Conclusion. Besides others business cycles synchronization became one of the features modern business cycles. So it's not a big surprise the increasing interest to the analysis of business cycle synchronization across different countries has in both academic and policy fields. Terms such as "globalization" or "world integration" can be found everyday in the press, with all kinds of associated implications. Developed economies have become more tightly integrated in recent years. In these countries, international trade flows have increased substantially and financial markets have become more homogeneous. Promoted by this international integration, growing attention is being devoted to examine whether the efforts to coordinate their economic policies lead to higher business cycle synchronization.

There are a great number of studies devoted to research and measurement of synchronization phenomenon. It is important to take into account all characteristics and to develop a complex methodology of the research. We set a goal to continue working in this direction, especially for developing and post-Soviet countries.

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ДОСЛІДЖЕННЯ СИНХРОНІЗАЦІЇ ЕКОНОМІЧНИХ ЦИКЛІВ

В статті вивчаються способи оцінки синхронізації економічних циклів. Вивчаються коливання економічної активності в пострадянських країнах. Оцінюються різні міри синхронізації в групах країн згідно визначених критеріїв.

Ключові слова. Економічний цикл, синхронізація, міри синхронізації, кредитний рейтинг.

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ИССЛЕДОВАНИЕ СИНХРОНИЗАЦИИ ЭКОНОМИЧЕСКИХ ЦИКЛОВ

В статье изучаются способы оценки синхронизации экономических циклов. Исследуются колебания экономической активности в постсоветских странах. Оцениваются разные меры синхронизации в группах стран согласно определенным критериям.

Ключевые слова. Экономический цикл, синхронизация, меры синхронизации, кредитный рейтинг.

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LABOUR MARKET IN UKRAINE: AN EMPIRICAL DYNAMIC ANALYSIS USING ERROR CORRECTION MODEL

The labor market background in Ukraine has not only economic but also significant social value, and therefore is an important element of social and economic policy. The effectiveness of the state socio-economic regulation mechanisms requires profound analysis, modeling and forecasting of the processes of the labor market by means of modern flexible econometric tools, taking into account the short-term dynamics of economic processes and features that are characteristic of the unstable economic development of our country. As a result of empirical research on relationships between the macroeconomic indicators of the labor market in Ukraine, we developed a set of dynamic econometric models using an error-correction mechanism which take into account the long-run equilibrium relationships, as well as provide an opportunity to model the short-term effects of several factors such as the rate of change of wages, size of the labor force, employment and unemployment. The developed model is used to predict future trends of the labor market, as well as to describe the dynamics of its operation under various alternative scenarios of economic development. The application of the developed specifications in the structure of an integral macroeconometric model of Ukraine will allow us to carry out a comprehensive analysis of economic processes in the national economy and its prospects both in the short term and in the long run.

Keywords: labour market; econometric modeling; error-correction model; wage; employment; unemployment; scenarios of development; forecasting.

Introduction (Problem definition). Long-term negative trends on the labor market in Ukraine generate economic and social problems associated with poverty and unemployment. They prevent creation of conditions for stabilization and economic growth, deepen social tension in society. The development of economic processes and events in Ukraine demonstrates the need for increased attention to the national labour market, which is an important element of the socio-economic system of the country. The background for carrying out qualitative changes in the socio economic area is a systematic analysis of the dynamics of local labour market development, which will help to form an effective mechanism for the use of human potential. Therefore, the development of relevant dynamic structural economic and mathematical models will allow us to reveal the particular nature of the relationships between the main macroeconomic indicators of the labor market and to predict the future situation in the socio-economic sphere.

Analysis of the latest research and publications. Scientific works by S. Babych, D. Bohynya, V. Vovk, V. Heyets', Yu. Gorodnichenko, O. Hrishnova, T. Holubyeva, O. Yermolenko, D. Zoidze, T. Kiryan, M. Kyzym,

T. Klebanova, Ye. Libanova, I. Lukyanenko, S. Panchyshyn, K. Petrenko, V. Ponomarenko, K. Sultan, T. Umanets', O. Chernyak, V. Fedorenko and others made a significant contribution to the study of theoretical and practical problems of the Ukrainian labour market and its regional characteristics [1–8]. Researchers justify the relevance and need for more detailed and in-depth analysis of the modern labour market characteristics to create a highly effective strategy for sustainable development of the regions and the state as a whole. In particular, Zoidze ([3], 2013) notes that the present stage of social-economic development of Ukraine's labor market and its individual regions is characterized by a significant excess of labour supply over demand and the existence of hidden unemployment and illegal employment. Babych ([1], 2012) states that an active policy of the government on the labour market in the field of employment should be a priority for both the economic and social policy of the state. Scientists indicate the need for forming an effective socio-economic mechanism of labour market regulation in order to promote productive employment of the population and to increase its real income (Fedorenko [7], 2009). Scientists propose criteria for the evaluation of structural unemployment and measures for state regulation of the economy; they also carry out an analysis of infrastructural changes in regional labor markets (Umanets, Kosmina [8], 2012). Moreover, the Ukrainian labour market, which is in the process of adaptating to the global economic space, requires an examination of its links with global trends.

Analysis and study of the labor markets' features in different countries by foreign scientists is based on the study of mathematical economic models. Among others, Checchi and García-Penalosa ([9], 2008) examine the overall impact of labour market institutions on income inequality of households in the European Union. Rotaru ([10], 2013) analyzes the labour market in Romania in terms of the demand for labour and explores a model that describes the relationship between the level of employment and socio-economic indicators of the functioning of the labour market. Mossfeldt and Osterholm ([11], 2011) consider the impact of the financial crisis on the labor market in Sweden. A number of authors use error correction econometric models for modeling the relationships between indicators of labour markets in different countries. In particular, Staneva ([12], 2008) examines problems of labour market development in Bulgaria, performs cointegration analysis and evaluates the ECM-model to describe the relationships between unemployment, employment, wages, productivity and inflation. Nakanishi ([13], 2001) uses new econometric tools to study problems in the Japanese labor market.

Therefore, considering that research on the labor market unit is an important component of the dynamical structural macroeconometric model of Ukraine [5, 6] (Lukyanenko, 2003), which is based on a new conceptual approach, the comprehensive econometric analysis of the dynamics and a mechanism for coordination of various economic processes on the labor market, as well as forecasting the possible scenarios of its development, is relevant and necessary in the current conditions in Ukraine. Experience of Ukrainian and foreign researchers indicates the need for modeling and analyzing the relationships between indicators of local labor markets and the application of multivariate dynamic econometric specifications that take into account the cointegrating relationships between the variables, long-term trajectory of their behavior and the dynamics of short-term fluctuations.

The aim of the paper is an empirical analysis and econometric modeling of relationships between labour market indicators in Ukraine based on a complex of error cointegration models that enable us to combine long-run equilibrium relationships and short-term dynamic adjustment mechanisms, and to consider the peculiarities of the dynamics of processes in the socio-economic sphere of the national economy.

Primary Material. To achieve the objectives of the research and define an adequate specification of the labor market macromodel, we must first thoroughly analyze the main trends of the socio-economic development of the Ukrainian economy on the basis of the available statistical database of the national labor market indicators and key macroeconomic indicators for the past thirteen years, in particular the quarterly dynamics of changes in average wages, nominal employment, number of unemployed, economically active population, unemployment rate of the population, as well as the factors that determine their behavior in the long and short term [14]. Following the pevious economic and statistical analysis to assess the interdependence of the labor market in Ukraine, we determined the following key indicators: *RGDP* – real gross domestic product (mln UAH); *LF* – the labor force or economically active population (thousands people); *EMPL* – employed population (thousands people); *UNEMPL* – unemployed population (thousands people); *POP* – population aged 15 – 70 years (thousands people); *AWAGE* – average monthly wages per full-time employee (UAH); *WARR* – arrears of wages (mln UAH); *RUN* – the unemployment rate of the population (ILO methodology) (%); *RUNOF* – registered unemployment rate (%); *UNB* – average size of unemployment benefits (UAH); *CPI* – consumer price index. During modelling to account seasonal movements of series we will use variables S1, S2, S3, S4, taking value1 for 1, 2, 3 and 4 quarter respectively and 0 for all other quarters.

We note that different socio-economic categories of human resources are used for the characteristics of various processes on the labor market in economic theory: the population as a source of manpower replenishment, particularly the economically active population, which ensures the supply of labor for the production of goods and services; the real workforce of workers, who are already employed in the economy; as well as potential workers who are not employed, but can work [1; 2]. The economically active population which determines the workforce in the economy depends on the number of available people of a certain age, and factors that are related to wages [8]. Analyzing the dynamics of the population aged 15 to 70 years in Ukraine (change POP), we can see (Fig. 1) that during 2004 – 2013 its quantity has been decreasing. The smooth line in Figure 1 is defined on the basis of the estimated non-linear trend model, the specification of which contains dummy variables (included in different ways) and allows us to evaluate the different intersections and different slope coefficients for different periods of time.

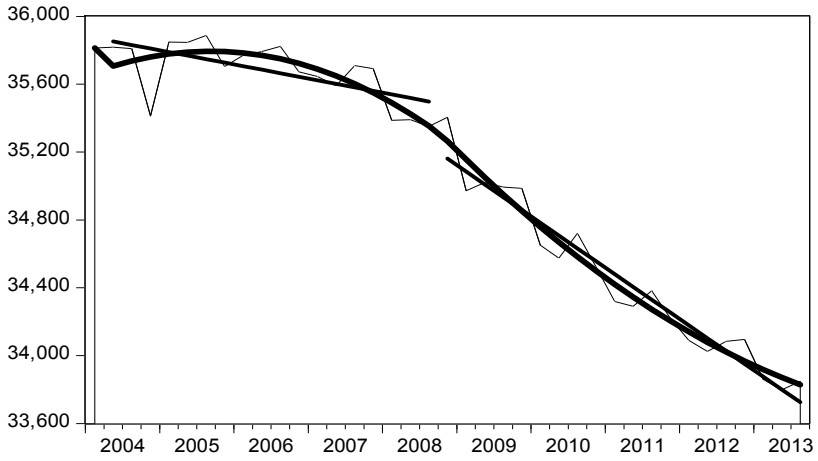
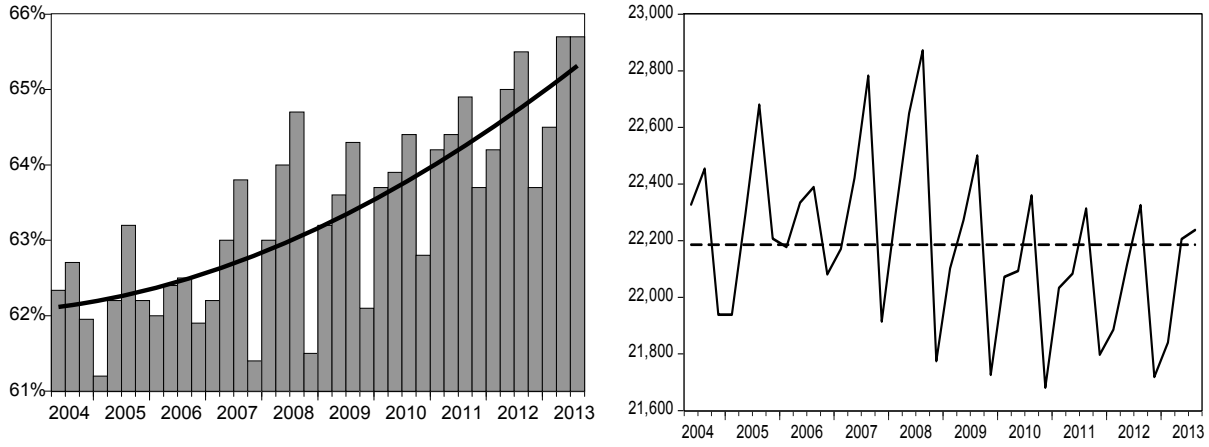


Fig. 1. Dynamics of the population aged 15 to 70 years during 2004 – 2013

Source: author's calculation

Differences in the rate of decline of the working age population deepened the impact of the global economic crisis and increased the negative trends in the economy of Ukraine. However, the percentage increase of the economically active population is positive (Fig. 2a), and during 2004 – 2013 it increased from 61% to almost 67% and as a result compensated for the fall in *POP*'s value.



a) **b)**

Fig. 2. Percentage rate of economic activity and the dynamics of the labour force in Ukraine

Source: author's calculation

As a result, the numbers for the economically active population (variable *LF*) after 2008 (Fig. 2b) have not experienced the negative changes that are inherent to the total population aged 15 – 70 years. It should be noted that economic activity is characterized by significant seasonal variations and is largest in the third quarter of each year.

If we construct an econometric model, it will describe and make it possible to predict the dynamics of the economically active population in Ukraine. Since the behavior of the variable *LF* does not show certain trends, which is also confirmed by Sultan's, Lukyanenko's and Gorodnichenko's researches ([6], 2000), we will apply the ARIMA modeling technique using exogenous variables and deterministic shifts in the specifications. As the exogenous variables we will take the total value of the working-age population *(POP)* and the value of the average wage *(AWAGE)*. As a result, the estimated model for the economically active population is the following

$$\begin{gathered}\Delta log(LF)_t = -0.0089 - 1.0922\ \Delta log\ (LF)_{t-1} - 0.7632\ \Delta\ log(LF)_{t-2} - 0.3679\ \Delta log\ (LF)_{t-3} + \\ (-3.27^{***})\ (-12.96^{***})\ \ (-9.27^{***})\ \ \ (-4.41^{***}) \\ - 0.1979\ \Delta log(POP)_{t-1} + 0.4164\ \Delta log(POP)_{t-3} + 0.087\ \Delta log(AWAGE)_t - \\ (-1.01)\ \ \ (2.39^{**})\ \ \ (2.36^{**}) \\ + 0.0222\ S3_t + 0.0118\ D2008Q4\_prolong_t + e_t + 0.4915\ e_{t-1}. \\ (6.23^{***})\ (-2.11^{**})\ \ \ \ (2.41^{***}) \\ Adjust.\ R^2 = 0.91,\ log\ L_{max} = 142.5,\ F = 42.1,\ DW = 2.07,\ LM = 1.12, \\ Q[4] = 3.9,\ J\text{-}B = 2.08,\ F(ARCH) = 0.29.\end{gathered} \quad (1)$$

The constructed model except for the impulsed dummy variable also includes stationary variables that determine the growth rate of average wages $\Delta log(AWAGE)_t$ and the lag rate of the change in the population of working age $\Delta log(POP)$. The coefficients of these variables determine the weighting of the transfer functions, and show how changes in the exogenous variables affect the temporal dynamics of the endogenous variable. We should note that the change in

the wage growth rate leads to the growth rate of the population's economic activity, in particular the short-term effect of such exposure is 0.087, while the long-term effect due to the autoregressive structure of the model is $d_0/(1-a_1-a_2-a_3)$=0.027. Decrease in the population's change rate leads to a decrease in economic activity but with a lag of three quarters. Therefore, as the conclusions of the model (1) show, increased incomes of Ukrainian citizens will raise the economic activity of the working population.

The positive dynamics of wages, which will help to increase the standard of living and improve the economic situation, in the opinion of many authors, requires the improvement of the existing state socio-economic policy of Ukraine, which in turn requires analysis and systemic modeling processes of the labor market. By comparing different specifications for modeling long-term behavior of the average wage, which is an important indicator of the demand for goods and services in the economy, this general model has been chosen:

$$log(AWAGE)_t = \alpha_1 + \alpha_2\, log(RGDP)_t + \alpha_3\, log(EMPL)_t + \alpha_4\, RUN_t + \alpha_5\, RUNOF_t + \alpha_6\, log(P\_CPI)_t + \alpha_7\, \Delta log(P\_CPI) + \alpha_8\, \Delta log(WARR)_t + \alpha_9\, TREND + \alpha_{10}\, S2_t + \alpha_{11}\, S3_t + \alpha_{12}\, S4_t + \alpha_{13}\, log(AWAGE)_{t-1} + \alpha_{14}\, log(AWAGE)_{t-4} + \varepsilon\_AWAGE_t. \quad (2)$$

According to economic theory, model (2) includes indicators of the price level *log(P_CPI)* and inflation *Δlog (P_CPI)*, which are calculated on the basis of the consumer price index, the value of real gross domestic product *log(RGDP)*, the number of employed in the economy *log(EMPL)*, unemployment rates *RUN* and *RUOF*, the amount of change of unpaid wages *Δlog(WARR)*, and also takes into account the adaptive nature of temporal changes in wages and includes lagged values *log(AWAGE)* for the past three periods. Coefficients of the model determine the elasticity changes of the average monthly wage in Ukraine under the relevant factors and indicate the percentage of salary change when increasing the factor by 1%, provided that all other factors remain unchanged.

For modeling the number of employed and the number of unemployed we will use the specifications

$$log(EMPL)_t = \beta_1 + \beta_2\, log(RGDP)_t + \beta_3\, log(LF)_t + \beta_4\, log\,(AWAGE/P\_CPI)_t + \beta_5\, log(UNB)_t + \beta_6\, \Delta log(WARR)_t + \beta_7\, S2_t + \beta_8\, S3_t + \beta_9\, S4_t + \beta_{10}\, log(EMPL)_{t-1} + \varepsilon\_EMPL_t, \quad (3)$$

$$log(UNEMPL)_t = \gamma_1 + \gamma_2\, log\,(RGDP)_t + \gamma_3\, log(LF)_t + \gamma_4\, log(AWAGE/P\_CPI)_t + \gamma_5\, log(UNB)_t + \gamma_6\, \Delta log(WARR)_t + \gamma_7\, S2_t + \gamma_8\, S3_t + \gamma_9\, S4_t + \varepsilon\_UNEMPL_t. \quad (4)$$

Model parameters ratings (3) and (4) determine the degree of influence of the real gross domestic product, the number of economically active population, the monthly average real wage, its debt and the unemployment benefit for the number of employed and unemployed in Ukraine. We will add equations (2) – (4) with identities

$$LF_t = EMPL_t + UNEMPL_t, \quad (5)$$

$$RUN_t = 100 \cdot UNEMPL_t / LF_t. \quad (6)$$

and estimate the system (2) – (6). The system (2) – (6) is a simultaneous equation model (SEM). The consistent estimation of SEM parameters is based on weighted two-stage least squares method using instrumental variables [15]. The evaluation results are shown in Table 1.

***Table 1*. Estimating Results for System (2) – (6)**

	The Equation System for					
	log (AWAGE)		*log (EMPL)*		*log (UNEMPL)*	
Variable	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
Const	-7.3965	-0.948	-0.2399	-0.130	24.410	1.007
log (RGDP)	0.4677	5.845***	0.0648	2.790***	-0.7882	-2.469**
log (LF)			0.7432	2.951***	-0.4905	-0.187
log (EMPL)	0.4154	0.518				
RUN	0.0064	0.445				
RUNOF	-0.0196	-2.197**				
log (AWAGE/P_CPI)			0.0341	2.235**	-0.6008	-3.288***
log (UNB)			-0.0169	-4.210***	0.2587	5.583***
log (P_CPI)	0.2120	2.499**				
Δ log (P_CPI)	0.0567	0.391				
Δ log (WARR)	-0.0146	-0.759	0.0035	0.452	-0.1724	-2.315**
TREND	0.0060	2.836***				
S2	-0.0137	-0.537	0.0031	0.894	-0.0267	-0.567
S3	-0.1230	-4.139***	-0.0022	-0.359	0.0110	0.130
S4	-0.1108	-3.372***	-0.0332	-2.681**	0.2325	1.689*
$log\,(AWAGE)_{t-1}$	0.4814	2.755***				
$log\,(AWAGE)_{t-4}$	0.1880	1.363				
$log\,(EMPL)_{t-1}$			0.1834	1.550		
Adjusted R-squared	0.999		0.973		0.882	
Durbin-Watson Stat.	2.093		1.967		2.019	

It should be noted that the time series included in the model are non-stationary and are characterized by stochastic trends. Research of the levels and first differences of these variables on the presence of a unit root using the augmented Dickey-Fuller test indicates their integration of the first order. Therefore, their joint modeling could lead to false regressions that do not reflect causal relationships between variables. However, in the case of cointegration, model (2) – (6) will describe the cointegrating relationships, which according to the terminology of Ingle-Granger characterize the causality or causal behavior of labor market indicators as long-term relationships between variables with similar trend properties. The research of residuals models (2) – (4) based on ADF-test results which are shown in Table 2, indicate their stationarity, and therefore rows *E_AWAGE*, *E_EMPL*, *E_UNEMPL* are I(0) variables. As a result, the model (2) – (6) can be interpreted as a system of long-term equilibrium relationships between the labor market indicators in Ukraine, deviations from which are really temporary.

Table 2. **ADF Test Results for Residuals of System (2) – (4)**

	E_AWAGE		E_EMPL		E_UNEMPL	
Augmented Dickey-Fuller unit root test for residuals	t-Stat	Prob.	t-Stat.	Prob.	t-Stat.	Prob.
	-5.9897	0.0000	-5.8090	0.0000	-5.9111	0.0000

Equation (2) defines the long-run equilibrium relationship among the average wage, the real GDP, the price level and the level of official unemployment. The variables that determine the number of economically active population, wage arrears and unemployment rate defined by ILO methodology is not statistically significant in this equation, and therefore have no significant impact on the behavior of the average wage in the long term. Equation (3) describes a long-term relationship between the number of employees, real GDP, real wages, labor force and unemployment assistance. In equation (6), which determines the long-term behavior trajectory of the number of unemployed, real GDP, real wages and their debt are significant.

For modeling the dynamics of labor market indicators in the short term we will examine the specifications of error correction in which the growth rate of endogenous variables depend on the rate of exogenous growth factors, as well as the derivation of value levels of system variables from long-term equilibrium equations (2) – (6), which were observed in the previous period. The following equations of short-term adaptations were derived as a result of the different specifications analysis

$$\Delta\log(AWAGE)_t = 0.112 + 0.386\,\Delta\log(RGDP)_t + 0.005\,\Delta RUN_t - 0.029\,\Delta RUNOF_t + \\ (3.2^{***})\ (4.1^{***})\quad (1.1)\quad (-3.0^{***}) \\ + 0.273\,\Delta\log(P\_CPI)_t - 0.115\,\Delta^2\log(P\_CPI)_t + 0.037\,\Delta\log(UNB)_t - 0.028\,\Delta^2\log(WARR)_t - \\ (2.1^{**})\quad (-0.7)\quad (1.7^{*})\quad (-1.6) \\ - 0.09\,S2_t - 0.20\,S3_t - 0.12\,S4_t + 0.596\,\Delta\log(AWAGE)_{t-1} + \delta_1\,E\_AWAGE_{t-1}, \qquad (7) \\ (-1.9^{*})\ (-4.4^{***})\ (2.8^{***})\ (5.8^{***}) \\ Adjust.\ R^2 = 0.94,\ DW = 1.81;$$

$$\Delta\log(EMPL)_t = 0.026 + 0.069\,\Delta\log(RGDP)_t + 0.857\,\Delta\log(LF)_t + 0.057\,\Delta\log(AWAGE/P\_CPI)_t - \\ (2.0^{**})\ (1.9^{**})\quad (6.9^{***})\quad (1.4) \\ - 0.009\,\Delta\log(UNB)_t + 0.011\,\Delta^2\log(WARR)_t - 0.02\,S2_t - 0.03\,S3_t - 0.05\,S4_t + \delta_2\,E\_EMPL_{t-1}, \qquad (8) \\ (-1.2)\quad (1.7^{*})\quad (-1.4)\ (-1.6)\ (-3.5^{***}) \\ Adjust.\ R^2 = 0.98,\ DW = 1.99;$$

$$\Delta\log(UNEMPL)_t = -0.315 - 0.986\,\Delta\log(RGDP)_t - 0.418\,\Delta\log(LF)_t + 0.107\,\Delta\log(UNB)_t - \\ (-2.1^{**})\ (-2.3^{**})\quad (-0.3)\quad (1.1) \\ - 0.284\,\Delta\log(AWAGE/P\_CPI)_t - 0.216\,\Delta^2\log(WARR)_t + 0.35\,S2_t + \\ (-0.6)\quad (-2.8^{***})\quad (1.7^{*}) \\ + 0.42\,S3_t + 0.48\,S4_t + 0.314\,\Delta\log(UNEMPL)_{t-4} + \delta_3\,E\_UNEMPL_{t-1}. \qquad (9) \\ (1.9^{*})\ (2.6^{***})\ (2.7^{***}) \\ Adjust.\ R^2 = 0.93,\ DW = 1.80.$$

The system of error-correction model (7) – (9) together with the model of behavior of the economically active population (1) describes the short-term fluctuations in the labor market. The variables E_AWAGE_{t-1}, E_EMPL_{t-1}, E_UNEMPL_{t-1} measure the deviation from the estimated long-term equilibrium of cointegrating relations (2) – (6), observed in the previous period. The parameters $\delta_1, \delta_2, \delta_3$ are the coefficients of the rate of adjustment and are important characteristics of the dynamics of the system. They define the convergence of long-term equilibrium relations. Estimates of the rate of adjustment are shown in Table 3.

Table 3. **Speed of Adjustment Parameters System (7) – (9)**

Awerage Wage Equation (7)		Employment Equation (8)		Unemployment Equation (9)	
Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
-1.0468	-4.27***	-0.8021	-3.77***	-0.965	-5.33***

The high statistical significance of the parameters $\delta_1, \delta_2, \delta_3$ indicates that wages, employment and unemployment are sensitive to past deviations from equilibrium trajectories (2) – (6). The negative sign of the coefficients and their proximity to 1 indicate that the variables tend to overcome the gap between them and tend to decrease in the next period if there is a positive deviation from equilibrium relationships.

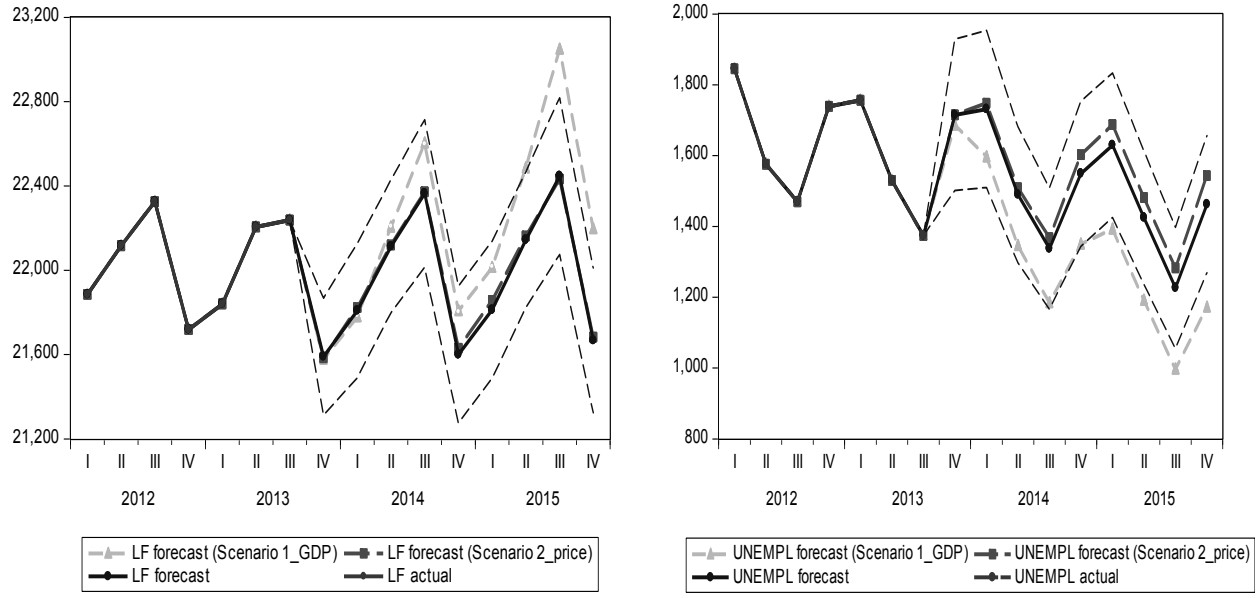
Analyzing the effects of exogenous variables on the dynamics of the main labor market indicators, we find that the higher the price level, the higher are nominal wages, but they do not grow commensurate with the cost of living. The long-term elasticity of wages caused by the consumer price index is less than one and equals 0.21. In the short run, wages are not flexible and do not respond in a statistically significant way to changes in the inflation rate in the current quarter. Salaries depend on the growth of real gross domestic product, the level of which is a measure of economic growth, and a growth of 1% leads to an increase in salaries of 0.47%. This stimulates employment and reduces the number of unemployed hence its impact on reducing unemployment is much higher (corresponding to elasticities of 0.06 and -0.79). In the short term, an increase in the growth rate of real GDP leads to wage increases and decreases in proportion to the rate of change in the number of unemployed. Note also that the unemployment rate, which is defined by the ILO methodology, i.e. the proportion of people who are actively looking for work, trying to organize their own business or waiting for answers to their proposed work, has no statistically significant effect on the change in wages in the long run. However, a statistically significant factor influencing wages in Ukraine is the level of unemployment. In particular, an increase of the registered unemployment rate by 1% associated with lower wages by 2% and an increase in the rate of change of the registered unemployment rate of 1% causes a decrease in the growth rate of wages of 3%. A change in the number of employees (as well as the number of economically active population) does not affect the dynamics of wages in the long run. However, increasing the number of economically active population by 10% and the the number of employees by 7.4%, reduces the number of unemployed by 4.9 %. Changes in the rate of growth in

employment in short-term adjustments almost proportionally reflect changes in the rate of change of the economically active population and do not affect the number of unemployed. An increase in real wages significantly reduces the number of unemployed. In the long run, an increase in real wages by 10% is accompanied by a decrease in the unemployment rate of 6%. Increasing unemployment benefits significantly increases the number of unemployed and reduces the number of employees, and increasing aid by 10% leads to an increase in unemployment of 2.5%. However, during the short-term, fluctuations in the rate of growth of real wages and the rate of growth of unemployment benefits do not result in significant changes in the rate of change of the number of employed and the number of unemployed. Moreover, the significance of the lag coefficient of wages in equation (2) shows the adaptive nature of the wage increas. Parameter α_{13} can be interpreted as a partial adjustment parameter to some desired level of wages. Estimates shows, that the actual salary increase averages 48 percent of the difference between its value and the desired level in the previous period.

The calculated values of the adjusted R-squared and F-statistics indicate the adequacy of both the long and short term specifications and the value of the Durbin-Watson statistic for autocorrelation of residuals by the developed models.

We use the model developed for predicting the future behavior of Ukrainian labor market indicators. To predict the exogenous variables we apply the autoregressive moving average model. Given the nonstationarity and seasonal characteristics of each series, we estimate the ARIMA (4,1,2) model for unemployment benefit UNB_t, the AR(1) model with trend and a combination of seasonal dummy variables for the logarithms of real GDP, the ARIMA (2,1 2) model for wage arrears $WARR_t$, the ARIMA (2,1,1) model for the registered unemployment rate $RUNOF_t$ and the ARIMA (4,1,4) model for the logarithm of a number that determines the dynamics of prices (*P_CPI*). Having obtained on the basis of these models the predicted values of exogenous variables and using the developed dynamic model (1) – (9), we construct forecasts of endogenous indicators. Fig. 3 shows the predicted behavior of the labor market indicators while maintaining the dynamics of the exogenous variables in the future, along with the boundaries of the projected ranges and dynamic variables predicted by the two possible scenarios of future behavior factors. The first scenario assumes that as a result of favorable economic policies real GDP growth in 2014 and 2015 reflects shear and increases by 1% compared to the expected. According to a second possible scenario for future development processes in Ukraine, we assume a quarterly growth rate of inflation in 2014 and 2015 of 2% more than forecasted by its previous dynamics prior to 2014.

The application of the developed complex models of the labor market shows that in accordance with the baseline scenario of the behavior of real GDP, prices, unemployment, the level of unemployment and wage arrears, during 2014 – 2015 in Ukraine we will see a further increase in nominal wages, a slight increase in nominal employment (2%) and in the number of unemployed (6%), while economic activity will almost unchanged (1.6%).



a) **b)**

Fig. 3. Estimates of economically active population and unemployment rate

Source: Authors' elaboration based on State Statistics Service of Ukraine Database

If the growth rate of real GDP increases, it will increase the demand for labor and result in improvements to all indicators of the domestic labor market. In particular, as per the simulation, the economic activity of the population and employment will increase by 4% and 6%, respectively, while the number of unemployed will decrease by 27% compared to the end of 2013. Price increases however would show negative consequences, because they would be accompanied by only a nominal growth of wages and practically minimal change in the amount of available labor and employment.

Conclusions.The labor market in Ukraine is not only of economic but also of significant social value, and therefore is an important element of social and economic policy. The effectiveness of the mechanisms of socioeconomic state regulation requires in-depth analysis, modeling and forecasting of labor market flexibility by using modern econometric tools, taking into account the short-run dynamics of economic processes and features that are characteristic of the unstable economic development of our country. As a result of an empirical investigation of the relationship between macroeconomic indicators of the labor market in Ukraine, we have developed a set of dynamic error-correction econometric models that take into account the long-term equilibrium economic relations, as well as allow us to model the short-term effects of several factors on the rate of change of wages, labor, employment and unem-

ployment. The developed models allow us to predict future trends in the labor market, as well as to describe the dynamics of its operation under various alternative scenarios of economic development. Using these developed models within the structure of overall integrated macro models will enable Ukraine to carry out a comprehensive analysis of economic processes in the national economy and its prospects both in the short and in the long run.

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РИНОК ПРАЦІ В УКРАЇНІ: ЕМПІРИЧНИЙ ДИНАМІЧНИЙ АНАЛІЗ З ВИКОРИСТАННЯМ МОДЕЛІ КОРЕГУВАННЯ ПОХИБКИ

У результаті емпіричного дослідження взаємозв'язків між основними макропоказниками функціонування ринку праці в Україні розроблено комплекс динамічних економетричних моделей з використанням механізму корегування похибок. Оцінено довгострокові рівноважні зв'язки та короткострокові ефекти впливу низки чинників. Здійснено прогнозування майбутніх тенденцій на ринку праці, а також проаналізовано різні альтернативні сценарії розвитку економіки.

Ключові слова: ринок праці; економетрична модель корегування помилки; сценарії розвитку; прогнозування.

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РЫНОК ТРУДА В УКРАИНЕ: ЭМПИРИЧЕСКИЙ ДИНАМИЧЕСКИЙ АНАЛИЗ С ИСПОЛЬЗОВАНИЕМ МОДЕЛИ КОРРЕКЦИИ ОШИБОК

В результате эмпирического исследования взаимосвязей между основными макропоказателями функционирования рынка труда в Украине разработан комплекс динамических эконометрических моделей с использованием механизма коррекции ошибок. Оценены долгосрочные равновесные связи и краткосрочные эффекты воздействия ряда факторов. Осуществлено прогнозирование будущих тенденций на рынке труда, а также проанализированы различные альтернативные сценарии развития экономики.

Ключевые слова: рынок труда; эконометрическая модель коррекции ошибок; сценарии развития; прогнозирование.

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ENVIRONMENTAL SECURITY: INTEGRAL ASSESSMENT (CASE OF UKRAINE)

Environmental security is a key issue in the context of the national security evaluating of each state and the world in whole. The lack of universality in the term definition, not to mention the technology of an assessment of environmental security, encourages researchers to develop and improve methods and approaches to assess integrated index of environmental safety at the level of the country and its regions. The main scientific results of this study include the following: given the analysis of the strengths and weaknesses of well-known techniques and approaches to the evaluation of ecological security in the world and in Ukraine, represented the authorial approach to the calculation of the integral index of environmental security of Ukraine and its regions, with the option of cross-state comparison; calculated integral index of ecological safety of Ukraine (1996 – 2013); held the comparative analysis of the ecological security of Ukraine and other selected countries; proposed the system of indicators for ranking of regions of Ukraine at the level of its environmental security.

Keywords: Environmental security, assessment, Ukraine, integral index.

Introduction. Modern economic development, growth and employment, world population increasing create a new challenge – to support the environmental security. The United States were the first state over the world that recognized the necessity to make significant adjustments in the concept of national security, its targets, strategies and tools with accounting the environmental security as an important component of national security [1]. In 1974 M.Taylor [2] firstly emphasized on the fact that the main threat to U.S. national security in developing non-military sphere is beyond the military aspect. A few years later, H. Brown [3] identified among the major threats for the national security such as the economic and environmental threats. In 90s the researchers began to assess the threats of national security that are related with environmental crisis. Exhaustion of global ecological potential was associated not only