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**THE INFLUENCE OF LEFT-SIDED CUT-OFF  
OF TEMPORAL SERIES ON EFFICIENCY  
OF FORECASTING WITH THE METHOD  
OF INDICATORS OF SEASONAL CHARACTER**

**Abstract.** In the paper an attempt has been made to assess the quality of forecasts of rate of unemployment for the year 2007 on the basis of data from the years 1999–2006 in Podkarpackie province. The forecasts were constructed on the basis of polynomial models, assuming the additive and multiplicative methods of determining the indicators due to the seasonal character of this phenomenon, at subsequently left-sided cut-off time series. The basis of selection of the function for elimination of the trend was constituted by statistical significance of parameters of polynomial models and the statistics of the test F of Fisher-Snedecor. This statistics allowed also determining the test probabilities for the assessment of diversification of the quantity of variance of errors of forecasts on the basis of which there was made the selection of the best model. The carried out analysis indicates that the most accurate forecast was obtained on the basis of the polynomial of second degree estimated on the left-sided cut-off time series including the data for the last 5 years.

**Key words:** time series analysis, seasonal ratio.

**INTRODUCTION**

Unemployment is one of the most essential social-economic problems. Its changes exert considerable influence both on households as well as on enterprises, which makes them an important aim of economic policy of the state. The phenomenon of unemployment is a frequent subject of social-economic research. In the years 1999–2007 the rate of unemployment underwent dynamic changes resulting both from fluctuation of economic situation as well as from changes of structural character. Due to the changes of the trend of this phenomenon there arises the need to describe it with various econometric models, and on their basis to make adequate forecasting.

In the paper there are presented the analysis and forecast of the rate of unemployment with the method of indicators of seasonal character, taking into

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consideration full and subsequently left-sided cut-off time series. For description of trend there were used the polynomial models of first, second and third degrees. The assessment of efficiency of forecast was made on the basis of variances of errors of forecasts and statistics of test  $F$ .

Numerical data are monthly quantities of rate of employment registered in Podkarpacie for the years 1999–2007, made available by the Institute of Economy of University of Information Technology and Management in Rzeszów.

## I. SOURCE DATA AND METHODOLOGY OF ANALYSIS

The basis of the analysis in this paper aiming at assessment of quality of forecasts with the method of indicators at left-sided cut-off of series is constituted by quantities of rate of unemployment registered for Podkarpackie province. It is the most often applied synthetic meter of situation in the labour market which is conditioned not only by matching of labour supply and demand for it, but also by some demographic changes, such as changes in number of people, or coefficient of vocational activity.

The rate of unemployment expresses participation of the number of unemployed in the general number of people active in the labour market. The information on the number of unemployed comes from the register of District Employment Offices and includes the registered unemployed. By unemployed person is understood every person in productive age who in a given period does not have a job, but he/she is capable of working and takes some steps in order to get a job.

The data used in this paper concern the rates of registered unemployment taking into consideration only the persons registered in Employment Office<sup>1</sup>. The merit of the assumed meter is its availability in monthly Statistical Bulletins GUS with relatively little delay, and its flaw is the fact that it takes into consideration only the unemployed registered in Employment Offices and passes over, among others, the persons employed in unregistered so called “black economy”.

The number of people active in the labour market is estimated on the basis of the results of National General Census and Register of Flats and General Agricultural Register. Both registers were made by GUS in 2002. The previous estimations came from General Agricultural Register of 1996. In the years 2002–03, when there were published the values of rates of employment for the results from the lists of the years 1996 and 2002, there was observed a difference in

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<sup>1</sup> In the Polish legislation the status of unemployed is specified by the act of 20 April 2004 on promotion of employment and institutions of labour market (Journal of Laws of 2004., no. 99, it. 1001) and the act of 28 July 2005 on the change of the act on promotion of employment and institutions of labour market and change of some other acts (Journal of Law of 2005, no. 164, it. 1366).

their readings. Since the beginning of 2004 there have started to be given the values of rates of unemployment determined only according to the methodology assumed in 2002. The changes of rates of unemployment caused by correction of estimations are presented in fig. 1.

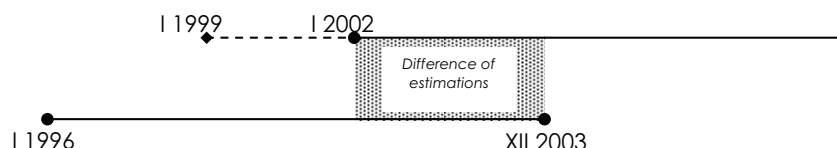


Fig. 1. Differences of estimation of rates of unemployment

Source: Own elaboration

The full lines symbolically illustrate the values of rate of unemployment according to both descriptions. The shaded field indicates the difference in both estimations, which, however, was not constant in time. In January 2002 the rate of unemployment according to the estimations with the old method was 17,8%, and when calculated according to the new principles it assumed the value 21,7%, but in December 2003 these magnitudes also differed and equalled 20,2% and 16,6% respectively.

In order to avoid errors in the analysis of rate of unemployment, its values for the period from I 1999 to XII 2001 were calculated in such a way that they correspond to the estimations from the lists in the year 2002 (the broken line in fig. 1). Due to the fact that GUS gave data concerning the rate of unemployment in the years 2002-03 both in the new as well as in the old nomenclature it was possible to estimate the dependences between them. For estimation of rate there was assumed the estimation according to the model of linear regression  $SB_{n,t} = \beta + \gamma SB_{s,t} + \eta_t$ , where  $SB_{n,t}$  is the rate of employment from estimations of the year 2002,  $SB_{s,t}$  – the rate of unemployment according to the estimations of the year 1996,  $\beta$  and  $\gamma$  – the parameters of equation, and  $\eta_t$  is the error being the white noise.

On the basis of the available data and the given model of regression there was estimated the rate of unemployment for the period from I 1999 to I 2002. The start of calculation from the given starting moment is justified both by the introduction of new territorial division of provinces as well as by the fact that these were the first months in which the rate of unemployment exceeded the bottom of the economic cycle.

Due to estimation there were obtained estimations of structural parameters and adequate statistics of t-Student:  $\beta=0,514$  ( $t=1,71$ ),  $\gamma=1,186$  ( $t=65,77$ ). The

corrected  $R^2$  was 0,995 and the statistics F showed associative significance of predictors on the set level of significance  $\alpha=0,01$ .

In order to illustrate the order of magnitude being the subject of the analysis of data, some of their values were presented in tab.1.

Table 1. Quantities of rates of unemployment in Podkarpackie province in the years 1999–2007

| Years | Months |      |      |      |      |      |      |      |      |      |      |      |
|-------|--------|------|------|------|------|------|------|------|------|------|------|------|
|       | I      | II   | III  | IV   | V    | VI   | VII  | VIII | IX   | X    | XI   | XII  |
| 1999  | 16,3   | 16,8 | 16,8 | 16,4 | 15,9 | 16,1 | 16,3 | 16,3 | 16,4 | 16,4 | 16,9 | 17,6 |
| ...   | ...    | ...  | ...  | ...  | ...  | ...  | ...  | ...  | ...  | ...  | ...  | ...  |
| 2007  | 18,9   | 18,9 | 18,6 | 17,9 | 17,2 | 16,7 | 16,6 | 16,5 | 16,4 | 16,2 | 16,2 | 16,5 |

Source: Institute of Economy of University of Information Technology and Management in Rzeszów.

The values of rates of unemployment during 9 years of research fluctuated within the limits from 15,9% to 21,7%, at the same time the arithmetic mean equalled 18,79% and the standard deviation was 1,49%.

In the time series of the rate of registered unemployment there are distinguished the following components: stochastic trend, cycles, seasonal fluctuations and irregular fluctuations. It is integrated in the first degree and anti-cyclic regarding the economic cycles. It also has “smooth” course indicating that it is not subject to essential short-term fluctuations. The results of this analysis are significantly influenced also by high inertia of the rate of unemployment, meaning slow influence of the factors conditioning it. In addition, particularly in Europe, it is conditioned also by the hysteresis of unemployment<sup>2</sup>. We deal with this phenomenon when the natural rate of unemployment depends on shaping of the rate of unemployment of balance in the past, from which its persistence arises. It can still remain at a high level long after ending of the factors which caused it. In other words, some events being the effect of cyclical fluctuation are the reason of structural transformations. The example may be the situation in which exceptionally deep recessions cause the increase of the natural rate. Such a situation actually occurred in Poland<sup>3</sup>. Since the beginning of the period covered by research the rate of employment went through essential structural changes result-

<sup>2</sup> Compare Phelps E. S.(1972), *Inflation Policy and Unemployment Theory: The Cost-Benefit Approach to Monetary Planning*, W. W. Norton, New York.

<sup>3</sup> Compare Drozdowicz-Bieć M., Pater R., Wargacki M., (2006), *Barometr Ofert Pracy a rynek pracy w Polsce*, w: red. M. Mocek, *Diagnozowanie i prognozowanie koniunktury gospodarczej w Polsce*, Poznań.

ing, among other things, from changes of efficiency in Polish enterprises, depreciation of the skills of labour supply and the supply shock<sup>4</sup>.

The date, on the basis of which there was carried out the analysis of results of forecasting, were the monthly rates of unemployment for the years 1999–2007 in Podkarpackie province, whose values were reduced to the comparable level, using the previously presented regression equation. As the basis of constructing the forecast there were assumed the rates of unemployment of the years 1999–2006, shortening left-wise this 8-year period by 12 months, starting from the year 1999 and ending in 2003. Thus, the first of the forecasts was determined on the basis of data from 8 years, and the last one – taking into consideration 3 years (2004–6). The period of forecast included monthly rates of unemployment of the year 2007. In connection with the fact that the magnitudes in this last year were known, it was possible to compare ex post the forecasts with the values of their realization.

Due to occurrence, in the tested period, of clear trend and seasonal fluctuations within the year, the method of indicators of seasonal character was used to determine the forecasts of the magnitudes of rates of unemployment. Its point of departure is the selection of adequate model describing the trend of the variable. For this purpose there were used the models of polynomial regression. The selection of their degree was carried out on the basis of the following procedure<sup>5</sup>:

a) there is made estimation of parameters of the linear model and determined the remainder variance  $S_1^2$

$$y_t = \beta_0 + \beta_1 t + \eta_t, \quad (1)$$

and there are estimated the parameters of the square model and determined the remainder variance  $S_2^2$

$$y_t = \beta_0 + \beta_1 t + \beta_2 t^2 + \eta_t, \quad (2)$$

b) there is selected the model which contains statistically significant parameter at a time variable in the highest power, and at the same time showing the remainder variable statistically significantly lower than the one calculated for the second model, which can be determined in the basis of the statistics  $F = \frac{s_1^2}{s_2^2}$ , comparing it at the set level of significance  $\alpha$  to the critical value of Fisher-

<sup>4</sup> See. *Forecasting with Composite Coincident and Leading Indexes and the CLIMA Model. Case of Poland* (2007), praca zbiorowa pod red. M. Bieć, Warsaw School of Economics, Warsaw.

<sup>5</sup> Osińska M., (2007), *Ekonometria współczesna*, Wyd. UMK, Toruń.

Snedecor's  $F$  distribution  $F_{\alpha, r_1, r_2}$ , where  $r_1 = n - 2$ ,  $r_2 = n - 3$  are the degrees of freedom of numerator and denominator of statistics  $F$  for models (1) and (2).

For the statistical assessment of significance of structural parameters of models (1) and (2) there was used the test probability  $p$ , the statistics of test of t-Student, which value was given by the program SPSS at estimating the model and then it was checked whether it is lower than the set significance level  $\alpha = 0.05$ .

In the matrix notation the models (1) and (2) assume the form

$$y = T^{(k)} \beta^{(k)} + \eta, \quad k = 1, 2 \quad (3)$$

where:

$y$  – vector of observation,

$T^{(1)} = [1 \ t]$  – matrix of system for the model (1), but 1 is the vector of ones,

$t$  – vector of successive numbers of time units,

$T^{(2)} = [1 \ t \ w]$  – matrix of system for the model (2), where beside the denotations as for the model (1), the vector  $w$  contains components being successive squares of numbers of time units,

$\beta^{(1)} = (\beta_0 \ \beta_1)'$   $\beta^{(2)} = (\beta_0 \ \beta_1 \ \beta_2)'$  – vectors of structural parameters in the models (1) and (2),

$\eta$  – vector of errors.

By analogy the model (3) may be noted for the polynomial models of higher degree. The presented procedure is continued regarding the successive models of trend of higher degrees, stopping however on the polynomials of fourth degree, which is generally assumed in economics.

Structural parameters in the model (3) were estimated with the least squares method according to the equation  $\hat{\beta}^{(k)} = (T^{(k)'} T^{(k)})^{-1} T^{(k)'} y$ , where the symbol  $(.)^{-1}$  denotes the inverse matrix from the function of the set argument, and the model assumes the form  $\hat{y} = T^{(k)} \hat{\beta}^{(k)}$ ,  $k = 1, 2, 3$ .

After determining the form of the model describing the trend, there were determined for individual months the indicators of seasonal character, which allows bringing closer the values of forecasts determined from equations to the values of their realization. In the subscripts of the given symbols the indicator  $t$  determines the number of the subsequent time unit in the series, and  $i$  denotes the subsequent month (season) in the year. The indicators of seasonal character are determined in a slightly different way in the case of the additive and multiplicative models, at using of which there is assumed constancy of absolute and

relative fluctuation of the variable in relation to the values determined according to the function of trend<sup>6</sup>:

a) isolation of the trend with the use of equation of the following models:

- additive  $y_{t_i} = \hat{y}_{t_i} + c_i + \eta_{t_i}$ ,

- multiplicative  $y_{t_i} = \hat{y}_{t_i} c_i \eta_{t_i}$ ,

where:

$y_{t_i}$  – empirical value in the moment  $t$  for the  $i$ -th month in a year,

$\hat{y}_{t_i}$  – theoretical value in the moment  $t$  for the  $i$ -th month in a year, determined from the model of trend,

$c_i$  – indicator of seasonal character for the  $i$ -th month in a year,

$i$  – number of month in a year  $1, \dots, r$ ,

$\xi_t$  – random component,

b) elimination of the developmental tendency for the following models:

- additive  $z_{t_i} = y_{t_i} - \hat{y}_{t_i}$ ,

- multiplicative  $z_{t_i} = \frac{y_{t_i}}{\hat{y}_{t_i}}$ ,

c) elimination of the random fluctuation by calculation of raw indicators of seasonal character for both models  $z_i = \frac{1}{l} \sum_{j=0}^{l-1} z_{i+12j}$  where  $l$  – number of years, and  $z_{i+12j}$  are the magnitudes calculated in point b),

d) pure indicators of seasonal character for the following models: additive

$c_i = z_i - q$  and multiplicative  $c_i = \frac{z_i}{q}$ , where  $q = \frac{1}{12} \sum_{i=1}^{12} z_i$ .

The values of the forecast for the moment  $t$  are determined respectively for the following models: additive  $y_{t_i}^* = y_{t_i}^{*(w)} + c_i$  and multiplicative

$$y_{t_i}^* = y_{t_i}^{*(w)} + c_i, \text{ for } t > n,$$

where  $y_{t_i}^*$  – forecast for the moment  $t$ ,  $y_{t_i}^{*(w)}$  – initial forecast for the moment  $t$  and  $c_i$  – indicator of seasonal character for the  $i$ -th month.

After obtaining the equations of additive and multiplicative models of three different polynomial forms of 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> degrees for 6 periods of different lengths of data (3 – 8 years), there were determined 36 different forecasts, thus the need to assess their quality arose. For this purpose there were used the variances of errors of forecasts and the statistics  $F$  calculated on their basis, which

<sup>6</sup> Dittmann P., (1997), *Prognozowanie gospodarcze, Metody i zastosowania*, PWN Warszawa

allowed selection of the basis for determining the best forecast and indicating the statistical significance of differences of quality of the obtained results. The variance of quadratic error of forecast was calculated according to the formula:

$$\hat{S}^P = \frac{1}{12} \sum_{t=1}^n (y_{t_i} - y_{t_i}^*)^2,$$

in which the used denotations were explained previously. For the quotients of variance, as the statistics of the test F, there was determined the test probability  $p$ , and then it was checked if it was lower than the set level of significance  $\alpha = 0.05$ . These values were determined for all variants of forecasts.

## II. THE CHARACTERISTICS OF THE TREND OF RATES OF UNEMPLOYMENT

In accordance with the procedure presented in the first chapter, for the purpose of determining the forecasts of rates of unemployment it was set about describing the trend of their values with the use of econometric models in polynomial analytical form, starting from the first degree.

Applying the least squares method there were obtained estimations of structural parameters of 6 models on the basis of different lengths of a period of time. The results of these estimations, in the form of test probabilities for the parameters at the time variable of the highest power and for the statistics of the test F, used for the assessment of diversification of the remainder variance of models of trend estimated at different number of years, are presented in table 2.

The test parameters, presented in table 2, for the parameters at the time variable in the highest power indicate the statistical significance of the parameters of all linear models apart from the situation when the basis of estimation was the period of 8 years. These parameters in the quadratic model were significant at determining them on the basis of data from all periods except one case, i.e. the last 3 years. In this situation about acceptance of models to further analysis decides the statistically significant decrease of the remainder variance at transition from linear models to parabolic ones. The test probabilities in favour of the latter occur at determining the parabolic models on the basis of data of the last 6, 7 and 8 years, thus in the case of taking into consideration longer periods of time.

In accordance with the accepted procedure it should be checked if in the case of the last quadratic models they should not be replaced by the polynomials of third degree. On the basis of table 2 it may be stated that the test parameters for the parameters at the time variable in third power indicate their statistical significance. However, taking into consideration the remainder variance one should



state that these models do not influence in a statistically significant way the decrease of these variances.

Table 2. Test probabilities for the parameters and for the differences of the remainder variance of models

| Basis of estimation<br>[years] | Test probabilities for parameters of the model |           |                 | Test probabilities for differences of the remainder value between the models |                               |
|--------------------------------|--|-----------|-----------------|--|-------------------------------|
|                                | linear   | quadratic | of third degree | linear and quadratic   | quadratic and of third degree |
| 3                              | 6,3E-13  | 0,684     | 0,003           | 0,529  | 0,237                         |
| 4                              | 2E-17  | 0,045     | 0,098           | 0,409  | 0,447                         |
| 5                              | 4,5E-21  | 0,002     | 0,066           | 0,280  | 0,436                         |
| 6                              | 1,5E-17  | 7,5E-11   | 0,588           | 0,006  | 0,517                         |
| 7                              | 2E-05  | 1,3E-23   | 0,015           | 3,7E-08  | 0,390                         |
| 8                              | 0,745  | 6,82E-37  | 0,049           | 1,7E-15  | 0,440                         |

Source: Authors' elaboration.

Finally, for forecasting on the basis of the model of trend one should assume the linear models determined on the basis of last 3 to 5 years, and when forecasting on the basis of data from 6 to 8 years, the polynomials of second degree turn out to be better.

### III. SEASONAL CHARACTER OF UNEMPLOYMENT

As it was stated in the beginning of the discussion, the analysed phenomenon, apart from the component of trend, is characterised by the influence of seasons, i.e. in the considered case – months. Its expression are the indicators of seasonal character which were presented in table 3 with consideration of additive and multiplicative forms for all three considered models on the basis of data for the period of 8 years.

The indicators of seasonal character, contained in table 3, calculated both from the model in additive form as well as in multiplicative one, unanimously indicate the generally known phenomenon that the rate of unemployment was lower outside the winter period, assuming the lowest quantity in October, and the highest in February. The highest difference between the rates of unemployment was 1,39 for the linear model, 1,41 for the polynomial of 2<sup>nd</sup> degree and 1,46 in the case of the model of 3<sup>rd</sup> degree. It means that the averaging for 8 years absolute differences of seasonal fluctuation of the rate of unemployment regarding the model of trend reached maximum about 1,4%. On the basis of multiplicative models one may state that these changes constituted about. 8% of the value determined from the trend, but, similarly to the previous case, this quantity was the lowest for the linear model, and the highest – for the polynomial of 3<sup>rd</sup> degree.

Table 3. Pure indicators of seasonal character according to the models determined for data from eight years

| Months | Additive model |           |                 | Multiplicative model |           |                 |
|--------|----------------|-----------|-----------------|----------------------|-----------|-----------------|
|        | linear         | quadratic | of third degree | linear               | quadratic | of third degree |
| 1      | 0.771          | 0.807     | 0.845           | 1.041                | 1.043     | 1.045           |
| 2      | 0.851          | 0.867     | 0.898           | 1.045                | 1.046     | 1.048           |
| 3      | 0.724          | 0.725     | 0.749           | 1.038                | 1.039     | 1.040           |
| 4      | 0.228          | 0.217     | 0.234           | 1.012                | 1.012     | 1.013           |
| 5      | -0.363         | -0.382    | -0.372          | 0.981                | 0.980     | 0.980           |
| 6      | -0.465         | -0.488    | -0.485          | 0.975                | 0.974     | 0.974           |
| 7      | -0.403         | -0.426    | -0.429          | 0.979                | 0.977     | 0.977           |
| 8      | -0.437         | -0.456    | -0.466          | 0.977                | 0.976     | 0.975           |
| 9      | -0.471         | -0.482    | -0.499          | 0.975                | 0.974     | 0.973           |
| 10     | -0.543         | -0.542    | -0.566          | 0.971                | 0.971     | 0.970           |
| 11     | -0.209         | -0.193    | -0.224          | 0.989                | 0.990     | 0.988           |
| 12     | 0.317          | 0.353     | 0.315           | 1.017                | 1.019     | 1.017           |

Source: Authors' elaboration

The presented results of calculations indicate slightly different results achieved at the use of different models. Of course, it results, on the one hand, from the specificity of the analysed time series, and on the other hand – from the properties of the used models. Shaping of the empirical values of rates of unemployment for the period of 8 years and the course of the trend for the models used in the paper are illustrated in fig. 2. It is observed that the graphs of the models of 2<sup>nd</sup> and 3<sup>rd</sup> degrees run close to each other, and the linear trend in this case strongly diverges from the empirical values. Of course, at the left-sided cutting-off of data the models will assume appropriately different shapes and positions.

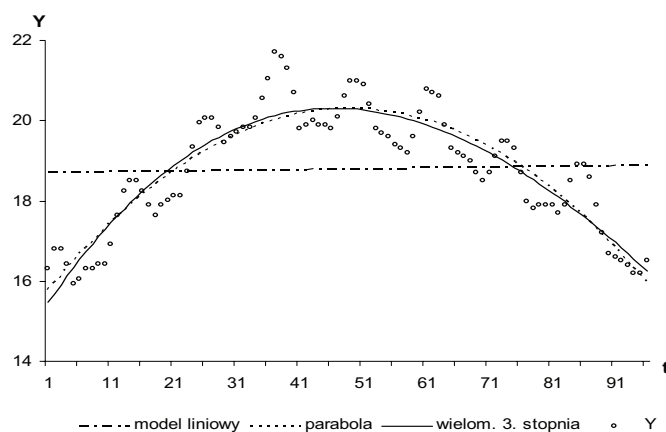


Fig. 2. Empirical values and models of trend

Source: Authors' elaboration.

#### IV. FORECAST OF RATES OF UNEMPLOYMENT AND ITS ACCURACY

The point of departure for forecasting the rates of unemployment was the data from 8 years, and then, due to the left-sided cutting off of the series by one year, the forecast was determined on the basis of shorter and shorter periods of time, ending on the information from the last 36 months and using for this purpose all forms of the determined models with consideration of the components of trend and the seasonal fluctuations. As the basis of the assessment of accuracy of forecasts which were determined for the year 2007 there was assumed the variance of error of forecast, and their quantities are presented in table 4.

Table 4. Variances of errors of forecasts

| Basis of estimation<br>[years] | Additive form of model |           |                 | Multiplicative form of model |           |                 |
|--------------------------------|------------------------|-----------|-----------------|------------------------------|-----------|-----------------|
|                                | linear                 | quadratic | of third degree | linear                       | quadratic | of third degree |
| 3                              | 0,353                  | 0,228     | 3,255           | 0,369                        | 0,243     | 3,212           |
| 4                              | 0,504                  | 0,108     | 0,178           | 0,517                        | 0,118     | 0,168           |
| 5                              | 0,605                  | 0,112     | 0,051           | 0,616                        | 0,121     | 0,048           |
| 6                              | 0,896                  | 0,029     | 0,071           | 0,903                        | 0,035     | 0,078           |
| 7                              | 1,473                  | 0,007     | 0,112           | 1,476                        | 0,009     | 0,120           |
| 8                              | 2,136                  | 0,012     | 0,029           | 2,136                        | 0,013     | 0,033           |

Source: Authors' elaboration.

The values listed in table 4 allow observing that the quality of forecasts obtained with the use of the multiplicative and additive forms of the model were very similar, with light advantage of accuracy of the latter method. The lowest variances of errors of forecasts occurred in the case of the use of the polynomial of 2<sup>nd</sup> degree as the model describing the trend, and the polynomial of 3<sup>rd</sup> degree performing this role turned out to be better only once, i.e. in the situation when the 5-year period was assumed as the basis for determining the level of rates of unemployment. The characteristics of trend with the use of the linear model always gave worse results than the parabola and only in one case it was better than the polynomial of 3<sup>rd</sup> degree, namely at forecasting on the basis of the shortest – three-year period, when the course of the variable was close to the linear form.

For the purpose of determining the statistical significance of differences of quality of forecasts achieved with the use of models differing in the assumed analytical form of trend, there were calculated the statistics of the test  $F$  for the variances of errors of forecasts presented in table 4 and there were determined the test probabilities of these values which are contained in table 5.

Table 5. Test probabilities for diversifying the variances of errors of forecasts between the models

| Basis of estimation<br>[years] | Additive models                     |                                     |   | Multiplicative models               |                                     |   |
|--------------------------------|-------------------------------------|-------------------------------------|---|-------------------------------------|-------------------------------------|---|
|                                | linear of 2 <sup>nd</sup><br>degree | linear of 3 <sup>rd</sup><br>degree | 3 <sup>rd</sup> and 2 <sup>nd</sup><br>degree | linear of 2 <sup>nd</sup><br>degree | linear of 3 <sup>rd</sup><br>degree | 3 <sup>rd</sup> and 2 <sup>nd</sup><br>degree |
| 3                              | 0.105                               | 2.1E-09                             | 7.1E-12                                       | 0.115                               | 4.7E-09                             | 2.1E-11                                       |
| 4                              | 4.0E-07                             | 3.6E-04                             | 0.048   | 9.9E-07                             | 1.4E-04                             | 0.117   |
| 5                              | 8.2E-10                             | 3.0E-17                             | 0.002   | 2.5E-09                             | 4.0E-18                             | 3.2E-04                                       |
| 6                              | 1.2E-33                             | 2.4E-21                             | 1.5E-04                                       | 4.5E-31                             | 3.9E-20                             | 5.4E-04                                       |
| 7                              | 9.8E-73                             | 2.6E-25                             | 3.6E-29                                       | 1.4E-67                             | 2.1E-24                             | 1.5E-25                                       |
| 8                              | 1.2E-78                             | 5.5E-61                             | 2.3E-05                                       | 1.1E-77                             | 1.9E-58                             | 4.3E-06                                       |

Source: Authors' elaboration.

The previously discussed advantage of the square / quadratic model in the additive form over the others turned out to be, regarding the variances of errors of forecasts, statistically proved, except the qualitatively better forecast at the use of the model of 3<sup>rd</sup> degree at the 5-year period as the basis of forecasting and the lack of statistical difference in the quality of forecast in comparison to the one obtained with the linear model on the basis of the last three years of analysis. Almost identical results were obtained at determining the forecasts with the use of the multiplicative models, and the only difference consists in the fact that in addition there turned out to be statistically insignificant the variance of error of forecast between the models of 2<sup>nd</sup> and 3<sup>rd</sup> degrees, when the models were estimated with consideration of data from the last 4 years.

Knowing that, apart from one case, the variances of errors of forecast were slightly lower for the additive model, it was checked if its higher efficiency was in a statistically significant way higher than the competitive multiplicative model. And the calculated statistics of the test F, and on their basis the test probabilities, contained within the limits from 0,09 to 0,43, showed that the assumed criterion of assessment of quality of forecasts did not show statistically significant differences between these results of prediction.

The presented discussion shows that it is hard, before setting about determining the forecasts with the method of indicators, to specify the correct model describing the trend, and the way of selection of the analytical form of this model, given in introduction, does not guarantee making the right decision in this respect.

A separate aspect of this paper is the attempt to answer the question how the accuracy of forecasting is influenced by the length of the period of time, and because of that also the number of data on the basis of which the forecasting is performed? Certainly, it is hard to find an unequivocal answer which is generally valid in this respect. From among all models used in the paper, the additive form of 2<sup>nd</sup> degree, determined on the basis of data from the last 7 years, turned out to be the best in respect of the criterion of quantity of deviations of forecasts from

the real values measured by the variance of error of forecast. Thus, the use of full information about the tested phenomenon in the analyzed situation would not allow obtaining such a good result as at the left-sided cut-off of the series by data from 12 months of the first year.

For the purpose of statistical assessment of the difference of the variance of error for the most accurate forecast obtained on the basis of the 7-year period and for the next one regarding the quality of the forecast determined with the use of data of the last 8 years, there were calculated the statistics of the test F and, on their basis, the test probability. It assumed the value 0,003, thus forecasting on the basis of the last 7 years gave, in comparison to all other variances of prediction, the best results.

The results presented in this paper were significantly influenced by the period of the analysis. It is so because it was performed in the time between the two bottoms of the economic cycle. It strongly influenced the dynamics of the rate of unemployment, determining its tendency which is best described by the parabola. It is also worth emphasizing the specificity of Podkarpackie province in the context of changes in the labour market. It is characterized by higher participation of agriculture, than the average for the country, in creation of the value of production, which moreover is strongly fragmented and low profitable, and at the same time by lower participation of the service sector. Both this as well as the other regional conditions, including poor results within the scope of attracting foreign investments caused slow changes of the rate of unemployment in the last years. As a result, its variability in Podkarpackie province in the years 1999-2007 was considerably lower than the one in the country.

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**WPLYW LEWOSTRONNEGO UCINANIA SZEREGU NA EFEKTYWNOŚĆ PR  
OGNOZOWANIA STOPY BEZROBOCIA REJESTROWANEGO NA PODKARPACIU  
ZA LATA 1999 – 2007 METODĄ WSKAŹNIKÓW SEZONOWOŚCI**

Zjawisko bezrobocia jest częstym przedmiotem badań socjologiczno-ekonomicznych. Ze względu na zmiany trendu tego zjawiska, powstaje potrzeba jego opisu różnymi modelami ekonometrycznymi, a na ich podstawie przeprowadzenia odpowiedniego prognozowania.

W pracy przedstawiono analizę i prognozę stopy bezrobocia metodą wskaźników sezonowości uwzględniając pełny oraz kolejno lewostronnie ucinane szeregi czasowe. Do opisu trendu wykorzystano wielomianowe modele pierwszego, drugiego i trzeciego stopnia. Ocenę efektywności prognozy dokonano w oparciu o wybrane mierniki.

Dane liczbowe stanowiły miesięczne wielkości stopy bezrobocia rejestrowanego na Podkarpaciu za lata 1999–2007 udostępnione przez Instytut Gospodarki WSIiZ w Rzeszowie.