured by the logarithm of population density in each region at the beginning of the transition in 1990 ($\ln \mathrm{Den1990}_r$). Two measures of proximity to regions with market potential are the logarithm of travel distance in kilometers from the principal city in each region to the center of the Polish economy in Warsaw ($\ln \mathrm{DisW}_r$)[12] and to the center of the EU in Brussels ($\ln \mathrm{DisB}_r$). We also measure access to external markets with dummy variables indicating whether the region was located on the Baltic Sea coast (Coast_r), the border with the EU before 2004 ($\mathrm{EU}_{r,t<2004}$) and the border with the EU after 2004 ($\mathrm{EU}_{r,t>=2004}$). We assume these variables are exogenous determinants of regional relative wages since they are geographic characteristics or, in the case of density, predetermined by policies and developments during the Communist era (Korcelli, 2005).

[12] Distance to Warsaw for the Mazowieckie region was approximated as $\frac{1}{3} * \sqrt{\frac{\text{area of region}}{\pi}}$, that is, one third of the radius of a circle with the same area as the Mazowieckie region (Leamer, 1997; Keeble *et al*., 1982).

In line with Hanson's model, studies of inter-regional migration by Bogumil (2009), Ghatak *et al.* (2007) and Dustmann and Görlach (2015) find that the very low rate of inter-regional migration seen within Poland largely reflects the availability of housing with in-migration rates highly correlated with the housing stock in destination regions. While migration between regions in Poland is low by international standards, emigration by Poles to other countries has historically been quite high and accelerated markedly with Poland's entry into the EU in 2004 (Okólski, 2006; Budnik, 2007; Kaczmarczyk and Okólski, 2008). Dustmann *et al*. (2015) present evidence for a positive correlation between regional differences in Polish emigration rates and average wages for lower skilled workers remaining in the home region.

Our regressions thus include three variables designed to control for the potential effect of labor supply changes through internal and external migration on regional relative wages through. The first is the logarithm of the region's stock of dwelling units relative to the resident population at mid-year ($\ln \text{House}_{rt}$). The second is the logarithm of the number of permanent emigrants from each region per 10,000 people in the resident population ($\ln \text{Emigr}_{rt}$). In addition, since Partridge (2010) finds that migration-inducing climate amenities are more important determinants of regional growth patterns in the U.S. than NEG type agglomeration effects, we include a measure of climate differences across Polish regions in our analysis. This is the logarithm of the ratio of average Centigrade temperature in each region over the period from 1981 to 2010 to the temperature range over the same period ($\ln \text{Climate}_{r}$). We assume these variables are also exogenous since climate is independent of regional labor market developments, the housing stock evolves slowly over time and factors external to the country and region are the most important drivers of emigration from Poland (Zaiceva, 2014). In a later section, we examine instrumental variable estimates that treat emigration as an endogenous regressor.

Table 4 presents regression estimates of the determinants of nominal regional relative wages in Poland along with descriptive statistics for all of the variables. Data for the independent variables mainly come from the Polish Central Statistical Office (Główny Urząd Statystyczny) website (http://stat.gov.pl/). The climate data are from the official website of the Polish National Meteorological Service **(**Państwowa Służba Hydrologiczno-Meteorologiczna) which is found at: http://www.pogodynka.pl/polska/daneklimatyczne/. Regional data on the number of dwellings and emigrants for each region are available only from 1995 so the results in Table 4 cover the period from 1995 to 2007. The first regression presents OLS estimates while the second presents weighted least squares results, using the inverse squared standard errors of the region coefficients from the Mincer cross-section regressions as analytic weights. This regression gives greater weight to region by year observations with more precise estimates of the regional wage coefficient.

The coefficient and robust standard error estimates in both regressions are very similar. The six variables measuring aspects of market potential are all statistically significant at the one percent level and have impacts on nominal regional relative wages that are consistent with the hypotheses in Hanson (2005). Regional relative wages are higher in areas with greater population density at the start of the transition to the market economy. A ten percent higher initial density level is associated with a four percent higher relative wage. The nominal

regional relative wage falls with distance from both Warsaw and Brussels with the elasticity estimate for the latter variable about three times larger at 0.21. Regional proximity to the center of the external EU market is more important than proximity to the center of the Polish economy. Regions on the Baltic coast with enhanced proximity to the Nordic countries and, indeed, the world have nominal relative wages about 6% higher than other regions. In addition, relative wages are about 2 to 3% higher for regions directly on the border with the EU both before and after the accession of Poland and other Central and Eastern European countries in 2004.

It appears that the EU border wage advantage may be slightly higher for the post-accession period but the difference in the coefficients on $EU_{r,t<2004}$ and $EU_{r,t>=2004}$ are not statistically significant. We also tested for pre- and post-accession differences in the coefficient estimates for the other market potential variables but none was statistically significant. As pointed out by Cieślik and Rokicki (2013b), Poland pursued an asymmetric trade liberalization policy with Germany and the EU right from the beginning of the transition in 1990 so that the process of economic integration with the EU began well before 2004. Looking at the effects of EU accession from the other side, Braakman and Vogel (2011) also find minor post-accession effects on small to medium size German firms located close to the Polish and Czech borders.

The estimated coefficients on the three migration related variables present interesting results. As suggested by the Hanson (2005) model, nominal regional relative wages are lower in regions with more abundant dwelling units relative to the resident population, since these regions can more readily accommodate the in-migration of workers attracted by higher labor demand. Relative wages are also lower in regions with more attractive climates although $\ln \text{Climate}_r$ is statistically significant at just the 0.07 level in the OLS regression.

Finally, the rate of emigration from a region has a statistically significant positive effect on nominal regional relative wages, suggesting that a reduction in local labor supply from outmigration raises relative wages for workers who remained at home. However, our estimates are that a ten percent increase in the regional emigration rate raises the regional relative wage by less than one percent. Dustmann *et al*. (2015) report a slightly higher elasticity of regional wage levels to emigration from Poland and Mishra (2006) and Hanson (2007) both report substantially higher home wage effects related to emigration from Mexican regions. This may be because our emigration variable captures only the number of people registered as leaving a region for permanent residence abroad. It does not capture temporary emigration nor does it measure emigrants who fail to register their change in residence, both of which have been important components of emigration from Poland (Bijak and Koryś, 2006; Dustmann and Görlach, 2015).

4.2. Real wage differentials

We take advantage of available annual regional and national price data for more than 130 goods and services to construct relative regional price indices (RRPI) beginning in 1999. The Polish Central Statistical Office reports prices in eight major categories: food and non-alcoholic beverages; alcoholic beverages and tobacco products; apparel and shoes; housing, utility and

household equipment and furnishings; health; transportation; recreation and entertainment; and other.

For each voivodship, we first computed a relative regional price ratio for each of the eight categories as the arithmetic mean of the price ratios (price in the region / price in Poland) for all goods and services listed in each category. We then calculated the RRPI as the weighted average of a region's relative price ratios, multiplying the relative regional price ratio for each major category by its relative weight in the consumer basket. The relative weights were those used by the Polish Central Statistical Office to calculate the CPI.

An example in Appendix A explains in detail how we calculated the RRPI for the Mazowieckie region in 2007. We computed the RRPI indices for all other years and regions in a similar fashion. The relative regional price index for each region shows the difference in living costs between a particular region and the national average level. If the RRPI is equal to 1, it implies that the price level in this region equals the average price level in Poland; if the RRPI is greater (less) than 1, the price level in this region is higher (lower) than the average price level in Poland.

We use the constructed RRPI to adjust our estimates of relative nominal wages in each region and each year to form a real relative wage variable equal to $\frac{\hat{\delta}_{rt}+1}{RRPI_{rt}}$. The logarithm of this relative regional wage differential is the dependent variable in two of the regressions reported in Table 5, which also reports OLS and weighted least squares estimates along with descriptive statistics for each variable. Since the cross-region price data are available beginning only with 1999, Table 5 also reports results with the nominal regional relative wage as the dependent variable over the 1999 to 2007 period for comparative purposes.

We see only marginal changes in the estimated effect of our market access and migration-related variables when comparing regressions with the real relative wage v. the nominal relative wage as the dependent variables. The estimated wage advantage to regions with higher initial population density, to those on the Baltic Sea coast and to those on the border with the EU before and after 2004 are slightly smaller in the regressions in Table 5 as compared to results reported in Table 4. The elasticities of relative wages to distance from Warsaw and Brussels are also slightly smaller for real than for nominal wages. The general conclusion is that regional access to internal and external markets and differences in factors affecting internal and external migration are important determinants of wage differences across Polish regions even when we control for differences in the cost of living across regions.

Our findings are in contrast to those of Egger *et al*. (2005), who analyzed regional disparities within eight Central and East European countries in 1991-1998 and found significant convergence of real wages in Poland.[13] At the same time, our findings are in line with a

[13] It is worth to note that the authors found regional convergence in real wages only for Poland and Bulgaria. For Romania wage convergence was insignificant, and in all other countries (Czech Republic, Estonia, Hungary, Slovakia, and Slovenia) evidence suggested divergence. The

methodologically similar and more recent study for Poland by Rokicki (2015). Like us, Rokicki adopts a more nuanced approach and constructs regional PPP deflators for the 16 Polish voivodships in 2000-2011.[14] He reports: "the application of regional PPP deflators significantly decreases the overall level of wage disparities across Polish regions (as compared to nominal wages). Nevertheless, it does not significantly change the overall pattern of their evolution. Hence, there is a tendency toward regional real wage divergence rather than equalization" (p. 353).

As a robustness check, we also estimated the model with the logarithm of the nominal relative wage as the dependent variable and the logarithm of our regional relative price index as a right hand side variable. The estimated coefficient on the relative price index was not significantly different from one and there was no major impact of this specification on the coefficients or standard errors of the remaining independent variables. These results are available from the authors on request.

4.3. Endogeneity of emigration

The regressions reported in Tables 4 and 5 assume that the emigration rate is an exogenous variable since the main drivers of emigration from Poland appear to be network connections with previous migrants and the substantially higher wages in destination countries (Kaczmarczyk and Okólski, 2008). Here we check on that assumption by treating $\ln Emigr_{rt}$ as an endogenous regressor and estimating our model by two-stage least squares. As instrumental variables we use a four year lag on the regional emigration rate ($\ln Emigr_{r,t-4}$) and a one year lag of the logarithm of employment in the main European destinations for Polish emigrants as network and external labor demand determinants of current emigration. The destination countries were Germany and Italy for the years prior to 2004 and, after accession, Germany, Italy, the UK, Ireland and Sweden.

Table 6 presents two-stage least squares estimates of the nominal relative wage and real relative wage models for the 1999 to 2007 period. Tests of the over identifying restrictions in these models cannot reject the null hypothesis of valid instruments and tests of the endogeneity of $\ln Emigr_{rt}$ cannot reject the null hypothesis that this variable is exogenous. The main effect on the coefficient estimates is a slight increase in the elasticity of relative wages in response to the emigration rate.

As a robustness check we substituted the net emigration rate for each region and time period for $\ln Emigr_{rt}$ in the OLS, weighted least squares and two stage least squares regressions. This

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shortcoming of this study was that the authors used the national (*i.e.*, not regional) consumer price indices to convert nominal wages into real wages.

[14] Rokicki uses the Éltetö-Köves-Szulc method (Köves, 1999) to calculate regional PPP deflators. Despite a more sophisticated methodology, the values of his regional price indices are very close to ours, suggesting that our indices provide accurate and reliable estimates of the regional cost of living. For instance, for the Mazowieckie voivodship, our RRPI is 1.024 for 2007, and Rokicki's PPP deflator is 1.036 for 2011. For the rest of voivodships, see Appendix B.

variable had a statistically significant negative effect on relative wages, which is consistent with the idea that the greater the rate of outmigration from a region, the smaller is regional labor supply and the higher is the regional relative wage. Regression results with this variable are available from the authors by request.

5. EU regional policy[15] and persistent regional disparities

Economic and social cohesion has been one of the fundamental objectives of European regional policy. The preamble of the Rome Treaty (1957) defined the mission of the EU cohesion policy as the need to ensure "harmonious development by reducing the differences existing between the various regions and the backwardness of the less favoured regions." The Single European Act (1986) established a European Community policy of economic and social cohesion, and the Lisbon Treaty (2007) recognized 'territorial cohesion' as a general political objective in addition to economic and social cohesion.

As a candidate country, Poland started receiving support from the Instrument for Structural Pre-accession Assistance (ISPA) as early as 2000. After accession to the EU in 2004, Poland became eligible for support from the EU Structural and Cohesion funds. Since 2004, Poland has been one of the main beneficiaries of EU regional policy since the allocation of funds depends, among other things, on a country's area, population and GNP. In 2000-2006, the EU allotted to Poland €14.2 billion (€8.6 billion from structural funds, €4.2 billion from the Cohesion Fund, and €1.4 billion from the ISPA fund) which constituted 6% of the total EU expenditure on these programs and more than a half of the funds allocated to the new member states.[16] Yet, Poland continues to exhibit strong regional asymmetries that seem to persist and even to intensify over time.[17]

Are these persistent regional disparities an objective phenomenon or a failure of EU cohesion policy? In 2002-2014, 976 studies evaluated the results of EU cohesion policy in Poland (MID, 2014). Different data sources and evaluation methods produced different estimates of the likely positive impacts of regional policy interventions. At the same time, doubts regarding the effectiveness of this policy also emerged.[18] Several plausible reasons were put forth to explain

[15] Whereas EU regional policy, cohesion policy and structural policy differ in their objectives, methods of financing and implementation, in this study these terms are used interchangeably, assuming that all three have the same ultimate objective of levelling economic differences among regions.

[16] Although this period is beyond the scope of this study, it is worth to noting that in the 2007-2013 planning period Poland became the main beneficiary with €67.3 billion (about 20% of the total EU structural and cohesion funds).

[17] In addition to growing regional disparities at the NUTS 2 (voivodship) level, the diverging tendencies were also documented at the NUTS 3 (poviat) level. See, for instance, Kowerski *et al*. (2014) who report growing regional polarization within the Lubelskie voivodship. The authors coin a "two-speed voivodship" term, similar to "two-speed Europe."

[18] It is worth to note that these doubts apply to the entire EU, and not only to Poland. The most widely cited works questioning the effectiveness of EU regional policy are Boldrin *et al*. (2001) and Ederveen *et al*. (2003, 2006).

the seeming absence of causal links between EU funding goals and regional convergence in Poland.

European regional policy in Poland is implemented at the NUTS 2 (*i.e.*, voivodship) level; thus, delineation of basic territorial units is of particular importance. Some economists argue that the Polish administrative structure is a serious impediment to effective regional policy. One group of economists criticizes the large number of voivodships, their unequal size and inadequate extent of devolution. For instance, Zientara (2009) states that large and rich voivodships managed to secure more EU grants and hence implement more regional projects due to their ability to co-finance,[19] while smaller and poorer voivodships received significantly less assistance from the EU. On the other hand, another group of economists believes that the Polish voivodships are too large, heterogeneous and often disintegrated, which makes the formulation of the regional policy objectives and goals difficult (Kowerski *et al*., 2014). The authors assert that regional policy would be more effective if conducted at the NUTS 3 (*i.e.*, poviat) level, which corresponds to smaller areas with stronger internal cohesion and distinct socio-cultural-economic homogeneity. However, unlike voivodships, poviats are not legal entities, do not have administrative and decision-making power, and statistical data for them are limited and delayed in collection and compilation.

There are also increasingly critical voices claiming that cohesion policies are ineffective in Poland because of 'the legacies of the past', that is, centralization, weak institutions and civil society, politicization of administration, bureaucratic rigidity, high corruption, and limited inter-institutional trust and collaboration (Dąbrowski, 2012, 2014). Dąbrowski's findings from the Śląskie and Lubelskie voivodships revealed that the adjustments to the EU policies' frameworks among regional administrators remained shallow and superficial due to their limited learning capacity. This resulted in formal compliance with the major principles of EU regional policy without fundamentally changing the preexisting 'ways of doing things', which in turn limited the effectiveness of the policies in question (*ibid.*, 2012, p. 731). Weak or poorly enforced mechanisms of accountability led to questionable choices as regional planners tried to allocate European resources to local projects in accordance with their self-interest and electoral concerns.

Many scholars maintain that EU regional policy has been successful in achieving convergence at the country level, and consider growing regional inequalities within countries a consequence (or a by-product) of a fast national catching-up process. This belief is based on theoretical and empirical works by a number of economists, from Kuznets (1955) and Williamson (1965) to Lucas (2000). They all suggest that regional inequalities follow a bell-shaped curve: economic growth at the national level first increases regional inequalities within a country but then tends to lessen them as the per capita national income level continues to rise. Kusideł (2013, pp. 50-152) tests this hypothesis econometrically using Polish regional data for 1995-2009. Her findings reveal growing regional divergence, however, according to the author, the values of the estimates suggest that regional disparity will soon reach its maximum and then will start to decline. If the

[19] The use of EU grants is subject to the co-financing (also known as additionality or complementarity) principle, which requires that at least 15% of the value of a project is financed from national/regional resources.

'bell-shaped' hypothesis is true, then regional inequalities are unavoidable, especially during the early stages of national catching-up processes in the least developed new EU member states.

Finally, most analysts agree that EU regional policy in Poland embodied the 'two-track' approach. On the one hand, it stimulated the development of metropolises and metropolitan regions by directing there the bulk of the EU co-financed investment (Bogumil, 2009). For instance, in the 2004-2006 programming period, in the Mazowieckie voivodship the number of co-financed projects was 10,832 with the total cost of 13,452.7 million zlotys (14-16% of the country's total); while in the Lubuskie voivodship – 1,409 and 1,803.9 million zlotys (1-2%), respectively. On the other hand, billions of Euros of financial support were channeled to the lagging peripheries in order to help them to catch-up. According to Brakman *et al*. (2005), the incoherence of European regional policy is conspicuous: "simultaneously promoting agglomeration and dispersion is bound to be ineffective (…) the incoherence stems from the difficulty to strike a balance between boosting overall productivity and growth, which is associated with agglomeration, and reducing regional disparities of wealth and employment, which is associated with dispersion" (p. 49). Evidently, the efficiency-equity (or, in other words, agglomeration-dispersion) tradeoff of regional policy in Poland was solved in favor of the former.

In this short discussion, we do not intend to determine which of the two outcomes of regional policy – polarization or cohesion – will prevail in the long run. In NEG terms, if agglomeration equilibria are the objective rule, then regional disparities (including those in nominal and real wages) are here to stay and difficult to counter with regional policies. At the same time, many scholars and practitioners would agree that policy makers should not abandon the goal of reducing spatial inequalities. There is an urgent need to reconsider EU regional and cohesion polices to adapt them to changes in economic theory, socio-economic trends, and globalization. Barca *et al*. (2012) summarize recent policy debates on the two emerging schools of thought, namely place-neutral and place-based policies for economic development. Regional policy in Poland has also been undergoing a fundamental change. In 2010 Poland developed a new paradigm and strategy for regional development, which are distinct from those of the EU (Ferry, 2013; Ambroziak, 2014).

6. Conclusion

The spatial disparities in Poland and in the EU as a whole are in striking contrast to the influential view (*e.g.*, Caimcross, 1997; Friedman, 2005) that in the twenty-first century geography will not matter. In this view, location will become irrelevant in the globalized world, and regional differences will dissipate because of decreasing transport costs and disappearing communication barriers. However, we observe exactly the opposite trend: regional divergence within countries increases, regions become more polarized, and location still matters.

Our analysis of Polish Labor Force Survey data from 1994 to 2007 indicates the presence of significant wage differentials across the 16 NUTS 2 regions (vovoidships) in Poland that have persisted over time. Controlling for a large number of individual wage determinants in annual cross-section Mincerian regressions serves to reduce but not eliminate the disparity in wages across regions. While it appears that some convergence occurred during the 1990s, this was

offset by developments during the period from 2000 to 2007. In the end, after controlling for detailed worker characteristics, our summary measures of regional wage dispersion in Poland were fully 25% higher in 2007 than in 1994.

Using our annual estimates of regional wage differentials as dependent variables in regressions across regions over time, we find evidence that is in line with the hypotheses drawn from NEG models. Regional differentials are positively correlated with historical patterns of agglomeration, as measured by population density in 1990 at the beginning of the economic transition in Poland, and with market access, measured by proximity to Warsaw and Brussels and location on the Baltic coast and the EU border. There is also evidence that regional wage differentials responded to the potential for internal migration and external migration. Differentials were lower in regions with more housing and a warmer climate and higher in regions that experienced larger outflows of people to other countries. We were able to take advantage of available data to construct indices of cross-region differences in the cost of living and measure real regional wage differentials. The conclusions about the correlates of nominal differentials also hold with regard to real differentials.

The evidence we find for the importance of historical agglomeration patterns and geographic location in explaining regional labor market differences in Poland raises the old question of whether policies to enhance worker mobility might be more effective at reducing regional disparities than policies designed to boost local labor demand. The transition to a market economy and growing economic ties with the EU do not appear to have changed significantly the historical wage disadvantage of Poland's eastern regions. As EU funding for regional development proceeds in the current budget cycle, a careful examination of the ability of such spending to overcome the historical and geographical determinants of disparities between Poland's eastern and western regions is needed. This might provide insight into the relative effectiveness of local development versus enhanced mobility in affecting labor market disparities on this part of the EU's eastern border.

Appendix A. Calculation of the Regional Relative Price Index (RRPI)

The Polish Central Statistical Office reports prices in eight major categories: food and non-alcoholic beverages; alcoholic beverages and tobacco products; apparel and shoes; housing, utility and household equipment and furnishings; health; transportation; recreation and entertainment; and other.

For each voivodship, we first computed a relative regional price ratio for each major category as the arithmetic mean of the price ratios (price in the region / price in Poland) for all goods and services listed in this category. The "food and non-alcoholic beverages" category includes 48 products. In 2007, the price of 1 kg of rice was 2.89 Zlotys nationally and 3.25 Zlotys in the Mazowieckie region, implying the price ratio of 1.125. The price of a wheat roll (50 g) was 0.35 Zlotys nationally and 0.32 Zlotys in the Mazowieckie region, implying the price ratio of 0.914. The price of a loaf of rye bread (0.5 kg) was 2.04 Zlotys nationally and 2.04 Zlotys, in the Mazowieckie region, implying the price ratio of 1.000. We computed the price ratios for the Mazowieckie voivodship for the remaining 45 products in the "food and non-alcoholic beverages" category and then computed the arithmetic mean of these 48 price ratios. The calculated average ratio was 1.033 meaning that, on average, prices of food and non-alcoholic beverages in the Mazowieckie region in 2007 were 3.3% higher than the national average.

The "apparel and shoes" category includes 17 products. In 2007, the price of a wool coat for women was 598.53 Zlotys nationally and 689.79 Zlotys in the Mazowieckie region, implying the price ratio of 1.152. The price of a pair of leather shoes for men was 149.85 Zlotys nationally and 158.58 Zlotys in the Mazowieckie region, implying the price ratio of 1.058. The price of a winter jacket for children 2-6 years of age was 95.74 Zlotys nationally and 104.96 Zlotys in the Mazowieckie region, implying the price ratio of 1.096. The calculated average ratio for all 17 products in this category was 1.042 meaning that, on average, prices of apparel and shoes in the Mazowieckie region in 2007 were 4.2% higher than the national average.

The overall RRPI for the Mazowiecki region in 2007 was computed by multiplying this region's relative price ratio for each major category of products by the relative weight of this category in the consumer basket and summing the results. In 2007, the weight of food and non-alcoholic beverages in the consumer basket was 26.20%, the weight of apparel and shoes was 5.38%, *etc*. Therefore, the overall RRPI = 1.033*0.2620 + 1.042*0.0538 + *etc*. for all other major categories = 1.024, meaning that the price level (for a particular bundle of goods and services) in this region was 2.4% higher than the price level (for the same bundle of goods in services) in Poland as a whole.

Appendix B. Comparison of our RRPI and regional PPP deflators from Rokicki (2015)

The table below compares our Relative Regional Price Indices (RRPI) used in this analysis and regional PPP deflators reported in Rokicki (2015).

Region	Our RRPI for 2007	Rokicki's PPP deflator for 2011
Dolnośląskie	1.000	1.011
Kujawsko-Pomorskie	0.972	0.994
Lubelskie	0.969	0.964
Lubuskie	1.042	1.026
Łódzkie	0.986	1.003
Małopolskie	1.014	1.004
Mazowieckie	1.024	1.036
Opolskie	0.985	0.988
Podkarpackie	0.971	0.978
Podlaskie	0.973	0.974
Pomorskie	1.038	1.034
Śląskie	1.007	1.013
Świętokrzyskie	0.985	0.985
Warmińsko-Mazurskie	0.981	0.989
Wielkopolskie	0.981	0.984
Zachodniopomorskie	1.033	1.022
Poland	1.000	1.000

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Table 1. Summary measures of the overall dispersion of regional wages: AVG|*delta*| and SD(*delta*)

Year	N obs	AVG|*delta*|			SD(*delta*)		
		using actual wages	using RLS coefficients	reduction in dispersion, % (d/c-1)*100%	using actual wages	using RLS coefficients	reduction in dispersion, % (g/f-1)*100%
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
1994	14941	0.0746	0.0411	-45.0	0.0886	0.0487	-45.0
1995	15245	0.0668	0.0347	-48.1	0.0768	0.0434	-43.5
1996	14708	0.0588	0.0317	-46.0	0.0682	0.0379	-44.4
1997	14566	0.0537	0.0262	-51.2	0.0634	0.0331	-47.8
1998	14600	0.0580	0.0374	-35.6	0.0704	0.0444	-36.8
1999	13312	0.0488	0.0354	-27.6	0.0592	0.0440	-25.7
2000	9599	0.0641	0.0375	-41.4	0.0897	0.0488	-45.6
2001	9461	0.0750	0.0461	-38.5	0.1003	0.0581	-42.1
2002	8636	0.0711	0.0404	-43.1	0.0968	0.0558	-42.4
2003	8040	0.0509	0.0411	-19.3	0.0619	0.0495	-20.1
2004	8116	0.0455	0.0306	-32.9	0.0601	0.0378	-37.2
2005	7924	0.0559	0.0271	-51.6	0.0670	0.0352	-47.5
2006	8147	0.0683	0.0400	-41.5	0.0846	0.0508	-39.9
2007	8391	0.0721	0.0515	-28.6	0.0867	0.0615	-29.0

The table shows the weighted average absolute regional wage differential (AVG|*delta*|) and the standard deviation of regional wage differentials (SD(*delta*)), where *deltas* are regional wage differentials measured as deviations from the average wage in the national economy.

Table 2. Mincerian 'human capital earnings function':
the restricted least squares (RLS) estimation procedure, 2007

Category	Variable	Coef	StErr	*t*-stat	Mean
Gender (Ref: Woman)	Man	0.219	0.009	24.644	0.563
Education (Ref: Elementary or incomplete elementary)	University	0.333	0.020	16.454	0.167
	Post-secondary	0.167	0.023	7.338	0.044
	Secondary vocational	0.134	0.016	8.534	0.278
	Secondary general	0.137	0.019	7.297	0.084
	Basic vocational	0.044	0.014	3.044	0.348
Marital status (Ref: Single)	Married	0.052	0.010	4.989	0.707
	Divorced/separated/widowed	0.021	0.018	1.164	0.060
Position in the household (Ref: Other)	Head of household	0.104	0.008	12.429	0.495
Sector of employment (Ref: Public)	Private	0.062	0.012	5.157	0.659
Industry (Ref: Other)	Agriculture and fishing	-0.057	0.030	-1.859	0.028
	Mining	0.198	0.032	6.121	0.021
	Manufacturing	-0.018	0.022	-0.820	0.306
	Energy supply	0.048	0.031	1.510	0.020
	Construction	0.057	0.024	2.356	0.077
	Trade	-0.027	0.023	-1.169	0.146
	Lodging and restaurants	-0.035	0.032	-1.084	0.021
	Transportation	0.088	0.024	3.731	0.073
	Financial services	0.094	0.031	2.992	0.021
	Real estate	-0.056	0.026	-2.183	0.043
	Public administration and defense	0.065	0.023	2.786	0.087
	Education	-0.066	0.025	-2.639	0.051
	Health care	-0.131	0.024	-5.422	0.070
Potential experience = Age(years) – Years of education - 6	Potential experience, years	0.012	0.002	7.135	20.839
	Potential experience squared	-0.00027	0.00004	-7.563	557.780
Tenure at the current workplace	Tenure, years	0.004	0.001	3.058	9.322
	Tenure squared	-0.00004	0.00004	-0.921	176.672
Firm size (Ref: < 5 employees)	6-20 employees	0.058	0.013	4.563	0.196
	21-50 employees	0.084	0.013	6.293	0.180
	51-100 employees	0.099	0.014	6.995	0.150
	> 100 employees	0.163	0.013	12.627	0.341
Occupation (Ref: Manual worker)	Top manager	0.494	0.022	22.215	0.044
	Specialist	0.309	0.019	15.920	0.105
	Technician	0.230	0.017	13.709	0.120
	Office employee	0.061	0.017	3.564	0.092
	Services	0.045	0.017	2.702	0.135
	Farmer	0.030	0.051	0.591	0.006
	Industrial worker	0.047	0.014	3.292	0.241
	Machinist	0.069	0.015	4.535	0.148

Category	Variable	Coef	StErr	*t*-stat	Mean
Type of employment (Ref: Temporary)	Permanent	0.098	0.010	10.050	0.725
Graduation (Ref: Graduated more than a year ago)	Recent (i.e., within the past 12 months) graduate	-0.120	0.019	-6.457	0.045
Second job (Ref: no second job)	Yes, the worker holds a second job	0.008	0.013	0.607	0.098
Looking for another job (Ref: Not looking)	Yes, the worker is looking for another job in accordance with his/her qualifications	-0.110	0.067	-1.640	0.003
Additional source of income (Ref: No additional sources of income)	Yes, the worker has an additional non-wage source of income	-0.089	0.024	-3.792	0.024
Region (voivodship)	Dolnośląskie	0.025	0.012	2.097	0.079
	Kujawsko-Pomorskie	-0.052	0.015	-3.467	0.053
	Lubelskie	-0.047	0.014	-3.467	0.065
	Lubuskie	0.024	0.014	1.706	0.059
	Łódzkie	-0.051	0.013	-4.032	0.073
	Małopolskie	0.053	0.017	3.023	0.039
	Mazowieckie	0.118	0.011	10.669	0.092
	Opolskie	0.012	0.019	0.637	0.032
	Podkarpackie	-0.112	0.014	-8.114	0.062
	Podlaskie	0.001	0.017	0.079	0.040
	Pomorskie	0.070	0.014	5.052	0.060
	Śląskie	-0.021	0.011	-1.849	0.095
	Świętokrzyskie	-0.120	0.016	-7.723	0.049
	Warmińsko-Mazurskie	-0.019	0.013	-1.468	0.066
	Wielkopolskie	0.032	0.011	2.895	0.092
	Zachodniopomorskie	0.039	0.016	2.388	0.044
Place of residence (Ref: Rural)	> 100,000 residents	0.111	0.010	10.823	0.232
	50,000-100,000 residents	0.029	0.013	2.272	0.102
	20,000-50,000 residents	0.018	0.012	1.496	0.109
	10,000-20,000 residents	0.046	0.013	3.472	0.093
	Town (< 10,000 residents)	0.008	0.015	0.519	0.067
	Constant	6.239	0.030	206.443	
Dependent variable	Log wage				7.062
Number of observations = 8,391					
R-squared = 0.478					

Table 3. Transition probability matrix for 1994-2007

RLS wage coefficient	The total sum of regions ever in *i* over the 13 transitions (share in parentheses)	The proportion of regions that moved from class *i* in Year(t) to class *j* in Year(t+1) over all the 13 transitions					
		less than -0.06	from -0.06 to -0.02	from -0.02 to 0.02	from 0.02 to 0.06	0.06 and above	Total
less than -0.06	14 (0.067)	0.357	0.643				1.000
from -0.06 to -0.02	58 (0.279)	0.172	0.690	0.138			1.000
from -0.02 to 0.02	75 (0.361)		0.106	0.627	0.267		1.000
from 0.02 to 0.06	44 (0.212)			0.409	0.546	0.045	1.000
0.06 and above	17 (0.082)				0.118	0.882	1.000
Total	208 (1.000)						
SUMMARY STATISTICS							
Steady-state (ergodic) distribution		0.072	0.268	0.347	0.226	0.087	1.000
Stability index	0.62						
Half-life	6.4						

The elements of the transition matrix were estimated from the observed frequencies in the changes of class from one year to another. The maximum likelihood estimator of p_{ij} is $\hat{p}_{ij} = \frac{n_{ij}}{n_i}$ where n_{ij} is the total number of regions moving from class *i* in Year(*t*) to class *j* in Year(*t*+1) over all the 13 transitions during 1994-2007, and n_i is the total sum of regions ever in *i* over the 13 transitions (Amemiya, 1985; Hamilton, 1994).

Table 4. Determinants of nominal relative wages across regions, 1995-2007

Variable	Notation	Mean, St. Deviation	OLS	WLS
Log population density in the region at the beginning of the transition in 1990	$\ln \mathrm{Den1990}_r$	4.74, 0.46	0.0407 (0.0059)*	0.0418 (0.0053)*
Log travel distance in kilometers from the principal city in the region to Warsaw	$\ln \mathrm{DisW}_r$	5.47, 0.61	-0.0665 (0.0065)*	-0.0668 (0.0048)*
Log travel distance in kilometers from the principal city in the region to Brussels	$\ln \mathrm{DisB}_r$	7.10, 0.15	-0.2167 (0.0268)*	-0.2195 (0.0237)*
The region is located on the Baltic Sea coast (Yes = 1, No = 0)	Coast_r	0.19, 0.39	0.0604 (0.0062)*	0.0621 (0.0058)*
The region was located on the border with the EU before 2004 (Yes = 1, No = 0)	$\mathrm{EU}_{r,t<2004}$	0.13, 0.34	0.0247 (0.0072)*	0.0188 (0.0071)*
The region is located on the border with the EU after 2004 (Yes = 1, No = 0)	$\mathrm{EU}_{r,t>=2004}$	0.15, 0.36	0.0308 (0.0083)*	0.0299 (0.0081)*
Log dwelling units in the region divided by the resident population at mid-year	$\ln \mathrm{House}_{rt}$	-1.16, 0.08	-0.1813 (0.0428)*	-0.2088 (0.0428)*
Log the ratio of average Centigrade temperature in the region over the period from 1981 to 2010 to the temperature range over the same period	$\ln \mathrm{Climate}_r$	0.97, 0.10	-0.0783 (0.0428)	-0.0636 (0.0414)
Log the number of permanent emigrants from the region per 10,000 people in the resident population	$\ln \mathrm{Emigr}_{rt}$	1.47, 0.97	0.0077 (0.0023)*	0.0073 (0.0025)*
Constant			1.5429 (0.2009)*	1.5134 (0.1735)*
R^2			0.5478	0.5924
N obs.			208	208

The dependent variable is $\ln(\hat{\delta}_{rt}+1)$. Its mean is -0.0010 with a standard deviation of 0.0460. WLS regression weights observation by the inverse squared standard error of the region coefficient in the cross-section Mincer regressions. Robust standard errors are in parentheses. * Coefficient is significant at the 0.05 level or better.

Table 5. Determinants of relative nominal and real wages across Regions, 1999-2007

Variable	Notation	Mean, St. Deviation	Relative nominal wage[a]		Relative real wage[b]	
			OLS	WLS	OLS	WLS
Log population density in the region at the beginning of the transition in 1990	$\ln \mathrm{Den1990}_r$	4.74, 0.47	0.0449 (0.0080)*	0.0425 (0.0073)*	0.0314 (0.0069)*	0.0259 (0.0066)*
Log travel distance in kilometers from the principal city in the region to Warsaw	$\ln \mathrm{DisW}_r$	5.47, 0.47	-0.0806 (0.0082)*	-0.0810 (0.0081)*	-0.0684 (0.0065)*	-0.0647 (0.0076)*
Log travel distance in kilometers from the principal city in the region to Brussels	$\ln \mathrm{DisB}_r$	7.10, 0.15	-0.2477 (0.0363)*	-0.2514 (0.0327)*	-0.2124 (0.0317)*	-0.2116 (0.0299)*
The region is located on the Baltic Sea coast (Yes = 1, No = 0)	Coast_r	0.19, 0.39	0.0731 (0.0078)*	0.0744 (0.0077)*	0.0416 (0.0061)*	0.0416 (0.0063)*
The region was located on the border with the EU before 2004 (Yes = 1, No = 0)	$\mathrm{EU}_{r,t<2004}$	0.11, 0.31	0.0309 (0.0094)*	0.0245 (0.0097)*	0.0129 (0.0099)	0.0063 (0.0101)
The region is located on the border with the EU after 2004 (Yes = 1, No = 0)	$\mathrm{EU}_{r,t>=2004}$	0.22, 0.42	0.0356 (0.0092)*	0.0331 (0.0091)*	0.0197 (0.0083)*	0.0167 (0.0083)*
Log dwelling units in the region divided by the resident population at mid-year	$\ln \mathrm{House}_{rt}$	-1.14, 0.07	-0.2355 (0.0612)*	-0.2409 (0.0605)*	-0.2307 (0.0505)*	-0.2137 (0.0504)*
Log the ratio of average Centigrade temperature in the region over the period from 1981 to 2010 to the temperature range over the same period	$\ln \mathrm{Climate}_r$	0.97, 0.10	-0.0706 (0.0546)	-0.0486 (0.0543)	-0.0867 (0.0471)	-0.0591 (0.0453)
Log the number of permanent emigrants from the region per 10,000 people in the resident population	$\ln \mathrm{Emigr}_{rt}$	1.53, 1.01	0.0073 (0.0026)*	0.0065 (0.0028)*	0.0093 (0.0022)*	0.0074 (0.0025)*
Constant			1.7496 (0.2648)*	1.7638 (0.2394)*	1.5208 (0.2313)*	1.5257 (0.2180)*
R^2			0.6086	0.6436	0.5304	0.5701
N obs.			144	144	144	144

[a] The dependent variable is $\ln(\hat{\delta}_{rt}+1)$ with the mean of -0.0012 and the standard deviation of 0.0489.

[b] The dependent variable is $\ln\left(\frac{\hat{\delta}_{rt}+1}{RRPI_{rt}}\right)$ with the mean of 0.0014 and the standard deviation of 0.0378.

WLS regression weights observations by the inverse squared standard error of the region coefficient in the cross-section Mincer regressions. Robust standard errors are in parentheses. * Coefficient is significant at the 0.05 level or better.

Table 6. Two-stage least squares estimates of the determinants of relative nominal and real wages across regions, 1999-2007

Variable	Notation	Relative nominal wage[a]	Relative real wage[b]
Log population density in the region at the beginning of the transition in 1990	$\ln \mathrm{Den1990}_r$	0.0443 (0.0077)*	0.0305 (0.0067)*
Log travel distance in kilometers from the principal city in the region to Warsaw	$\ln \mathrm{DisW}_r$	-0.0819 (0.0079)*	-0.0702 (0.0065)*
Log travel distance in kilometers from the principal city in the region to Brussels	$\ln \mathrm{DisB}_r$	-0.2491 (0.0354)*	-0.2133 (0.0313)*
The region is located on the Baltic Sea coast (Yes = 1, No = 0)	Coast_r	0.0726 (0.0075)*	0.0409 (0.0059)*
The region was located on the border with the EU before 2004 (Yes = 1, No = 0)	$\mathrm{EU}_{r,t<2004}$	0.0311 (0.0090)*	0.0132 (0.0096)
The region is located on the border with the EU after 2004 (Yes = 1, No = 0)	$\mathrm{EU}_{r,t>=2004}$	0.0348 (0.0089)*	0.0187 (0.0078)*
Log dwelling units in the region divided by the resident population at mid-year	$\ln \mathrm{House}_{rt}$	-0.2392 (0.0594)*	-0.2358 (0.0498)*
Log the ratio of average Centigrade temperature in the region over the period from 1981 to 2010 to the temperature range over the same period	$\ln \mathrm{Climate}_r$	-0.0698 (0.0526)	-0.0857 (0.0456)
Log the number of permanent emigrants from the region per 10,000 people in the resident population	$\ln \mathrm{Emigr}_{rt}$	0.0087 (0.0031)*	0.0113 (0.0025)*
Constant		1.7631 (0.2597)*	1.5393 (0.2284)*
R^2		0.6081	0.5286
N obs.		144	144
Overindentifying restrictions Chi^2 (1)		0.174 (p=0.6769)	0.038 (p=0.8451)
Endogeneity Chi^2 (1)		0.688 (p=0.4067)	1.93 (p=0.1646)

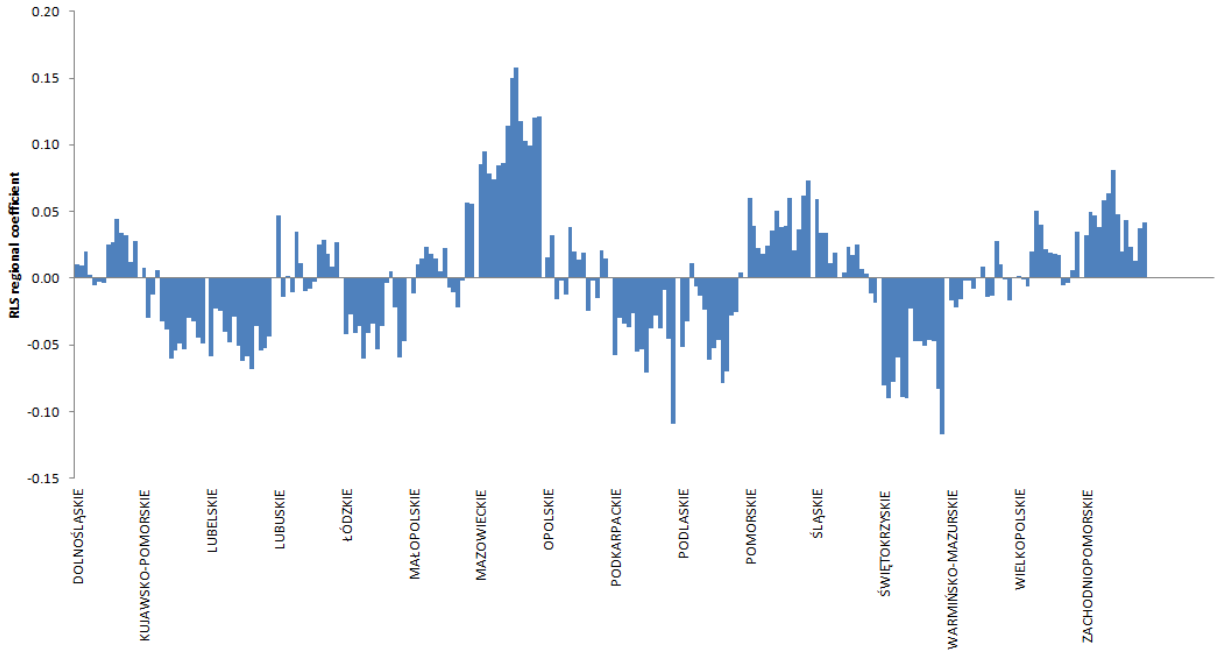
[a] The dependent variable is $\ln(\hat{\delta}_{rt}+1)$.

[b] The dependent variable is $\ln\left(\frac{\hat{\delta}_{rt}+1}{RRPI_{rt}}\right)$.

Endogenous regressor is $\ln \mathrm{Emigr}_{rt}$. Instrumental variables are $\ln \mathrm{Emigr}_{r,t-4}$ and the lagged logarithm of total employment in destination countries. Robust standard errors are in parentheses. * Coefficient is significant at the 0.05 level or better.

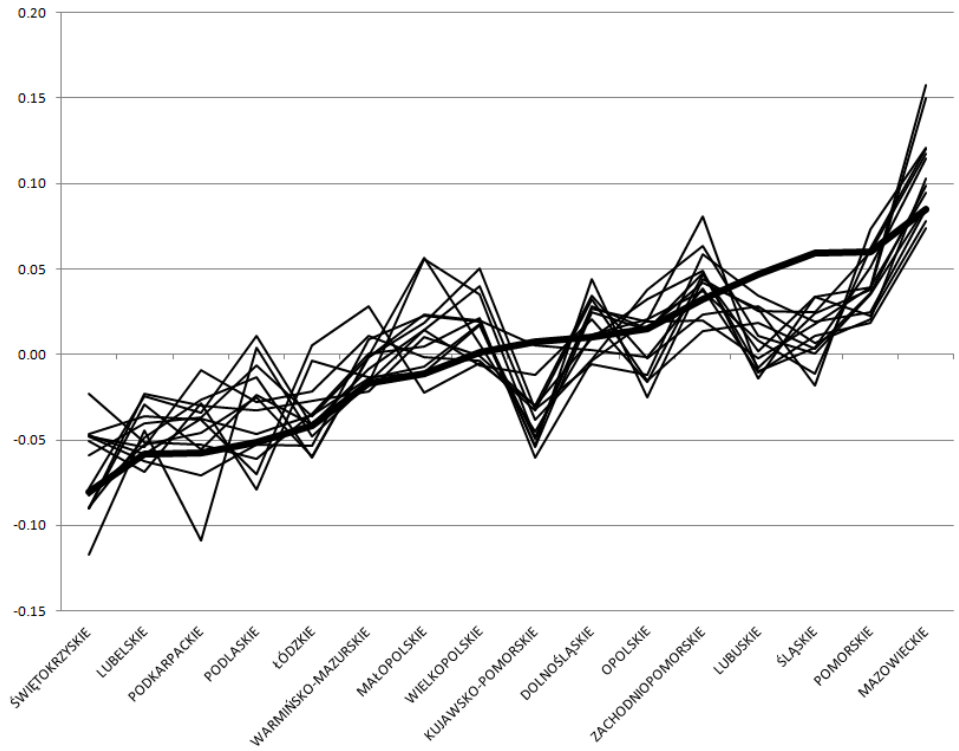
Figure 1. Polish regions (voivodships)

Figure 2. RLS regional wage coefficients, 1994-2007



For each region (voivodship), the graph shows the estimated RLS wage coeffcients for 1994-2007 (from left to right). The 0.0 line represents a benchmark (*i.e.*, the average wage in the national economy).

Figure 3: RLS regional wage coefficients: Salter graph



The graph shows the estimated RLS regional (16 voivodships) wage coefficients. The 0.0 line represents a benchmark (*i.e.*, the average wage in the national economy). The thick line represents the regional wage coefficients in the base year, 1994. The fine lines show the wage coefficients for each voivodship in 1995-2007. The overall pattern emerging in the graph helps us identify low-wage and high-wage regions as well as those regions that widened or narrowed their wage gap with respect to the national average after 1994.