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**Poland vs Spain in the First Decade After EU Accession.
Parallel Convergence Patterns?**

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Poland vs Spain in the First Decade After EU Accession. Parallel Convergence Patterns?¹

JEL Classification: O15, P25, R11, C21

Keywords: *Poland vs Spain; parallel regional convergence; convergence of clubs; distribution dynamics; spatial model*

Abstract

Research background: Poland and Spain share many common features resulting both from similarities of historical experience and also cultural, political, socio-demographic factors. Both countries have similar area, population and GDP structure. They also share historical experience related to political and economic transformation after a long period of non-democratic, centralized governments. Therefore the experience of Spanish membership in the EU is often considered as a model for Poland.

Purpose of the article: The purpose of this research is to perform a comparative empirical analysis of income convergence processes in Poland and Spain on a regional level (NUTS3). We aim to verify if and how these processes are related to one another (show similar paths). Special attention is paid to the periods after accession of these countries to the EU. Convergence patterns in both countries are compared with several tools.

Methodology/methods: Spatial econometric model for absolute beta convergence, sigma convergence indicators and the analysis of distribution dynamics – transition matrices.

Findings & Value added: The impact on EU accession on income convergence in Spain was positive both on a national and regional level. Regional convergence processes sped-up and interregional disparities decreased. The poorest subregions had relatively high probability to increase their income and catch-up with initially more developed regions. In the first decade after accession to EU Poland has also achieved a significant improvement of income indicators on a national level. However, empirical analyses of GDP *per capita* distribution and its dynamics on a regional level in Poland show that the above mentioned progress does not spread out

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proportionally on all regions. Neither beta nor sigma convergence is observed. Instead, relatively fastest growth of initially richest regions (mostly large cities) introduces convergence of clubs leading to polarization. EU accession accelerated divergence processes in Poland.

Introduction

Poland and Spain share many common features resulting both from similarities of historical experience and also cultural, political, socio-demographic factors. Both countries have similar area, population and GDP structure. They also share historical experience related to political and economic transformation after a long period of non-democratic, centralized governments. In the context of these analogies Spanish experience in the period during EU accession and in subsequent years is often seen as a model for Poland. For both countries, joining the EU was seen from a common perspective as a chance for a civilizational jump and catching-up to the level of development of European countries.

It is important to check to what extent the internal disparities between regions of the two countries are sustainable and whether they decrease over time since EU entry. This is an interesting research question in the context of the EU cohesion policy aimed at eliminating disparities in the regional level of development.

The subject of research in this article will be the phenomenon of convergence of income in Poland and in Spain at the regional level in the first decade after the accession to EU. The main purpose of this research is to perform a comparative empirical analysis of regional income convergence processes in Poland and Spain after joining EU and to verify if these processes show similar paths, or in other words are parallel.

There are several types of convergence. Beta convergence involves verification of the relationship between average yearly growth rate over some period and initial income. Sigma convergence analyses whether the dispersion of *per capita* income among countries or regions decreases with time – see e.g. Barro, Sala-i-Martin (2004).

The hypothesis about beta convergence is derived from neoclassical growth models assuming decreasing marginal productivity of capital (Solow, 1956) and is verified as absolute or conditional convergence. Absolute convergence assumes that countries or regions converge independently of their initial conditions and poorer regions grow faster than the richer ones. Conditional convergence assumes that countries or regions converge only if they are similar in terms of some structural characteristics. The process of increasing disparities is called divergence. These approaches tell nothing about the mobility within the distribution. This can be mod-

elled with the use of transition matrices as proposed by Quah (1996a, 1996b) or Durlauf and Quah (1999). This also allows to verify existence of convergence of clubs, observed in subgroups of regions similar in terms of initial income. Its presence leads to polarization.

The remaining part of the article is structured as follows. The next section explains research methodology. In the empirical part we provide the description of the data and apply different methods to analyse regional convergence patterns in Poland and Spain. The last part summarizes conclusions. All calculations and figures were prepared with R environment (R Core Team, 2016).

Research Methodology – sigma and beta convergence

The traditional approach of beta and sigma convergence analysis uses relatively simple statistical tools (see for example Sala-i-Martin, 1996). Sigma convergence is tested by calculating a selected measure of dispersion of *per capita* income across countries or regions and comparing its values in subsequent periods of time. If dispersion is decreasing, one concludes about sigma-convergence. Increasing dispersion indicates sigma+divergence.

The verification of beta convergence is applied by running a regression model²:

$$\frac{1}{T} \log \left(\frac{y_{i,t+T}}{y_{i,t}} \right) = \alpha - \left(\frac{1 - e^{-\beta T}}{T} \right) \log(y_{i,t}) + \gamma X_{i,t} + u_{i,t,t+T} \quad (1)$$

where $y_{i,t}$ indicates *per capita* income of region i at time t , $X_{i,t}$ is a vector of exogenous structural variables that can influence *per capita* income, T refers to time interval (for yearly data $T=1$), and $u_{i,t,t+T}$ is an error term. If structural variables $X_{i,t}$ are omitted, one tests for the absolute convergence hypothesis, while using additional control variables $X_{i,t}$ in the regression results in testing for conditional convergence. Positive β means that poorer regions grow faster than richer and the value of β is interpreted as convergence speed.

This approach ignores the fact that observations are located in space and their proximity might result in autocorrelated residuals. The spatial regression solves this issue. It has an additional component – in the simplest form there is only a spatially lagged dependent variable included. This captures the spatial interaction effect. Usually it is applied in a linear form, as

² Estimated by Nonlinear Least Squares.

$$y_i = \rho W y_i + X_i \beta + \varepsilon_i \quad (2)$$

where W is a spatial weights matrix and ρ is the spatial autoregressive coefficient. The matrix W defines how units relate to one another. Its values depend on a definition of neighbourhood. The term $W y_i$ is a spatially lagged dependent variable or spatial lag – see e.g. Herbst and Wójcik (2012) or Tortosa-Ausina *et al.* (2005) for applications of spatial models to regional convergence analysis.

Research Methodology – distribution dynamics

Alternative methodology is based on transition matrices, which allow to analyze the whole distribution and its dynamics in time. One can also test for convergence of clubs and polarization (see e.g. Magrini 1999).

Initial distribution is divided into intervals. Based on that division the transition matrix (M) is estimated. It shows how the distribution of relative GDP *per capita* (d) changes with time³:

$$d_t = M \times d_{t-1} \quad (3)$$

Estimated elements of transition matrix M show the share of regions which being initially in a particular income class, remain in the same group or move to other classes⁴.

$$p_{ij} = P(X_{t2} = j \mid X_{t1} = i) \quad (4)$$

Transition matrix allows also for estimation of the long-run evolution of income distribution⁵. Ergodic vector is a synthetic indicator of tendencies in the analyzed period. One concludes about convergence if ergodic probabilities move towards the average group. If probability moves into extreme groups, it shows polarization and convergence of clubs. High probabilities on the diagonal reflect strong persistence. The limitation of transition matrices is an arbitrary selection of interval boundaries.

³ This method can be compared to the first order autoregression in time series analysis.

⁴ Therefore all the values in transition matrix are nonnegative and sum of probabilities in each row equals unity.

⁵ Transition matrix M raised to power s with $s \rightarrow \infty$ converges to an ergodic matrix (with rank=1), called also an ergodic vector.

Data description and research hypotheses

The research is based on the data for subregions (NUTS3). Data for Polish GDP *per capita* were collected from the Local Data Bank of CSO for the period 2000-2014. In order to obtain comparable data GDP *per capita* for each region was reflected in relation to the average on the country level.

Data for Spain was obtained from the Spanish National Institute of Statistics (INE) for the period 1980-2014. Data for different periods were expressed in different currencies and in current prices. To obtain fully comparable data all GDP *per capita* values were converted into relative to country average for a particular year. Canarias were treated as a single region, similarly to the Balearic Islands. Finally, 51 Spanish subregions were considered in the analysis.

In the analysis we put particular emphasis on the first decade after EU accession (2004-2014 for Poland and 1986-1996 for Spain).

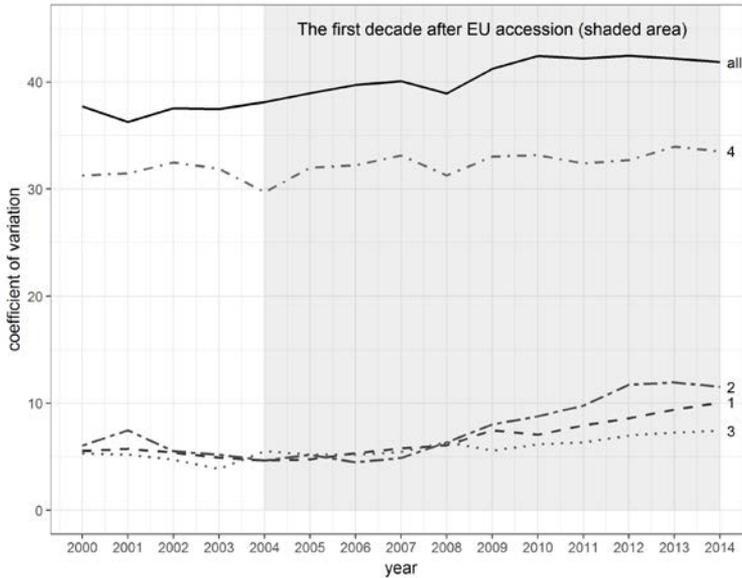
Empirical results

Caselli *et al.* (2004) attempted to answer the question of whether Poland could follow Spain with the analogous path of development after EU accession. Spain managed to achieve an above-average increase in productivity. In less than 15 years from the late 1950s to the early 1970s, Spain managed to increase its labour productivity in relation to France from 65% to 90%. When joining EU Poland had similar level of productivity as observed in the southern European countries during their accession to the EU. Therefore, the experience of Spain might indicate opportunities for Poland.

First we analyse sigma convergence for Polish regions with the use of coefficient of variation (CV) - see Figure 1. The light-grey shaded area indicates the first decade after Polish accession to EU (2004-2014). A solid line shows CVs for all regions and dashed lines CVs for regions from particular quartile groups. Before joining EU the dispersion of income *per capita* was stable and between 2004 and 2010 it increased to 42 and remained stable until 2014.

In the first years after EU accession income disparities in Poland were increasing with exception in 2008. Largest and relatively stable disparities were observed for the top quartile group (4). The remaining groups were much less diversified. Since 2008 disparities across regions from two lowest quartile groups significantly increased. Polish subregions faced sigma-divergence process strengthened by EU accession.

Figure 1. Analysis of sigma convergence for Poland: CV of relative GDP *per capita* (2000–2014, all subregions and different quartile groups)



Note: labels on the right refer to the quartile group number – division based on GDP *per capita* in 2004; shaded area is the first decade after Polish EU accession.

Source: own calculations based on Polish CSO data.

Figure 2 shows sigma convergence analysis across Spanish regions between 1980 and 2014. Conclusions are different than for Poland. Before joining EU the dispersion of income was stable, but on much lower level than for Poland. Between 1986 and 1996 it decreased. Therefore in the first decade after accession to EU income disparities between Spanish regions decreased, sigma-convergence was observed. Disparities in four quartile groups were small and stable over the whole long period.

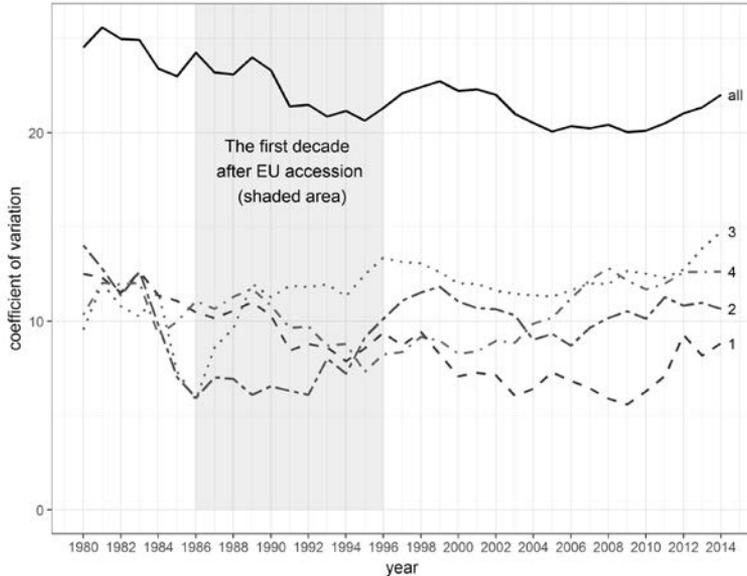
Therefore sigma convergence patterns for Polish and Spanish regions were not parallel.

In the next step we verify the existence of absolute beta convergence, taking into account only the first 10 years after EU accession. Figure 3 depicts the relationship between the average yearly growth of relative GDP *per capita* in the period 2004–2014 and initial relative GDP *per capita* (2004) for Polish regions, which appears to be positive (beta divergence). In addition we run a spatial autoregression model in which average yearly growth is regressed on initial income and spatial lag⁶. Results are presented

⁶ A simplified linear approach to beta convergence – we only need to assess the direction of relationship and its statistical significance.

in Table 1. We assumed k-nearest neighbours as the definition of neighbourhood and applied several values (3, 5, 10).

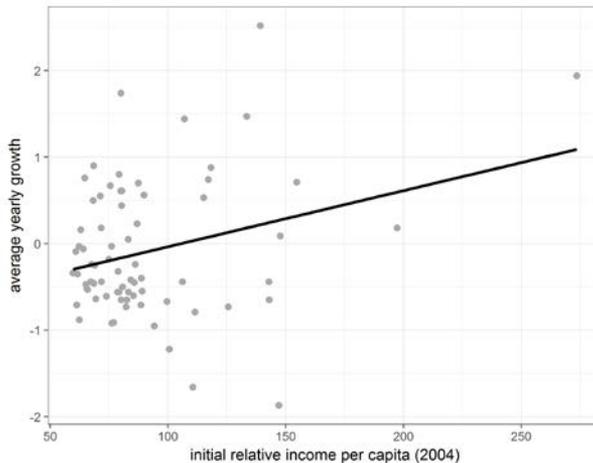
Figure 2. Analysis of sigma convergence for Spain: CV of relative GDP *per capita* (1980–2014, all subregions and different quartile groups)



Note: labels on the right refer to the quartile group number – division based on GDP *per capita* in 1986; shaded area is the first decade after Spanish EU accession.

Source: own calculations based on Spanish INE data.

Figure 3. Analysis of beta convergence for Polish subregions: average yearly growth of relative GDP *per capita* in 2004–2014 vs. initial income (2004)



Source: own calculations based on Polish CSO data.

Table 1. Analysis of beta convergence for Polish subregions: average yearly growth of relative GDP *per capita* in 2004–2014 vs. initial income (2004)

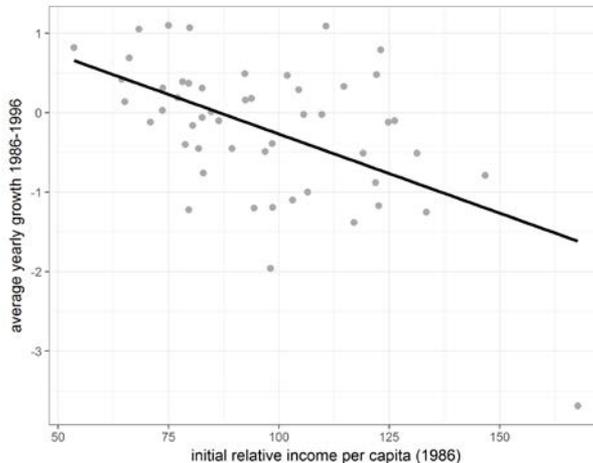
variable	knn = 3	knn = 5	knn = 10
intercept	-0.6757 **	-0.6347 **	-0.6309 **
initial income (2004)	0.0064 **	0.0062 **	0.0063 **
spatial AR (ρ)	0.3524 **	0.5144 ***	0.4937 **

Source: own calculations based on Polish CSO data.

Initial income is significantly and positively related with the average growth. This confirms that in the first decade after joining EU Polish regions faced beta-divergence.

Similar analysis was applied for Spain. Figure 4 depicts the relationship graphically and one can observe a negative slope (beta convergence). The results of a spatial autoregression are presented in Table 2. It confirms that initial income is significantly and negatively related with the average growth. Therefore Spanish subregions faced beta-convergence process.

Figure 4. Analysis of beta convergence for Spanish subregions: average yearly growth of relative GDP *per capita* in 1986-1996 vs. initial income (1986)



Source: own calculations based on Spanish INE data.

For transition matrices we divide regions into five quintile groups with respect to the initial distribution of relative GDP *per capita*. Table 3 depicts the transition probabilities calculated for regions for yearly transitions between 2004 and 2014.

Table 2. Analysis of beta convergence for Spanish subregions: average yearly growth of relative GDP *per capita* in 1986-1996 vs. initial income (1986)

variable	knn3	knn5	knn10
intercept	2.0106 ***	2.0540 ***	1.9957 ***
initial income (1986)	-0.0240 ***	-0.0247 ***	-0.0242 ***
spatial AR (ρ)	-0.4471 **	-0.6156 **	-0.7838 *

Source: own calculations based on Spanish INE data.

Table 3. Transition matrix for Polish subregions (2004–2014, yearly transitions)

	group 1 <=67.18	group 2 (67.18, 76.26]	group 3 (76.26, 84]	group 4 (84, 108.24]	group 5 >108.24
group 1 (144)	95.8%	4.2%			
group 2 (144)	7.6%	86.8%	5.6%		
group 3 (145)		9.0%	83.4%	7.6%	
group 4 (143)			8.4%	90.9%	0.7%
group 5 (144)				1.4%	98.6%
ergodic	59.2%	25.2%	9.9%	5.4%	0.3%

Source: own calculations based on Polish CSO data.

One can observe a strong persistence of the distribution (high values on the diagonal), the strongest in extreme groups. There is little chance to get richer for the poorest group of regions (4.2%). The probability of becoming poorer is always higher than for getting richer. This suggests strong tendencies to polarization, confirmed by the ergodic vector.

Table 4. Transition matrix for Spanish subregions (1986–1996, yearly transitions)

	group 1 <=77.78	group 2 (77.78, 84.76]	group 3 (84.76, 98.2]	group 4 (98.2, 116.52]	group 5 >116.52
group 1 (102)	88.2%	11.8%			
group 2 (102)	11.8%	70.6%	17.6%		
group 3 (103)	1.0%	14.6%	79.6%	4.9%	
group 4 (101)			8.9%	86.1%	5.0%
group 5 (102)				6.9%	93.1%
ergodic	32.7%	27.2%	27.3%	9.6%	3.6%

Source: own calculations based on Spanish INE data.

Table 4 shows transition matrix calculated for Spanish regions (group borders based on quintiles of income distribution in 1986). One can also observe strong persistence of the distribution, but all diagonal probabilities are lower than for Poland. The chance to get richer for the poorest group of Spanish regions is equal to 11.8%. Tendencies to polarization (ergodic vector) are still moderately high. Most of the probability mass is concentrated in the two poorest groups, but now “only” 32.7% in the poorest and 27.2% in group 2.

One can therefore conclude that the analysis of mobility within the distribution of income revealed somehow different results for Polish and Spanish regions. Both show tendencies for polarization, but much weaker in Spain. The poorest Spanish regions had much higher chance to catch-up after Spain joined UE than the poorest Polish regions after 2004.

Conclusions

The aim of the study was to compare regional (NUTS3) income convergence patterns in Poland and Spain in the first decade after their EU accession with a variety of research tools.

Poland's accession to the EU has accelerated the divergence process. Neither beta nor sigma convergence was observed in Poland. The fastest growing regions were the largest cities and regions abounding in natural resources. Regions were more often becoming poorer than richer.

Spain was subject to much smaller dispersion in regional income. In contrast to Poland, both beta and sigma convergence was observed. Spain's accession to the European Union has accelerated regional convergence processes. The poorest regions were more likely to increase their relative income and catch-up with the initially more developed regions. Faster development of the richest regions led to income polarization both in Poland and Spain, but it was weaker in case of Spain.

Based on the analysis one can conclude about the existence and persistence of the problem of regional disparities in *per capita* income. The gap between the poorest and richest regions is not diminishing or is even increasing over time. And convergence patterns in Poland and Spain were not parallel.

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