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FORECASTING ECONOMIC DEVELOPMENT OF ZAPORIZHZHIA REGION

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The article is devoted to the study of economic development trends of the Zaporizhzhia region. The concepts of "development" and "economic development" were investigated. The characteristics and criteria of the economic development of the region were determined. Development is characterized by a complication of the system and an increase in adaptation to external conditions, an increase in the scale of the phenomenon or process. The economic development of the region is characterized by qualitative changes and irreversibility, and as a complex and dynamic process by the variability and uncertainty of the future. Taking into account the tendencies of economic development of individual regions allows to develop strategic measures to increase the country's competitiveness. The analysis of scientific researches of socio-economic development of the regions is conducted and it is established that the construction of sound forecasts using modern forecasting methods is an important practical task of analyzing the dynamics of economic indicators. The main macroeconomic indicators that are appropriate to use in the study of the economic development of the region were analyzed. The main macroeconomic indicators of the region's economic development are gross output of goods and services and gross value added at actual prices. A comparative analysis of the dynamics of the gross output of goods and services and gross value added in the Zaporozhzhia region. An analysis of the dynamics of gross output of goods and services and gross value added in the Zaporizhzhya region shows that both indicators show an exponentially increasing trend. Trend and autocorrelation models of the dynamics of these indicators are constructed. Applying an approach of combining forecasts, in particular, the variance-covariance method, a forecast of the economic development of the Zaporizhzhia region was made using a trend and autocorrelation model. The prediction error for the trend models and autocorrelation models is determined.

ПРОГНОЗУВАННЯ ЕКОНОМІЧНОГО РОЗВИТКУ ЗАПОРІЗЬКОГО РЕГІОНУ

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Ключові слова:
автокореляційна модель, динаміка, економічний розвиток, модель, прогноз, регіон, тренд.

Статтю присвячено дослідженню тенденцій економічного розвитку Запорізького регіону. Проведено аналіз понять: «розвиток» та «економічний розвиток». Визначено характеристики та критерії економічного розвитку регіону. Розвиток характеризується ускладненням системи та підвищенням пристосованості до зовнішніх умов, збільшенням масштабів явища або процесу. Економічний розвиток регіону характеризується якісними змінами та незворотністю, а як складний та динамічний процес - мінливістю та невизначеністю стану в майбутньому. Урахування тенденцій економічного розвитку окремих регіонів дозволяє розробляти стратегічні заходи щодо підвищення конкурентоспроможності країни. Проведено аналіз наукових досліджень соціально-економічного розвитку регіонів та встановлено, що побудова обґрунтованих прогнозів із застосуванням сучасних методів прогнозування є важливим практичним завданням аналізу динаміки економічних показників. Проаналізовано макроекономічні показники, що доцільно використовувати при дослідженні економічного розвитку регіону. Основними макроекономічними показниками економічного розвитку регіону є валовий випуск товарів та послуг та валова додана вартість у фактичних цінах. Проведено порівняльний аналіз динаміки валового випуску товарів та послуг та валової доданої вартості в Запорізькому регіоні. Аналіз динаміки валового випуску товарів та послуг і валової доданої вартості по Запорізькому

регіону свідчить, що в обох показниках спостерігається експоненційно зростаючий тренд. Побудовано трендові та автокореляційні моделі динаміки означених показників. Побудовано прогноз економічного розвитку Запорізького регіону із застосуванням моделі тренду, автокореляційної моделі та підходу комбінування прогнозів, зокрема дисперсійно-коваріаційного методу. Визначено помилку прогнозів за моделями тренду та автокореляційними моделями.

Statement of the problem

Development is a purposeful, irreversible, regular change of objects. Under development it is also understood the complication of the system (the emergence of new elements, the complication of relationships between them), the increase of adaptation to external conditions and increase in the scale of a certain phenomenon, etc. Economic development is a fundamental, qualitative change in the economic sphere of society. The economic sphere of society is a system that ensures the production, distribution, exchange and consumption of goods and services. In a general sense, economic development is characterized by qualitative changes and irreversibility, but as a complex and dynamic process, by variability and uncertainty in the future. The development indicators of the regional economy make it possible to determine the level of the country's economic development, that is, at the regional level, issues of the reproduction of productive forces are being solved, social and economic development strategies are being implemented, the social needs of the population are being met, etc. The process of economic development of the region is aimed at enhancing its economic potential, meeting the needs of the population, increasing production volumes, increasing the products competitiveness and, ultimately, increasing the living standards of the population in the region. The economic development of the region is a process of cumulative changes in the economic system of the region, aimed at its transition to a new qualitative and quantitative state under the influence of factors of the internal and external environment, acting in time and space [1]. Forecasting the economic development of regions is relevant in the process of making strategic decisions in managing the country's socio-economic development. Taking into account the economic development trends of individual regions allows us to develop strategic measures to increase the country's competitiveness. Therefore, in our opinion, one of the main tasks of modern economic research is the construction of scientifically based forecasts applying a range of modern forecasting methods.

Analysis of recent studies and publications

The problems of the economic development of the regions, issues of the influence of the components of the economic potential of the regions on socio-economic processes, fundamental and applied basics of territorial development, problems of developing and implementing the regional policy of the state were studied by such domestic scientists: Z. Varnaliy [2], V. Geyets, M.Herasimchuk, B. Danilishyn, M. Dolishnyiy, I. Lukinov, I.Murashko and others.

Thus, I. Murashko [3] emphasized the principles of sustainable development, which should be aimed at establishing long-term, prospective and short-term goals of the region, comparing the goals and objectives of each development subject not only with the availability of resources, but also on the principle of conservation and rational use of resources as a necessary condition for achieving sustainable development of the region. V. Geyets [4] focused on the study of effective innovative technological changes, which are the main factor in the long-term socio-economic development. Among those who study the problem of building strategies for economic development stand out: Z. Varnaliy, S. Yerokhina [5], B. Budzan, V. Solovyov, S. Mocherny, G. Mintzberg, A. Chandler and others. Z.Varnaliy, V. Geyets and other Ukrainian scientists took part in the development of important for Ukraine programs and strategies for socio-economic development.

The works of Yu. Lysenko [6], O. Makarenko [7], L. Serhieieva, V. Solovyov [8], E. Libanova [9] and others are devoted to the analysis of dynamics, modeling and forecasting of indicators of economic development of regions. In particular, the works of Yu. Lysenko and L. Serhieieva [6] are dedicated to the problems of building of the structure of goals in the regional management as an ideal-seeking system. The authors note that one of the main goals of the budget process is the allocation of budget funds to different spheres of activity of the country and the region, and they propose a method for allocating budget funds, taking into account the structure of goals.

Despite a significant number of studies on the economic development of regions, the issues of forecasting indicators of economic development using modern methods are not sufficiently covered, which determines the relevance of the chosen research topic.

Objectives of the article

The purpose of the article is to build a combined forecast of economic development indicators of Zaporizhzhya region on the basis of the trend model and the autoregressive model, determining the quality of the obtained forecast.

The main material of the research

To measure economic growth, a system of indicators is used which makes it possible to identify and analyze the production productivity at the regional level. One of the main macroeconomic indicators of the development of the region’s economy is the gross output of goods and services, it is defined as the sum of goods and services produced for all types of economic activity.

Equally important is the indicator of gross value added at basic prices, defined as the difference between output and intermediate consumption, and reduced by the value of financial intermediation services. This indicator is

applied in order to avoid multiple counting of parts of products that are used to produce other goods. That is, gross value added reflects the added value of goods and services produced. We analyze the dynamics of these indicators in actual prices in the Zaporozhzhia region for the period form 2000 to 2017 (Fig. 1) according to the State Statistics Service of Ukraine [10].

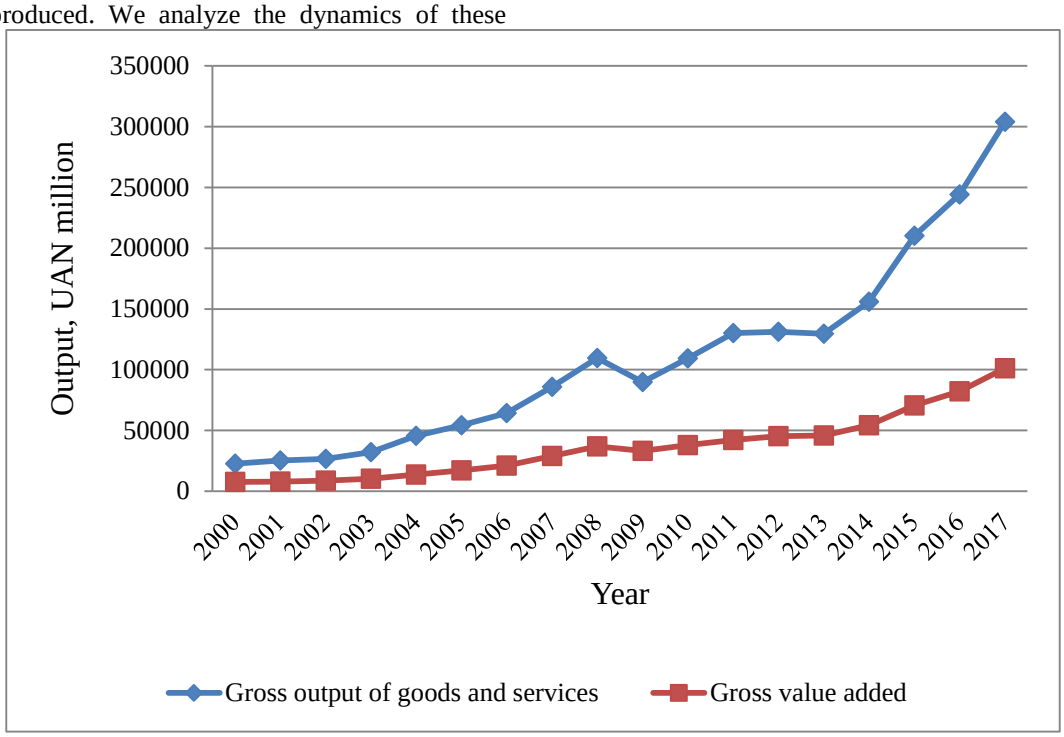

Fig. 1. Dynamics of gross output of goods and services and gross value added in the Zaporizhzhya region, 2000-2017
Source: summarized by the authors according to the State Statistics Service of Ukraine [10]

The analysis of the dynamics of the gross output of goods and services and gross value added in the Zaporizhzhia region suggests that both indicators have an exponentially growing trend. The exponential model of the trend of gross output of goods and services $(GGA(t))$ is as follows:

$$GGA(t) = 20701 \cdot e^{0,1467t}, \quad (1)$$

where t - time period, $t = 1,..T.$

The exponential model of the trend of gross value added of goods and services $(GVA(t))$ is as follows:

$$GVA(t) = 6598,5 \cdot e^{0,1513t}. \quad (2)$$

The models (1) and (2) are qualitative, statistically significant. Comparison of the parameters of models (1) and (2) leads to the conclusion that the growth rate of the analyzed indicators is almost the same. In 2017, gross output of goods and services increased 13.46 times compared to 2000 and amounted to UAH 304 billion. Gross value added in the Zaporizhzhya region in 2017 increased 13.35 times compared to 2000 and amounted to UAH 101 billion.

In addition, the ratio between the stated indicators for the analyzed period remains almost unchanged: in 2000 the gross output of goods and services was 2.98 times higher than the gross value added, and in 2017 - 3.01 times. Therefore, the question arises about the nature of the change in these indicators: are such growth rates caused by an increase in the volume of physical production (which is typical for countries introducing the latest technologies) or by an increase in actual prices (which is typical for countries with high inflation)?

An autoregressive model for gross output of goods and services (GGA_t) is as follows:

$$GGA_t = -2254 + 1,19 \cdot GGA_{t-1}, \quad (3)$$

Model (3) is qualitative (the coefficient of determination R2 is 0.96), statistically significant (the calculated value of the Fisher test ($(F = 372,2)$) is greater than the critical one $(F_{crytical} = 4,54)$ with the level of statistical significance), the coefficients are statistically significant.

The autoregressive model for the gross value added of goods and services (GGA_t) is as follows:

$$GVA_t = -612 + 1,18 \cdot GVA_{t-1}. \quad (4)$$

Model (4) is qualitative (the coefficient of determination R2 is 0.98), statistically significant (the calculated value of the Fisher test $(F = 603.39)$ is greater than the critical one $(F_{crytical} = 4,54)$ compared with the level of statistical significance), the coefficients are statistically significant. $\alpha = 0,05)$ Since models (1) - (4) take into account various aspects of the dynamics of gross output of goods and services and gross value added (models (1) and (2) show the dependence of changes over time, and models (3) and (4) show the dependence

of indicators changes upon the previous values), then taking into account these trends it is considered appropriate to build a combined forecast by the dispersion-covariance method.

The forecast by the variance-covariance method $(A_3(t))$ is made according to the rule:

$$A_3(t) = \lambda A_1(t) + (1-\lambda)A_2(t), \quad (5)$$

where $A_1(t), A_2(t)$ - forecasts made by different methods, λ - forecast weight.

More details on the evalutaion procedure of λ are given in [11].

Using the models (1) - (4) for the indicators of economic development of the Zaporizhzhia region, that is, the gross output of goods and services and gross value added, a forecast is made. The forecasting results are presented in table 1-2.

Table 1 - The forecasted values of the gross output of goods and services and gross value added are obtained using models (1), (3)

Year	Gross output of goods and services at actual prices (mln. UAH)			
	Actual value	Forecast value		
		Model 1	Model 3	Combined forecast
2017	304010	290261,43	288874,1	289911,83
2018	X	336124,63	360108,2	342168,48
2019	X	389234,51	426974	398744,85

Source: calculated by the authors

Table 2 –The gross value added forecasted values of obtained by using models (2), (4)

Year	Gross value added at actual prices (mln. UAH)			
	Actual value	Forecast value		
		Model 2	Model 4	Combined forecast
2017	101060	100508,51	96584,23	99519,59
2018	X	116926,13	119097,6	117473,35
2019	X	136025,5	140464	137144,00

Source: calculated by the authors

The forecast properties of models (1) - (4) are determined using the *RMSPE* (Root Mean Squared Percentage Error). The value of RMSPE forecasts of the gross output of goods and services and gross value added are presented in Table 3.

Table 3 – Errors of forecast of the gross output of goods and services and gross value added

Gross output of goods and services			
	Model 1	Model 3	Combined forecast
Mean absolute percentage error, %	4,5	4,9	4,6
Gross value added			
	Model 2	Model 4	Combined forecast
Mean absolute percentage error, %	0,5	4,4	1,5

All three methods present forecasts with high accuracy, because the mean absolute percentage error is less than 10%.

Conclusion

The analysis of the economic development trends of the Zaporizhzhya region led to the conclusion that the gross output of goods and services and gross value added in the Zaporizhzhya region are growing. The dynamics of changes in these indicators is accurately described by an exponential dependence.

The comparison of the trend models parameters states that the growth rate of the indicators that are analyzed is almost the same. In 2017, the gross output of goods and services increased 13.46 times compared to 2000 and amounted to UAH 304010 million. In 2017 the gross value added in the Zaporizhzhia region increased 13.35 times compared to 2000 and amounted to UAH 101060 million.

In addition, the ratio between the stated indicators for the analyzed period remains almost unchanged: in 2000 the gross output of goods and services was 2.98 times higher than the gross value added, and in 2017 - 3.01 times.

Using the proposed procedure for forecasts building of macroeconomic indicators of the development of the region will improve the efficiency of the process of developing strategies for economic development of the region. The prospect of further research is the construction of a forecast of structural changes in the economy of the Zaporizhzhia region.

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