

## WAGE CONVERGENCE ON THE COUNTY-LEVEL IN POLAND: A PANEL DATA APPROACH

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### ABSTRACT

This study investigates nominal wage convergence on the county level in Poland from 2005 till 2017, while accounting for the structural heterogeneity of the units and common time shocks. Results reveal that wage levels converge to their own steady-state with the speed of 7.6% of the imbalance per year. When time fixed effects are accounted for, this speed becomes higher and has a value of 34.5%. Common time effects, such as economic cycle considerably contribute to the convergence speed. The exclusion of time effects tends to bias downward the estimated convergence rate. With regard to  $\sigma$ -convergence, wage inequalities across the counties decreased over the years 2005–2010 with their levels moving toward the national average. However, as of 2010 this process, if any, is very slow.

**Key words:** wage convergence, wage disparities,  $\beta$ -convergence process

### INTRODUCTION

Reducing regional disparities is a major issue of European Union policies. Since joining EU in 2004, Poland has been under European Single Market policy, targeting the free movement of people, goods, and services. The free market provides conditions for factor price equalization by enabling reallocation of resources. In case of labour market this happens through a change in demand and supply of labour what, in turn, influences their prices, i.e. wages. Furthermore, reduction in wage differences might be a signal of their convergence. Absent convergence of wages can result in further divergence of real living standards.

Empirical evidences for Poland consistently report considerable interregional wage disparities and lack of convergence with a persistent gap between

western and eastern Poland and between the Mazowieckie region and the rest of the country [Rogut and Tokarski 2007, Misiak et al. 2011, Zieliński 2011, Ferens 2015, Vera et al. 2016]. Some studies indicate wage convergence process among counties but without accounting for structural differences between the units [Adamczyk 2016].

The aim of this study is to examine nominal wage convergence on the county level in Poland in the years 2005–2017. In order to correct the bias generated by omitted variables and heterogeneity in the classical cross-sectional regression, it is suitable to introduce panel data approach which allow for specific differences across economies, by modelling the unit specific effect [Mankiw et al. 1992, Islam 2003]. Therefore, the empirical analysis in this paper is based on a panel data set for 380 Polish counties for the time span of 13 years and the wage convergence

is examined, while taking into account the heterogeneity of the researched counties. The tested hypothesis assumes that wage convergence on the county level in Poland occurs when some county-specific structural characteristics (such as different resource endowments, infrastructure, demographic characteristic, migration rates, human capital, employment rate etc.) are under consideration. Three important questions are addressed in this study. First, is there wage convergence on the county level in Poland? Second, do these wage levels converge to their own long term growth trajectory (own steady-state)? Third, to what extent common time specific shocks, such as economic cycle, influence the speed of potential wage convergence?

The rest of the paper is structured as follows: the next section offers a brief review of relevant theory, followed by a short description of wage inequalities among Polish counties, next data and estimation method are described, and further results are reported. The last section concludes the study.

## **THEORETICAL BACKGROUND OF WAGE CONVERGENCE**

The concept of convergence in the most general sense is the decreasing or equalising of disparities. The neoclassical paradigm hypothesizes that if information is perfect, and labour and capital can move freely, nominal wages of labour with similar human capital characteristics will equalize across regions. However, many empirical evidences do not confirm this assumption, indicating persistent regional wage disparities. Therefore, some alternative theories have been put forward, such as the amenity theory, the efficiency wage hypothesis, the bargaining theory or the new economic geography (NEG) theory.

In order to explain wage differentials, some authors [Rosen 1986, Roback 1988, Gyourko and Tracy 1989] extended the neoclassical approach by taking into account a variety of non-wage factors affecting the location decision of labour and companies. These unique factors, named as “amenities”, may include family considerations, climate, environment, transportation networks, infrastructure, avail-

ability and quality of public services, etc. If workers consider both wage factors and amenities in order to maximize their overall utility, wages will not necessarily be equalized across regions even in the free market.

Next, the efficiency wage hypothesis holds that, in some markets, employees with identical productive characteristics might receive different wages if companies pay premiums to increase their efficiency and to minimize costs associated with rotation, in industries where the costs of replacing labour are high.

Another approach is the bargaining theory of wages assuming that wages are determined by the relative bargaining power of the parties to the agreement. Therefore, there is a range of wage rates, any of which may exist simultaneously. These rates can be influenced by numerous factors, including the productivity of the workers, the competitive situation, the size and type of the investment, and the employer’s prognosis of future business conditions.

Finally, NEG assumes that the agglomeration of human capital creates regional clusters of high-skilled employees generating knowledge spillovers that increase productivity and efficiency and allow for higher wages. Moreover, economic agglomeration may generate congestion costs, and companies in agglomerated areas must pay workers higher nominal wages [Vera et al. 2016].

The widely used way of testing convergence hypothesis is  $\beta$ -convergence analysis that arises from the neoclassical theory of the economic growth.  $\beta$ -convergence reflects a negative association between the growth rates of a variable and the initial values of that particular variable. *Ceteris paribus*, the parameter  $\beta$  on the lagged dependent variable is expected to be negative. Within a neoclassical approach, it is because diminishing returns to scale imply that out of a steady state, regions with low capital intensity will grow faster than those with high intensity, *ceteris paribus* [Ostrybe and Westerlund 2007]. Following a Cobb–Douglas production function [Barro and Sala-i-Martin 1992, Sala-i-Martin 1996], cross-region growth regression, without accounting for growth determinants, may be expressed as:

$$\gamma_i = \beta \ln(y_{i,0}) + \varepsilon_i \quad (1)$$

where:

- $\gamma_i$  – growth rate of economy;
- $y_{i,0}$  – initial level of per capita income;
- $\varepsilon_i$  – error term.

Following equation 1, an absolute  $\beta$ -convergence equation can be expressed in levels as follows:

$$\ln(y_{i,t_0+T}) = \theta + (1 + \beta T) \ln(y_{i,t_0}) + \varepsilon_{it} \quad (2)$$

where:

- $y_i$  – income per capita in economy  $i$ ,
- $t_0$  – initial years in the data;
- $t_{0+1}$  – final years in the data;
- $T$  – number of years minus one;
- $\theta$  – constant;
- $1 + \beta T = e^{-bT}$  with  $b > 0$  – convergence speed;
- $\varepsilon_{it}$  – error term.

The unconditional  $\beta$ -convergence occurs when the sign of the coefficient  $\beta$  is negative.

Wage convergence is actually a part of a total convergence.  $\beta$ -convergence is said to exist if growth rates of wages are negatively correlated with the initial values of wages for each economy. Thus, lower-wage units grow faster than higher-wage units and in the long-run their labour markets tend to converge toward the same average wage. This approach assumes that wages converge toward a single steady state regardless of the initial endowments of different factors specific for particular economies.

In this study the conditional  $\beta$ -convergence hypothesis is tested, which takes place when, after adding other variables to equation 1 or 2, the coefficient  $\beta$  becomes negative [Barro and Sala-i-Martin 1992]. The fundamental idea behind conditional convergence is that growth disparities are not permanent only because of differences in initial values of some specific variable, e.g. wages but also due to other unit specific factors, such as different resource endowments, infrastructure, institutions, migration rates, or human capital differences. In the regression

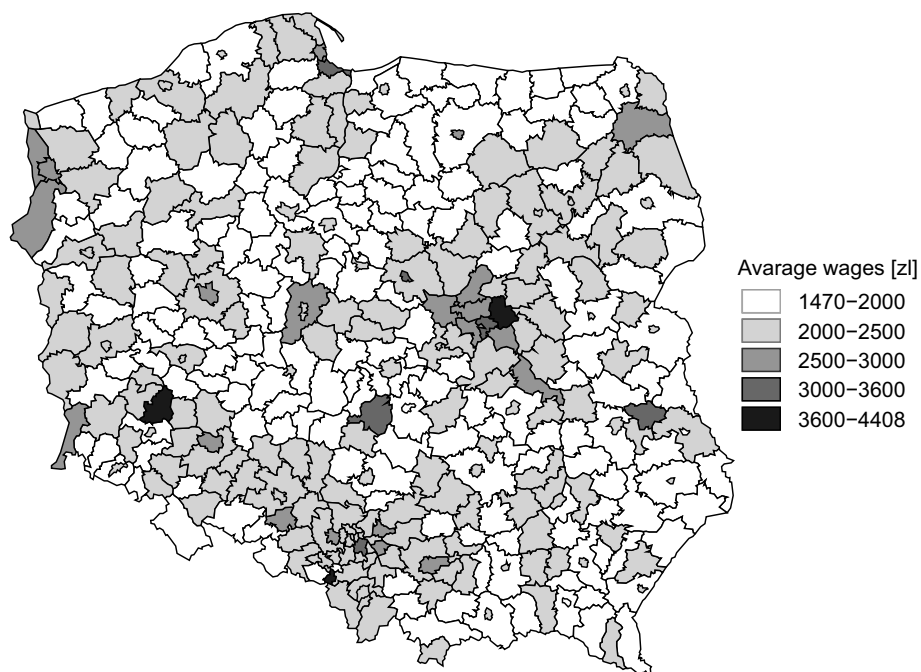
equations, each of these factors can be a “conditioning” variable.

Since  $\beta$ -convergence does not give a clear answer about distribution of wage differences across economies over time, it is useful to test  $\sigma$ -convergence, suggested by Quah [1993]. This concept is also derived from the neoclassical theory of the economic growth, according to which regions are headed towards the same steady and homogenous state in the future.  $\sigma$ -wage convergence occurs if over time the dispersion of wages across economies, measured by the standard deviation or variance, becomes more equitable. This indicates that wage levels move toward the national average. It should be noted that  $\beta$ -convergence is a necessary condition for  $\sigma$ -convergence to occur [Sala-i-Martin 1996] but does not necessarily imply a reduction in variation of wage levels over time.

## WAGE DISPARITIES ON THE COUNTY LEVEL IN POLAND

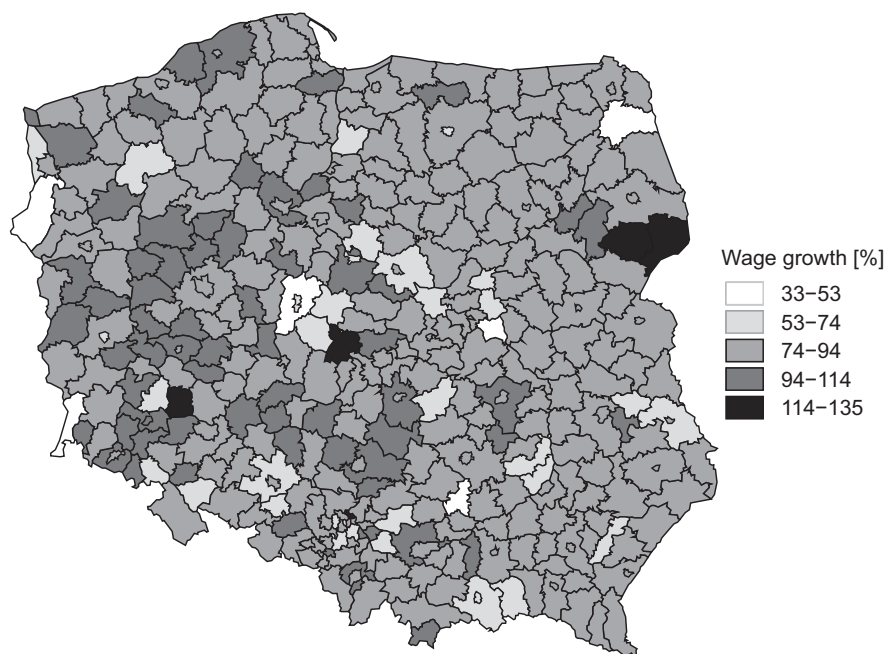
This section provides a brief overview of wage disparities across Polish counties. Figure 1 illustrates average monthly nominal wages in the counties in 2005. Wage disparities were significant with numbers oscillating between PLN 1,470 and 4,408. The highest wages featured the units with mining industry, cities with county rights, or units located close to big cities. In this group, nine units indicated monthly wages over PLN 3,000 (Lubiński, Jastrzebie-Zdrój, Warszawa, Łęczyński, Katowice, Bełchatowski, Pruszkowski, Gdański, Płock). The lowest wages, instead, could be observed in the outlying areas, with 175 counties with pays below PLN 2,000.

Figure 2 shows the rate of wage growth in 2017 in comparison to 2005. The greatest growth numbers were in five counties (Poddębicki, Wołowski, Piekary Śląskie, Hajnowski, Bielski) where wages rose more than 114%. Looking at Figures 1 and 2 together gives an overall picture that counties with the lowest wages in the initial year performed very well with regard to the growth rate in the final year. In this group, 67 counties demonstrated growth rate over 94%.



**Fig. 1.** Average monthly nominal wages in Polish counties in 2005

Source: Own elaboration.



**Fig. 2.** Growth rate of average monthly nominal wages in Polish counties in 2017 (base year = 2005)

Source: Own elaboration.

## DATA AND ESTIMATION METHOD

In this study, wage convergence is analysed by introducing a panel data approach. The panel contains 4,940 observations with annual data for 380 Polish counties (NUTS 4) over the period 2005–2017. All data are collected from the Central Statistical Office of Poland (GUS). Wages are expressed by average monthly nominal gross wages<sup>1</sup> in the county. Table 1 reports descriptive statistics of wage variable denoted as  $W$ .

Taking up the equation 2, an absolute  $\beta$ -convergence of wages can be formulated as follows:

$$\ln(W_{i,0+T}) = \theta + (1 + \beta T) \ln(W_{i,0}) + \varepsilon_{it} \quad (3)$$

where:

- $W_i$  – average wages in county  $i$ ;
- $t_0$  – initial years in the data;
- $t_{0+T}$  – final years in the data;
- $T$  – number of years minus one;
- $\theta$  – constant;
- $1 + \beta T = e^{-bT}$  with  $b$  – convergence speed;
- $\varepsilon_{it}$  – error term.

In order to correct the bias generated by omitted variables and to allow for county specific differences and for time specific shocks equation 3 is reformulated as a panel fixed-effect regression:

$$\ln(W_{it}) = \theta + (1 + \beta) \ln(W_{i(t-1)}) + \alpha_i + \alpha_t + \varepsilon_{it} \quad (4)$$

where:

- $t$  – time periods in the data;
- $\alpha_i$  – time invariant county specific effects that reflects all those omitted variables that influence the wage growth process;
- $\alpha_t$  – sets of year effects that control common time specific shocks (such as common economic cycle effects) to all counties.

It should be noted that convergence is a process that is likely to occur in the long run. Thus, one year time span can capture random adjustment towards the trend. However, including the wage growth rate over a longer time period would mean less time observations in the analysis. Moreover, the objective of this research is to examine the wage convergence at county level while considering local heterogeneities and the influence of time shocks. For this reason, the dependent variable is defined in terms of annual growth rate.

Further, based on  $\beta$  value, the half-life of the convergence process ( $hl$ ) is computed (eq. 5) which is defined as the number of years necessary for current wage inequalities to be halved [Ben-David 1996].

$$hl = \frac{-\ln(2)}{\ln\left(1 + \frac{\beta}{T}\right)} \quad (5)$$

In the last step  $\sigma$ -convergence process is measured by the standard deviation as follows:

$$\sigma_i = \sqrt{\frac{\sum_{i=1}^N (\ln W_{it} - \ln \bar{W}_t)^2}{N}} \quad (6)$$

where:

- $N$  – number of counties;
- $W_{it}$  – average monthly wage in county  $i$  in year  $t$ .

## RESULTS

The outcomes of the  $\beta$ -wage convergence estimation are reported in Table 2. County fixed effects are included in both columns, whereas time effects only in the last column.

In case of both estimations, parameter  $\beta$  is negative and statistically significant indicating wage con-

**Table 1.** Descriptive statistics of wage variable

Variable	<i>AVG</i>	<i>Mdn</i>	Max	Min	<i>SD</i>
Wages ( $W$ )	3 002.86	2 988.52	7 515.99	1 470.09	669.53

Wages in PLN.

Source: Own elaboration.

<sup>1</sup> Excluding economic entities employing up to 9 persons.

**Table 2.** Results of wage convergence estimation

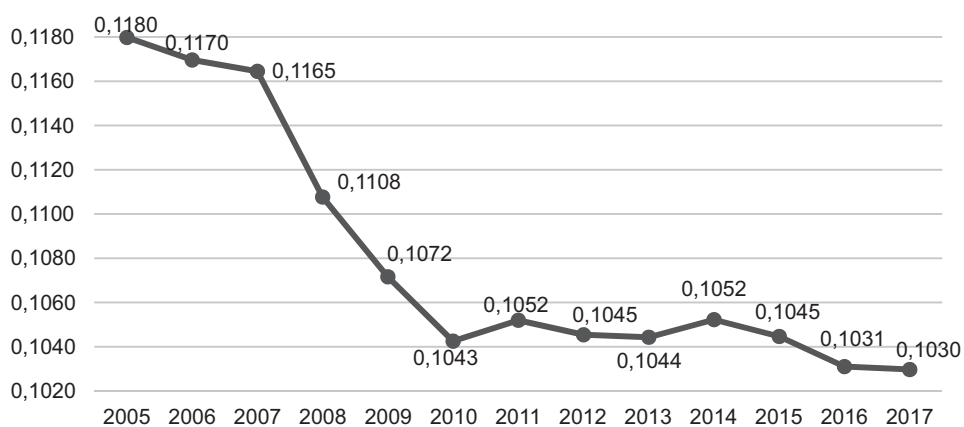
Parameter	Panel regression	
	without time effects	with time effects
$\ln(W_{-1})$	0.926*** (0.002)	0.708*** (0.010)
$\beta$	-0.074*** (0.002)	-0.29*** (0.083)
Convergence speed	0.076	0.345
Intercept	0.634	2.373
Half-life ( <i>hl</i> )	9.07	1.99
County specific effects ( $\alpha_i$ )	yes	yes
Time effects ( $\alpha_t$ )	no	yes
Total panel observations	380	380
Observations per county	12	12
Adj. $R^2$	0.98	0.99
F-statistics	796.58***	1 390.13***
Durbin–Watson statistics	2.09	2.07

\* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ . Standard errors in parentheses.

Source: Own elaboration.

vergence process. When only time-invariant county-specific factors are included, the estimated convergence rate is 0.076, meaning the counties converge towards their own steady state with the speed of 7.6% of their imbalance per year. This result, while in principle suggesting convergence, implies that this process is slow and the time necessary for the economies

to cover half of the initial lag from their steady states is around 9 years. Nevertheless, when additionally conditioned on common time specific shocks, convergence speed becomes considerably faster, and is 34.5% of the imbalance per year, corresponding to half-life of around 2 years only. Next,  $\sigma$ -wage convergence is examined. Figure 3 illustrates dispersion



**Fig. 3.** Wage  $\sigma$ -convergence among Polish counties in the years 2005–2017

Source: Own elaboration.

of standard deviation of wages over the years 2005–2017. At first glance, diminishing values of standard deviation confirm  $\sigma$ -convergence process. However, a clear decline in wage inequalities across the counties can be observed only in the years 2005–2010. As of 2010 this process is very slow, showing slight fluctuations.

## CONCLUSIONS

The aim of this study is to investigate nominal wage convergence on the county level in Poland in the years 2005–2017, while accounting for structural heterogeneity of the units. This heterogeneity can result from differences in resource endowments, demographic characteristic, migration rate, human capital, etc.

In contrast to existing empirical evidences for Poland suggesting lack of wage convergence on the regional level, the results of this study confirm the hypothesis of conditional  $\beta$ -convergence of wages on the county level. In other words, wage levels across counties converge to their own steady-state. Calculated speed of the convergence is 7.6% of the imbalance per year, meaning that this process is very slow and the time necessary for the current wage inequalities to be halved is around 9 years.

Another interesting finding is that when common time fixed effects are accounted for, convergence speed becomes significantly higher. In a general sense, when time effects are added to the set of independent variables in the regression, it means they are kept constant and are ignored as a potential source of convergence. When time effects are excluded from the equation, their effect is allowed to influence the speed of the convergence. Results reveal that rate of convergence increases from 7.6 to 34.5% of the imbalance per year after keeping time effects constant in the equation. Therefore, it can be concluded that common time shocks, such as economic cycle or political changes considerably contribute to the estimation of wage convergence rate. The exclusion of time effects tends to bias downward the estimated convergence speed, especially when there are no other time-invariant explanatory variables in the equation.

With regard to  $\sigma$ -convergence, the results confirm that wage inequalities across the counties decreased over the years 2005–2010 with their levels moving toward the national average. However, as of 2010 this process, if any, is very slow.

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## **KONWERGENCJA WYNAGRODZEŃ NA POZIOMIE POWIATÓW W POLSCE: PODEJŚCIE PANELOWE**

### **STRESZCZENIE**

W artykule zbadano konwergencję wynagrodzeń nominalnych na poziomie powiatów w Polsce w latach 2005–2017, biorąc pod uwagę ich strukturalną heterogeniczność i wpływ wspólnych efektów czasowych, takich jak cykl koniunkturalny. Wyniki wskazują, że na poziomie powiatów zachodził proces konwergencji warunkowej wynagrodzeń, a jego szybkość wyniosła 7,6% nierównowagi rocznie. Po uwzględnieniu efektów czasowych, szybkość konwergencji wzrosła do 34,5% nierównowagi rocznie. Odnośnie  $\sigma$ -konwergencji stwierdzono, że nierówności w wynagrodzeniach zmniejszyły się głównie w latach 2005–2010. Od 2010 roku proces ten zachodzi w minimalnym stopniu.

**Słowa kluczowe:** konwergencja wynagrodzeń, nierówności wynagrodzeń,  $\beta$ -konwergencja