




## THE RESILIENCE OF REGIONS TO ECONOMIC RECESSION: THE ANALYSIS OF EMPLOYMENT TRENDS

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### ABSTRACT

The aim of the paper is to identify the reactions of Polish regions to the negative macroeconomic shocks triggered by the global economic crisis dated for 2008–2010. In the course of the research, econometric forecasting and statistical hypothesis testing methods were used. The research was based on the analysis covering dynamics of increase in the employment using the indicator of employed persons in enterprise sector (as a fixed-based index of dynamics). The findings showed that the crisis of the end of the first decade of the 21st century had different course and impact on regional economies in Poland. Negative impact of the breakdown on regional labour markets prevailed, while positive outcome (a new, more dynamic growth rate of employment) was recorded in only one region.

**Key words:** Poland, regions, economic resilience, econometric forecasting, employment trends, comparison of slopes

### INTRODUCTION

The increasing economic risk and uncertainty that accompany the acceleration of growth dynamics of various phenomena and economic sectors, provoke the discussion on the reactions of spatial-economic systems to crises. The identification and measurement of economic resilience is currently one of the key problems of evolutionary approach to economic development studies.

Major challenge faced by researchers within the field of regional economic resilience is to develop a research method that allows for measurement and evaluation of recession's impact on economies. The lack of universal methods in this area is a result of a multi-dimensional approach to the concept of regional resilience and the need to study various aspects related to changes in the economy caused by macroeconomic

disturbances. Domański [2018] emphasizes that resilience is not a simple static state of the regional economy, but a sequential and complex process depending on the nature, depth and span of the crisis, previous growth path and many other determinants of this path (structure of the regional economy, resources, capacities and competences of the local and national institutions, etc.). Wojtyna [2011] further argues that the diversification of the recession-induced impact on economies may result from institutional features of the economy (such as regulatory solutions) and structural features (mainly the degree of openness and flexibility of the markets). Therefore, according to Kudłacz [2012], regions placed under pressure of the same phenomena, differ with respect to time needed for resuming the old growth path or stabilizing the new one.

The main goal of the paper was to identify the reactions of Polish regions to the negative macroeconomic

shocks triggered by the global economic crisis dated for 2008–2010. The theoretical frame of the study was the concept of economic resilience. Adapted to the regional context, resilience was perceived as the ability of regions to respond to macroeconomic disturbances, reflected by the degree of crisis-driven changes in regional economies.

The methodological goal of the paper was to present the possibilities of using econometric forecasting methods and statistical hypothesis testing methods in regional resilience research. In this aspect, a research procedure was proposed to analyse changes of regional economies' growth paths by statistical comparison of the slopes of regression lines.

The research was based on the analysis covering growth dynamics of employment using the rate of employed persons in enterprise sector (as a fixed-based index of dynamics). The analysis spanned the period 2005–2017 using quarterly time-series.

## ECONOMIC RESILIENCE CONCEPTS

Fluctuations of economic activity have been a commonly addressed issue for many years, yet they are still gaining interest among researchers. One of the increasingly popular approach to business cycle research is economic resilience that describes how recessions affect national, regional or urban economies.

The resilience research was developed on the background of the physical, engineering and ecological sciences [Holling 1973]. Much later the concept was adapted for regional and spatial economic analyses. Their main goal was to identify how local societies and regional economies reacted to external disturbances. Researchers examined how long it took regional systems to resume the pre-crisis state and how deep shocks determined trajectories of regional growth [Martin 2012, Domański 2018].

Martin [2012] argues that spatial economists' growing interest in the issue of resilience is the outcome of the evolutionary perspective within economic geography and the application of models developed in other disciplines for the analysis of reaction of spatial economics systems (urban and regional) to major disturbances and perturbations (called shocks) hindering their growth. According to Simmie and Martin [2010],

such shocks can take form of periodic economic recessions, unpredictable rise of major competitors elsewhere, unexpected plant closures, as well as challenges arising from technological change and the like. Martin [2012] emphasizes that the global economic crisis in the years 2008–2010 had the greatest impact on the development of the economic resilience research.

In spite of numerous attempts to conceptualize and define the term of regional economic resilience, it still rises concerns. On a general level, it is described as an ability of a region to predict, prepare for, react to and recover from a crisis situation [Foster 2007]. In this context, the attention of researchers focuses on resilience mechanisms, i.e. the ability of regional socio-economic systems to continue the existing growth path [Zaucha et al. 2014]. Other definitions equate the term with the systemic property that ensures stability of a system against interference [McGlade et al. 2006]. In microeconomic terms, resilience to crisis is defined as long-term development capacity of enterprises while maintaining good business performance despite the economic recession [Romanowska and Mierzejewska 2016].

More detailed interpretations refer to similarities of the concept to resilience researched in the field of physical and ecological sciences, as well as within the complexity theory. In case of physical sciences, the concept of engineering resilience prevails. It is understood as the ability of a system to return to, or resume, its assumed stable equilibrium state following a shock or disturbance. In case of ecological sciences, the focus is on "far from equilibrium" behaviour of a region. It describes the scale of an economic downturn a region can absorb before it is destabilized and moved to another stable position. It is assumed that after exceeding the border of elasticity, the system undergoes changes of the structures and relationships. As a result, the system redirects its equilibrium path (changes its course compared with the pre-existing one). Due to its roots in the ecosystem resilience and stability research, this approach is called ecological resilience. In the third case (the complexity theory), another sphere of resilience is explored. The concept is called adaptive resilience and may be traced back to the complex adaptive systems theory. It focuses on adaptive capability of regions that enables continuous adjustment

and reorganisation of economic structures and functions in order to minimize the impact of destabilizing disturbances [Pimm 1984, Holling 2001, Simmie and Martin 2010, Boschma 2015].

The existing body of literature describes regional resilience in four main dimensions: resistance, recovery, re-orientation, and renewal. Resistance means the degree of volatility that translates into the depth of reaction to the shock. Recovery is identified with the speed and degree of resumption of the previous state by regional economy after experiencing disturbances. Re-orientation refers to changes in direction and structure of the regional economy in response to the shock. Renewal determines the degree and rate at which regional economy returns to the previous growth path or moves to a new path [Martin 2012, Martin et al. 2016].

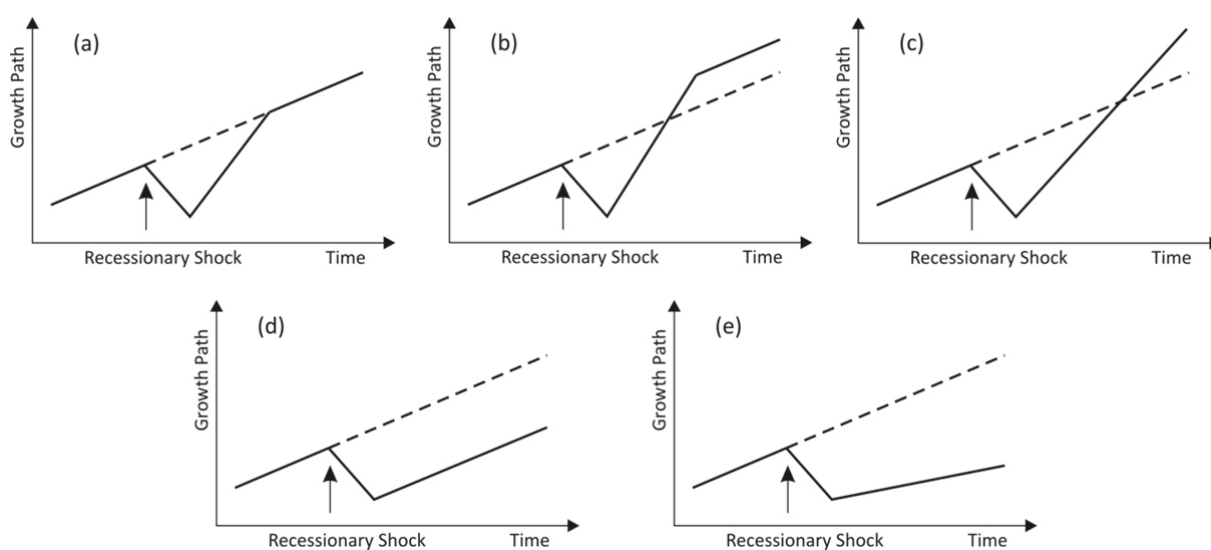
Based on the approaches mentioned above, one can distinguish some model reactions of regional economies to severe external shocks (Fig. 1).

In the first reaction type (a) the growth path is recovering from the disturbance caused by the recessionary shock and it is back on the pre-existing trajectory. This situation is identified with returning of a region to its previous steady growth path after the shock. The other types are related to achieving stability in a

situation that is far from equilibrium, with positive or negative impact of a recessionary shock on a region's growth path. The positive impact of a shock on a regional economy can manifest itself in two ways. The regional economy, rebuilding itself after the recession, may return to pre-recession growth rate, yet at a higher level (b) or enter the path of lasting, more dynamic growth (c). Negative impacts of economic shocks occur when a region's economy fails to resume the previous growth path but achieves the same growth rate on an inferior path, i.e. on a lower level, (d), or undergoes steady decrease both in the growth level and rate (e).

## RESEARCH PROCEDURE

A comprehensive analysis of the different reactions of regional economies to the crisis would require considering both the depth of the recession, its duration, the speed of recovery of the economy and the level of resuming the state from before the crisis. It is crucial to check whether it is a full recovery to the pre-recession growth path, or a shift to another, less or more dynamic path. These phenomena are vividly reflected by changes in production and employment, thus in numerous studies resilience is usually measured by the GDP growth rate and the employment dynamics.



**Fig. 1.** Reactions of regional economies to severe shocks (explanations in the text)

Source: Simmie and Martin [2010] and Martin [2012].

This paper presents research on resilience in terms of the speed and degree of regional economies' recovery after the recession that occurred at the end of the first decade of the twentieth century. The assessment of regional resilience was conducted by means of analysis of the current and previous growth paths (before and after the recessionary disturbances) using the employment rate as a quantitative measure sensitive to changes within the regional economy and adequately reflecting the depth and pace of economic fluctuations [Bosworth et al. 1996, Smith 2003, Cichocki et al. 2015]. Previously, the scope of changes of employment as a reaction to the global financial crisis was analysed e.g. by Kwiatkowski [2011], Marelli et al. [2012], Cezes et al. [2013], Zieliński et al. [2014], Gabrielczak et al. [2016], Ferreira and Gómez [2017].

The point of departure for the formal analysis was to chart for all Polish regions the course of changes in time using the employment index. As a base period, the first quarter of 2005 was adopted. The span of the analysis was determined by the availability of statistical data obtained from the Local Data Bank of the Polish Central Statistical Office (GUS).

In the next step, the time series were divided into three stages. The first period (here called a pre-recession phase – PR) spanned the time up to the recessionary shock. It was reflected in a clear change of the growth trajectory in the form of a continuous and significant decrease in the employment index. The phase spanning the period between the breakdown in the regional labour markets and the increase in the dynamics of the analysed rate was referred to as recession phase (RP). The last sub-period was denoted in the paper as a recovery phase (RE). It covered the years after the recession, when the growth paths were in the stage of recovery, rebuilding their previous shapes, yet in different time and scope.

On the basis of the analysed variable in the pre-recession phase, an ordinary least squares method was used to estimate the linear<sup>1</sup> trend function:

$$y_{i(\text{PR})} = b_1 t_1 + a_1 \quad (t_1 = 1, 2, \dots, n_1)$$

Next, the trend was extrapolated on the subsequent time series (between the recessionary shock and the year 2017). This way predicted values were obtained, i.e. the values that would theoretically have occurred in the regional economy if it had not been for the recession. Similarly, the linear trend function was estimated on the basis of the recovery phase data:

$$y_{i(\text{RE})} = b_2 t_2 + a_2 \quad (t_2 = 1, 2, \dots, n_2)$$

Finally, coefficients of the estimated trends were compared. For this purpose,  $t$  statistic was used to test the statistical hypothesis about the equality of two slopes of regression lines ( $H_0: b_1 = b_2$  to  $H_1: b_1 \neq b_2$ ). To verify the  $H_0$  hypothesis, test statistic is used based on the following formula [McClave and Benson 1988, Andrade and Estévez-Pérez 2014]:

$$t = \frac{b_2 - b_1}{\sqrt{\frac{s_{yx_1}^2}{sd_{x_1}^2 (n_1 - 1)} + \frac{s_{yx_2}^2}{sd_{x_2}^2 (n_2 - 1)}}$$

where:

$$s_{yx_1} = sd_{y_1} \sqrt{\frac{n_1 - 1}{n_1 - 2} (1 - r_1^2)}$$

- $y$  – endogenous variable – employment index in the pre-accession phase ( $y_1$ ) and recovery phase ( $y_2$ );
- $x$  – exogenous variable (time variable  $t_1$  and  $t_2$ );
- $b$  – estimate of the slope of regression line in pre-recession phase ( $b_1$ ) and recovery phase ( $b_2$ );
- $n$  – size of the sample in the pre-recession phase ( $n_1$ ) and recovery phase ( $n_2$ );
- $sd$  – standard deviation for the values of two variables in both samples;
- $r$  – Pearson's correlation coefficient between variables  $y$  and  $x$  in pre-recession phase ( $r_1$ ) and recovery phase ( $r_2$ ).

<sup>1</sup> The linear form has been chosen as the best fitted to the empirical data among four tested functions: linear, exponential, logarithmic and power.

Assuming the  $H_0$  hypothesis is true, the test statistic has Student's  $t$ -distribution, which is defined by  $n_1 + n_2 - 4$  degrees of freedom. The  $p$ -value determined on the basis of the test statistic is compared with the significance level  $\alpha$ . If the condition  $p \leq \alpha$  is met, the hypothesis  $H_0$  about the equality of the slope lines should be rejected in favor of the alternative  $H_1$  hypothesis. If opposite case occurs ( $p > \alpha$ ), evidence exists to reject  $H_0$ .

A statistically significant change in the value of the slope  $b$  (decrease or increase) was interpreted as the impact (respectively negative or positive) of the shock on the growth rate of the analysed variable. Proving the statistical equality between the slopes of regression lines was interpreted as resumption of the previous growth rate distorted by the shock.

## RESULTS

The study revealed that the global economic crisis affected labour markets in all Polish regions, but the recession phase in individual regions differed with respect to the beginning time and duration (the table). The earliest decrease in the number of employees was recorded in Lesser Poland, i.e. as early as third quarter of 2007. It should be noted, however, that this tendency was neither clear nor long-lasting and it interweaved with small increases and periods of stagnation. In other regions, the breakdown was observed in 2008 (in the first quarter – three regions, second and third quarter – six regions each).

The downturn in most of the analysed regional labour markets lasted up to the fourth quarter of 2009.

**Table.** Impact of the economic crisis on the regional labour markets – identification of the recession phase and estimation of the slope of the pre-recession and recovery phase trends

Region	Recession		Slope coefficient $b^x$ (regression $R^2$ )		Change <sup>xx</sup> ( $b_2 - b_1$ )
	start	end	pre-recession	recovery	
Dolnośląskie	2008 1Qr	2012 4Qr	1.31 (0.94)	0.75 (0.89)	-0.56***
Kujawsko-Pomorskie	2008 2Qr	2014 1Qr	1.01 (0.91)	0.75 (0.92)	-0.26*
Lubelskie	2008 3Qr	2014 4Qr	0.82 (0.85)	1.01 (0.92)	0.19
Lubuskie	2008 3Qr	2013 1Qr	1.36 (0.94)	0.6 (0.83)	-0.76***
Łódzkie	2008 3Qr	2012 4Qr	1.26 (0.94)	0.64 (0.89)	-0.62***
Małopolskie	2007 3Qr	2013 4Qr	1.09 (0.88)	1.14 (0.92)	0.05
Mazowieckie	2008 3Qr	2013 2Qr	1.22 (0.97)	0.93 (0.93)	-0.29**
Opolskie	2008 3Qr	2013 4Qr	0.59 (0.86)	0.65 (0.86)	0.06
Podkarpackie	2008 2Qr	2015 3Qr	1.23 (0.97)	1.04 (0.93)	-0.19
Podlaskie	2008 2Qr	2013 4Qr	0.81 (0.81)	0.84 (0.82)	0.03
Pomorskie	2008 2Qr	2013 4Qr	1.08 (0.96)	1.21 (0.93)	0.13
Śląskie	2008 2Qr	2013 4Qr	0.72 (0.90)	1.03 (0.92)	0.31*
Świętokrzyskie	2008 2Qr	2015 1Qr	1.1 (0.95)	1.01 (0.84)	-0.09
Warmińsko-Mazurskie	2008 1Qr	2014 1Qr	0.92 (0.96)	0.59 (0.91)	-0.33**
Wielkopolskie	2008 3Qr	2012 4Qr	1.4 (0.98)	1.46 (0.99)	0.06
Zachodniopomorskie	2008 1Qr	2014 3Qr	0.82 (0.92)	0.97 (0.87)	0.15

<sup>x</sup> Slope coefficients  $b$  statistically significant at  $p < 0.0001$ .

<sup>xx</sup> Statistically significant at \*0.05, \*\*0.01 and \*\*\*0.001 level.

Source: Own elaboration based on data obtained from GUS (Polish Central Statistical Office).

However, after the first symptoms of recovery, the second wave of recession and a longer period of stagnation occurred, yet they spanned different periods in individual regions. In some regions (Dolnośląskie, Łódzkie and Wielkopolskie), a long-lasting recovery began in the fourth quarter of 2012. Most of the regions under examination returned to the path of dynamic growth in 2013 and 2014. Świętokrzyskie and Podkarpackie regions struggled longest with the recession phase (until the first and third quarter of 2015 respectively).

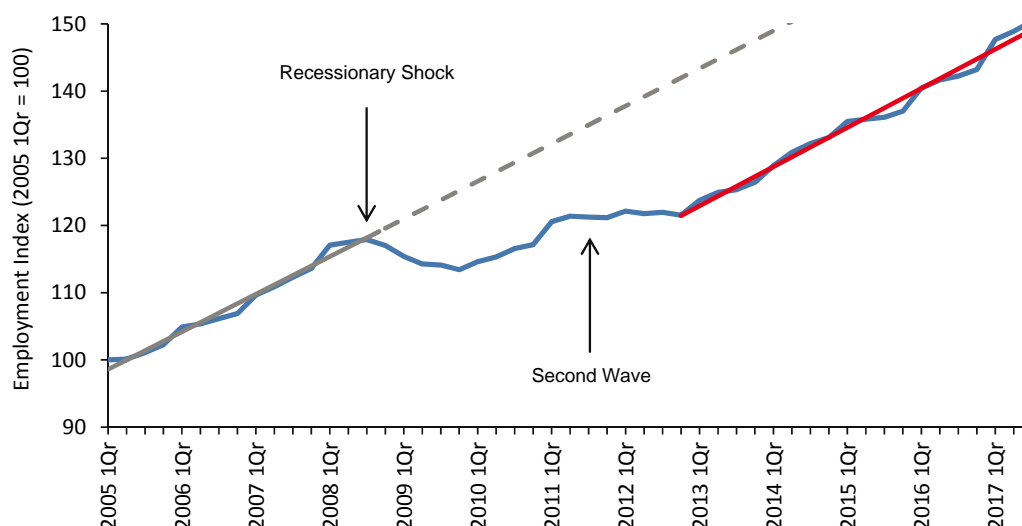
In the light of the results obtained, it was observed that the reactions of regional economies to recessionary shocks were diversified. The negative impact of the crisis on the labour market prevailed, and until the end of the analysed period none of the regional growth paths reached the level of the extrapolated pre-crisis trend.

The most common reaction of regional economies to the recessionary shock was resuming the pre-recession growth rate (slopes of the lines did not differ in a statistically significant way) while the level of growth path decreased (decrease in the value  $y$ -intercepts) – Figure 2. This applied to nine out of 16 Polish regions (Lubelskie, Małopolskie, Opolskie, Podkarpackie,

Podlaskie, Pomorskie, Świętokrzyskie, Wielkopolskie and Zachodniopomorskie). In seven of these regions, values of the slopes of lines in the recovery phase were higher than in the pre-recession phase. However, on the basis of the  $t$ -statistic, it was assumed that these differences were statistically insignificant.

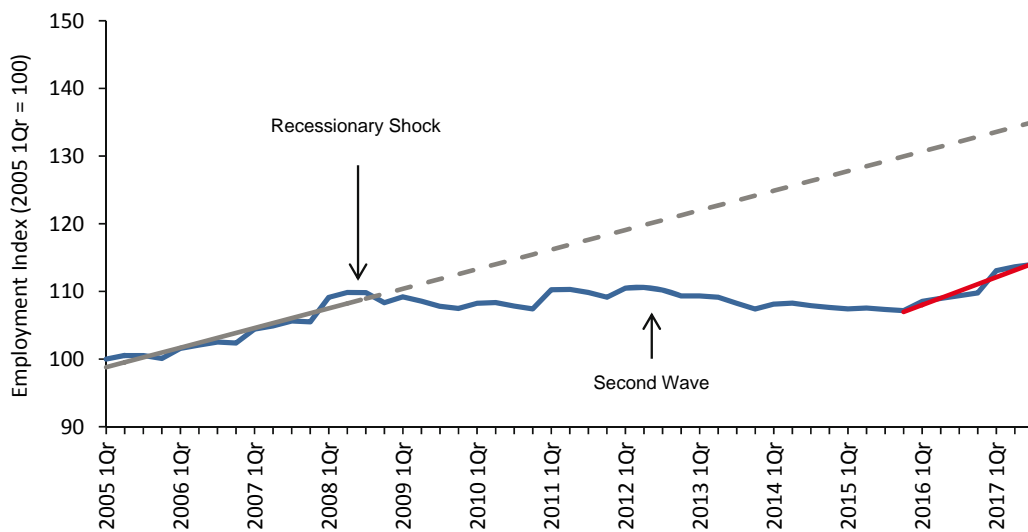
Only in one region (Śląskie) the economy entered the path of more dynamic growth. The labour market in this region, after experiencing the recessionary shock, gained new dynamics, which was reflected in a higher growth rate of the number of employed persons. However, the new trajectory did not exceed the extrapolated trend from the pre-recession period and if the situation does not improve radically, it will not happen in the near future (Fig. 3).

In six regions (Dolnośląskie, Kujawsko-Pomorskie, Lubuskie, Łódzkie, Mazowieckie and Warmińsko-Mazurskie) a decrease was recorded both in the level and in the growth rate of the employment index (Fig. 4). Although in these regions the post-crisis trend lines boasted increasing slopes, the negative impact of the recessionary shock on the growth rate was clearly visible. Differences in the value of the slopes of lines (in the pre-recession and recovery phase) were statistically significant at the level of  $p < 0.05$ .

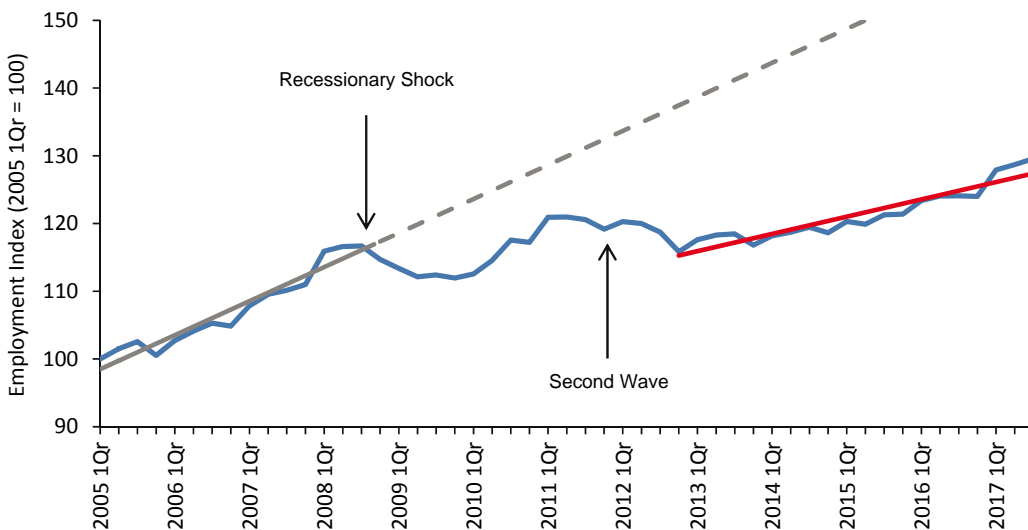


**Fig. 2.** Resuming the interrupted growth rate yet on a lower level in reaction to recessionary shock on the example of Wielkopolskie region

Source: Own elaboration based on data obtained from GUS (Polish Central Statistical Office).



**Fig. 3.** Increased dynamics of growth in the aftermath of the crisis – example of Śląskie region  
Source: Own elaboration based on data obtained from GUS (Polish Central Statistical Office).



**Fig. 4.** Decreased rate and level of growth path in the aftermath of the crisis – example of Łódzkie region  
Source: Own elaboration based on data obtained from GUS (Polish Central Statistical Office).

## SUMMARY

The conducted research showed that the global economic crisis at the end of the first decade of the twentieth century affected all regional labour markets in Poland. It also led to the conclusion that the recessionary shock had different course and impact on the

regional economies. The vast majority of the regional employment growth paths lost their pre-recession rate. Only one region gained a new, more dynamic growth path.

It is difficult to identify regularities that link the scope of the response (measured by the change in the growth path of the employment index) with factors

like: location, economic situation or demographic potential of the regions. The negative impact of the crisis could be observed both in well-developed regions with large population (Mazowieckie, Dolnośląskie), as well as in those least developed and populated (Warmińsko-Mazurskie, Lubuskie).

While the negative impact of the recession on the regional labour markets prevailed (i.e. decrease in the level of regional employment growth paths), the fact that most of the regions resumed the growth rate lost as a result of the recession, appears to be a positive circumstance. However, it should be emphasized that the final impact of the crisis on the regional economies becomes apparent with considerable delay. Reaching the steady state is a long-term process. Therefore, it is advisable that further research should be conducted with the use of longer time series, which are currently unavailable in public statistics.

The conducted study proved the usefulness of the applied procedure based on the estimation of trends and statistical comparison of the differences in the slopes of the lines. The statistics used are rarely applied in economic studies and described in statistical textbooks, yet apparently they facilitate obtaining a full picture of changes in the analysed processes. The methodological challenge will be to develop a method that will enable the identification of the depth of the crisis as well as the range of reactions of economies in the recovery phase.

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## **ODPORNOŚĆ REGIONÓW NA RECESJĘ GOSPODARCZĄ: ANALIZA TRENDÓW ZATRUDNIENIA**

### **STRESZCZENIE**

Celem artykułu jest rozpoznanie reakcji gospodarek regionalnych w Polsce na negatywne szoki makroekonomiczne wywołane globalnym kryzysem gospodarczym (umownie datowanym na lata 2008–2010). W postępowaniu badawczym wykorzystano metody prognozowania ekonometrycznego oraz testy statystycznej weryfikacji hipotez. Badaniom poddano dynamikę wzrostu poziomu zatrudnienia, wykorzystując wskaźnik liczby pracujących w sektorze przedsiębiorstw (przeliczony w formie jednopodstawowego indeksu dynamiki). Stwierdzono, że kryzysowe zjawiska gospodarcze końca pierwszej dekady XXI wieku miały różny przebieg oraz wpływ na gospodarkę regionów w Polsce. Dominował negatywny wpływ załamania na regionalne rynki pracy, a tylko jedno województwo zyskało nowy, bardziej dynamiczny trend wzrostu liczby pracujących.

**Słowa kluczowe:** Polska, regiony, odporność gospodarcza, prognozowanie ekonometryczne, trendy zatrudnienia, porównanie współczynników nachylenia