# Dynamic Analysis and Modeling of the Labor Market Development in Ukraine

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| Abstract | Negative tendencies on the labor market in Ukraine caused social and economic problems which are connected with low level of income and unemployment. The article deals with investigation of dynamics peculiarities of socio-economic processes and modeling of the relationships between macroeconomic indicators on labor market in Ukraine during 2002–2013. The econometric model for labor force behavior is conducted. We also estimated system that models short-term adjustments and makes it possible to determine the short-run effects of some factors on the growth rate of wages, labor force, employment and unemployment. On the basis of simultaneous equation models the different alternative behavior scenarios of labor market indicators are analyzed. |
|---|---|
| Key words | Labor market, labor force, employment, simultaneous equation models, behaviour scenarios |

## 1. Introduction

Instability of economy market development in Ukraine causes economic and social problems associated with low income, unemployment and inflation. Insufficient labor market development, its institutions and long-term negative processes in the employment sphere deepen crisis phenomena and social disapproval, strengthen social movements and are the basis of social and political revolutions. That's why it is important to conduct an analysis and to model the dynamics of domestic labor market trends which will introduce effective measures for the state regulation and management of national economic development. On the basis of modern econometric models construction and investigation we can catch out peculiarities of relationships between macroeconomic labor market indicators, analyze and predict possible scenarios of its development.

## 2. Literature review

Many Ukrainian economists made a significant contribution to the study of labor market forming problems, investigation of employment and unemployment, among them S. Babych, D. Bohynya, V. Vovk, Yu. Gorodnichenko, O. Hrishnova, T. Holubyeva, O. Yermolenko, D. Zoidze, T. Kiryan, Ye. Libanova, I. Lukyanenko, S. Panchyshyn, K. Petrenko, T. Umanets', O. Chernyak, V. Fedorenko and others. They substantiate the need for a more detailed analysis of the labor market functioning characteristics for creating an effective strategy development of the country. In particular, Petrenko (2013) states that the structural imbalance between supply and demand for the labor force leads to the need to strengthen the active role of the state in regulating the social-economic system of the country and a balanced regional policy in dealing with employment problems. Different approaches concerning the methods of labor market regulation and determination of their efficiency are considered and their multivariate connections are analyzed (Yermolenko, 2013). In order to increase the employment levels and reduce structural unemployment the problems related to the efficient use of human capital assets are examined (Podra, 2012). Therefore, Ukrainian scholars justify the need for state regulation of the labor market at both regional and national levels.

Analysis and study of the labor market in different countries on the basis of econometric models are carried out by many scientists. Among them, Rotaru (2013) analyzes processes on the labor market in Romania, investigates its regional peculiarities and models the relationships between the labor force, employment and other socio-economic indicators of the labor market. Herwartz and Niebuhr (2011) examine the cross-sectional differences in dependence of regional labor markets indicators from their major factors on the basis of panel data for European countries. Czarniewski (2014) emphasizes that the quality of human capital is one of the main factors influencing the location decisions of economic activity. Owusu *et al.* (2014) investigate the relationship between budget participation and employees' performance of public universities in Ghana.

A number of authors use error correction econometric models for modeling the relationships between indicators of labor markets in different countries. In particular, Damette, Fromentin (2013), Boubtane, Coulibaly and Rault (2013) examine the relationship between migration, growth and unemployment on the labor market in OECD countries using the VEC-models. Carstensen and Hansen (2000) analyze West German labor market by means of the cointegrating structural VAR model. Wahiba (2014) constructs an econometric model to detect the size of the effect of opening to the global economy on inequality in the labor market.

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 cointegration relationships between the variables, long-term trajectory of their behavior and the dynamics of short-term fluctuations.

## 3. Econometric modeling of labor force behavior

We will analyze the main trends of the socio-economic development of the Ukrainian economy on the basis of statistical database of the key domestic labor market macroeconomic indicators during 2002 – 2013. We will also investigate the dynamics of the quarterly average wage, labor force, the number of employed and unemployed, as well as the factors that determine their behavior in the long and short term. Data has been obtained on the basis of statistical reports of the State Statistics Service of Ukraine. When analyzing we

will use the natural logarithms of these variables, since it is in such a transformed state that they are most often used in empirical modeling, due to the concavity of the theoretical economic relationships, as well as the statistical properties of the researched series. We determined the following key indicators: *POP* – population aged 15 - 70 years (thousands people); *LF* – the labor force or economically active population (thousands people); *EMPL* – employed population (thousands people); *UNEMPL* – unemployed population (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); *RGDP* – real gross domestic product (mln UAH); *CPI* – consumer price index.

Dynamics of the population in Ukraine indicates its sharp decrease. Empirical research on the dependence of *POP* as a function of time shows a shift of the regression line, and a statistically significant change in the angle of inclination at the end of 2008. In particular, until the 4th quarter in 2008 the average decrease of the population per quarter amounted to 20.8 thousand people, while starting from 2009 such decrease was 74 thousand people. However, during this period there was an increase in the population's economic activity that as a result compensated the falling value of *POP*.

We will construct an econometric model that describes the dynamics of the labor force in Ukraine based on the ARIMA modeling technique using exogenous variables and deterministic shifts in the specification. To take into account changes in the structure of the model in late 2008 and early 2009, we will examine the effects of different types of dummy variables *D2008q4(k)* (*k = 1,2,3*), the values of which are zero for all periods prior to the 4th quarter of 2008. As the result of research on a number of alternative options, the ARMAX (3.1.1) specification has been chosen

$$\Delta log(LF)_t = a_0 + a_1 \Delta log(LF)_{t-1} + a_2 \Delta log (LF)_{t-2} + a_3 \Delta log (LF)_{t-3} + d_0 D2008Q4(k) + s_0 S3_t + B(L) \Delta log(POP)_t + C(L) \Delta log (AWAGE)_t + G(L) e_t,$$
                (1)

Where $B(L)$, $C(L)$, $G(L)$ are lag operator polynomials with unknown coefficients.

On the basis of the model (1) we will conduct an interventional analysis, which allows to checking the differences in average dynamic trends of time series. Let us denote *D2008Q4(1) = D2008Q4_jump* a dummy variable that takes the value 1 for all periods starting from the 4th quarter of 2008 and characterizes the pure jump (Fig. 1a). When using this dummy variable in specification (1) until the $4^{th}$ quarter 2008, the intersection model is measured as $a_0$, and from the 4th quarter abruptly shifts to $a_0 + d_0$. Then the estimated value $d_0$ determines the initial or impact effect, the significance of which is based on the value of the t-statistic parameter $d_0$. The long-term impact effect of this type of intervention variable, taking into account the autoregressive structure of the model, is $d_0/(1 - a_1 - a_2 - a_3)$ and is larger than the short-term effect $d_0$. Different temporary effects can be obtained by analyzing the impulse response function MA($\infty$) image of the model (1)

$$\Delta log (LF)_t = a_0/(1 - a_1 - a_2 - a_3) + d_0 (A(L))^{-1} D2008Q4(k) + s_0/A(L) S3_t + B(L)/A(L) \Delta log (POP)_t + C(L)/A(L) \Delta log (AWAGE)_t + G(L)/A(L) e_t,$$

Where $A(L) = 1 - a_1 L - a_2 L^2 - a_3 L^3$, $(A(L))^{-1}$ – the inverse operator to the operator $A(L)$, $d_0(A(L))^{-1}D2008Q4(k)_t = \sum_{j=0}^{\infty} \lambda_j D2008Q4(k)_{t-j}$, $\lambda_j$ are nonlinear functions of the coefficients $a_1$, $a_2$, $a_3$. In particular, in the case of the first order autoregression $\lambda_j = (a_1)^j$, the impact effect is $d_0$, the effect of each successive period increases and in $k$ period equals $d_0(1+a_1+(a_1)^2+(a_1)^3+…+(a_1)^k)$, and in the long-term period when $k \to \infty$ reaches the value of $d_0/(1-a_1)$. Having estimated the model (1) with variable *D2008Q4_jump*, we obtain a statistically insignificant coefficient value $d_0$, which indicates that the disturbances that took place in the Ukrainian economy as a result of the events of late 2008 had no significant permanent long-term effect on the economic activity of the population.

Another possibility for taking into account shifts in the structure of the model is the use of first differences of the pure jump variable. Then the variable *D2008Q4(2)=D2008Q4_impulse=Δ(D2008Q4_jump)* will acquire the value 0 in all periods, except for one particular period (4th quarter 2008), in which it equals one (Fig. 1b). This impulse function best characterizes a purely temporary intervention. This single impulse will have an effect on the rate of change in economic activity directly in the same period, and will affect its value in all subsequent periods through the autoregressive nature of the model. However, the magnitude of such an effect will fade away with time and in the long term will approach zero. In particular, in the case of the AR(1) process the effect in the $k$th period equals $d_0(a_1)^k$. Having estimated the model (1) using a dummy variable *D2008Q4_impulse*, we get statistically significant values of parameters $d_0$, $a_1$, $a_2$, $a_3$ (Table 1). The obtained parameter estimation $d_0$ indicates that at the end of 2008 there was a shift in the rate of labor force change of 0.9 percent.

Another possibility to take into account in the structural changes in the model (1) is to study the influence of the variable that reflects the prolonged impulse function. Let the variable *D2008Q4(3) = D2008Q4_prolong* acquire the value 1 in the 4th quarter 2008, 0.75 in the 1st quarter 2009, 0.5 in the 2nd quarter 2009, 0.25 in the 3rd quarter 2009 and 0 in all other periods (Fig. 1c). Thus the defined dummy variable determines the pronged impulse and unlike the impulse function (1 only in the 4th quarter 2008) describes the gradual decrease in each quarter over the next year.
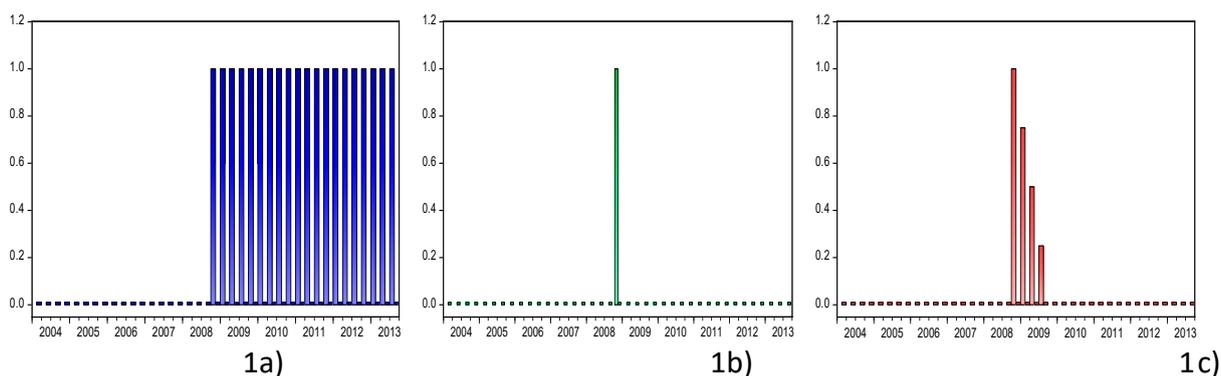


*Figure 1.* Pure jump, single impulse and prolonged impulse functions

With this dummy variable an instant effect is also $d_0$, and then within four quarters gradually increases, reaching a new value within a year. In particular the AR(1) process effect in the next quarter equals $d_0(1+0.75a_1)$, after two quarters $d_0(1+0.75a_1+0.5(a_1)^2)$, after three quarters $d_0(1+0.75a_1+0.5(a_1)^2+ 0.25(a_1)^3)$, and then gradually decreases. In the case of a third order autoregression we will have the same behavior, but the magnitude of exposure effects will be estimated as the nonlinear function of the estimated values $a_1$, $a_2$, $a_3$. Having estimated

the specification (1) with prolonged impulse we get the significant coefficient value $d_0$. Table 1 shows some results of estimating model (1) with various options for interventional variable (t-statistic in parentheses).

Comparing the results, we can see that the values of the autoregressive coefficients are stable, but the coefficients are significant only with variables that reflect impulses. Both criteria AIC and SBC indicate the preference of models with prolonged impulse. Therefore, it could be argued that as a result of events that occurred at the end of 2008, there took place an important but temporary negative shift in the growth rate of the economically active population that lasted throughout the following year.

*Table 1.* Interventional Analysis Results for LF Model (1)

| Intervention Variable | $a_1$ | $a_2$ | $a_3$ | $d_0$ | AIC | SBC |
|---|---|---|---|---|---|---|
| D2008Q4_jump | -1.0989 (12.2**) | -0.7796 (-8.48**) | -0.3840 (-4.24**) | -0.0035 (-1.07) | -7.2504 | -6.8105 |
| D2008Q4_impulse | -1.0943 (-12.8**) | -0.7163 (-8.14**) | -0.3333 (-3.83**) | -0.0098 (-1.78*) | -7.3138 | -6.8739 |
| D2008Q4_prolong | -1.0922 (-12.9**) | -0.7632 (-9.27**) | -0.3678 (-4.41**) | -0.0118 (-2.11*) | -7.3655 | -6.9257 |

**Note:** ** denotes statistical significance at the 0.05 level; ** – at the 0.01 level.
***Source:*** evaluations of the authors.

As a result, the estimated model for the economically active population has the following form

$$\Delta \log (LF)_t = -0.001^{***} - 1.09^{***} \Delta \log (LF)_{t-1} - 0.76^{***} \Delta \log (LF)_{t-2} - 0.37^{***} \Delta \log (LF)_{t-3} + 0.02^{***} S3_t - 0.19 \Delta \log (POP)_{t-1} + + 0.42^{**} \Delta \log (POP)_{t-3} + 0.08^{**} \Delta \log (AWAGE)_t - 0.01^{**} D2008Q4\_prolong_t + e_t + 0.49^{**} e_{t-1}.$$

(2)

*Adjust.* $R^2 = 0.91$, DW = 2.07.

## 4. Econometric modeling of labor market indicators

Studying the different specifications for modeling long-term behavior of the average wage, the number of employed and the number of unemployed we received a simultaneous equations model (Oliskevych, 2014)

$$\log (AWAGE)_t = -7.39 + 0.47^{***} \log (RGDP)_t + 0.41 \log (EMPL)_t + 0.01 RUN_t - 0.02^{**} RUNOF_t + 0.21^{**} \log (P\_CPI)_t + 0.06 \Delta \log (P\_CPI) - 0.01 \Delta \log (WARR)_t + 0.01^{***} TREND - 0.01 S2_t - 0.12^{***} S3_t - 0.11^{***} S4_t + 0.48^{***} \log (AWAGE)_{t-1} + 0.19 \log (AWAGE)_{t-4} + E\_AWAGE_t.$$

(3)

*Adjust.* $R^2 = 0.98$, DW = 2.09.

$$\log (EMPL)_t = -0.24 + 0.06^{***} \log (RGDP)_t + 0.74^{***} \log (LF)_t + 0.03^{**} \log (AWAGE/P\_CPI)_t - 0.02^{***} \log (UNB)_t + 0.004 \Delta \log(WARR)_t + 0.003 S2_t - 0.002 S3_t - 0.03^{**} S4_t + 0.18 \log(EMPL)_{t-1} + E\_EMPL_t,$$

(4)

*Adjust.* $R^2 = 0.97$, DW = 1.96.

$$log(UNEMPL)_t = 24.4 - 0.78^{**}log\,(RGDP)_t - 0.49log(LF)_t - 0.60^{***}log\,(AWAGE/P\_CPI)_t + 0.26^{***}\,log\,(UNB)_t - 0.17^{**}\Delta\,log\,(WARR)_t - 0.03\,S2_t + 0.01\,S3_t + 0.23^*\,S4_t + E\_UNEMPL_t$$
(5)

*Adjust. $R^2$ = 0.88, DW = 2.02.*

$$LF_t = EMPL_t + UNEMPL_t\,,$$
(6)

$$RUN_t = 100^*UNEMPL_t / LF_t\,.$$
(7)

The research of residuals from models (3) – (5) using augmented Dickey-Fuller unit root test indicates their stationarity, so equation (3) – (7) can be interpreted as a system of long-term cointegration equilibrium relationships between indicators of labor market in Ukraine.

For modeling the dynamics of labor market indicators in the short term we will examine the error-correction specifications 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 (3) – (7), which were observed in the previous period. After the estimation and analysis of different specifications we received short-term adjustments equations (Oliskevych, 2014).

$$\Delta\,log\,(AWAGE)_t = 0.11^{***} + 0.38^{***}\,\Delta\,log\,(RGDP)_t + 0.01\,\Delta\,RUN_t - 0.03^{***}\,\Delta\,RUNOF_t +0.27^{**}\,\Delta\,log\,(P\_CPI)_t - 0.12\,\Delta^2\,log\,(P\_CPI)_t + 0.04^*\,\Delta\,log\,(UNB)_t - 0.03\,\Delta^2\,log\,(WARR)_t - 0.09^*\,S2_t - 0.2^{***}\,S3_t - 0.12^{***}\,S4_t + 0.59^{***}\,\Delta\,log\,(AWAGE)_{t-1} - 1.0468^{***}\,E\_Awage_{t-1}\,,$$
(8)

*Adjust. $R^2$ = 0.94, DW = 1.81;*

$$\Delta\,log\,(EMPL)_t = 0.03^{**} + 0.07^*\,\Delta\,log\,(RGDP)_t + 0.85^{***}\,\Delta\,log(LF)_t + 0.06\,\Delta\,log\,(AWAGE/P\_CPI)_t - 0.01\,\Delta\,log(UNB)_t + 0.01^*\,\Delta^2\,log\,(WARR)_t - 0.02\,S2_t - 0.03\,S3_t - 0.05^{***}S4_t - 0.80^{***}E\_EMPL_{t-1},$$
(9)

*Adjust. $R^2$ = 0.98, DW = 1.99;*

$$\Delta\,log\,(UNEMPL)_t = -0.31^{**} - 0.98^{**}\,\Delta\,log\,(RGDP)_t - 0.418\,\Delta\,log\,(LF)_t - 0.284\,\Delta\,log\,(AWAGE/P\_CPI)_t + 0.11\,\Delta\,log\,(UNB)_t - 0.21^{***}\,\Delta^2\,log\,(WARR)_t + 0.35^*\,S2_t + 0.42^*\,S3_t + 0.48^{***}\,S4_t +0.31^{***}\,\Delta\,log\,(UNEMPL)_{t-4} - 0.96^{***}\,E\_UNEMPL_{t-1}\,.$$
(10)

*Adjust. $R^2$ = 0.93, DW = 1.80.*

The high statistical significance of the parameters determining speeds of adjustment indicates that wages, employment and unemployment are sensitive to past deviations from equilibrium trajectories (3) – (7). Modeling shows that the long-term elasticity of wages caused by the consumer price index is statistically significant and less than one. In the short run, wages do not respond in a statistically significant way to changes in the inflation rate. In the long term, a salaries depend on the growth of real gross domestic product, а реальний випуск stimulates employment and reduces the number of unemployed hence its impact on reducing unemployment is much higher. 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. An increase in real wages significantly reduces the number of unemployed. Increasing unemployment benefits significantly increases the number of

unemployed and reduces the number of employees. 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. In the long run a change in the number of economically active population does not affect the dynamics of wages. However, increasing the number of employees and reduces the number of unemployed. 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.

We use the estimated model to study various scenarios of development of Ukraine for the past 10 years. To do this, we examine some possible changes in the behavior of the exogenous variables. Because the study of changes of unemployment benefits indicates that the growth rate of this indicator over the period studied exceeded the growth rate of average wages (i.e. the growth rate series *AWAGE* averaged 4.4% in the quarter, at a time when the growth rate of the unemployment benefit equalled *UNB* 5.8%), according to the first scenario, we analyze what effect there would be on labor market indicators if unemployment benefits during 2005-2013 increased by the same rate as wages. Fig. 2a shows the dynamics of wages, the actual behavior of the value of unemployment benefits, and its behavior under the alternative scenario in a logarithmic scale.
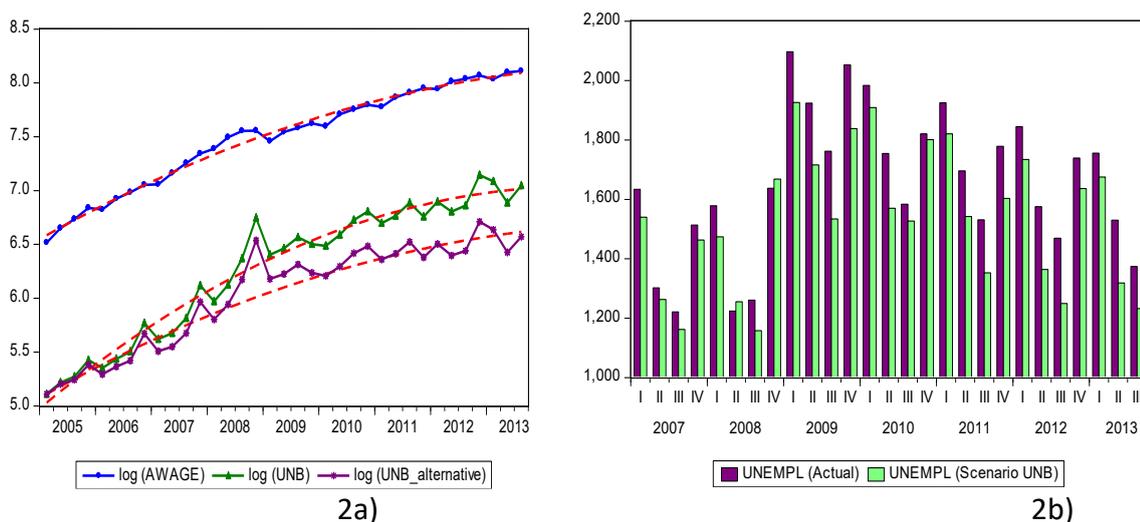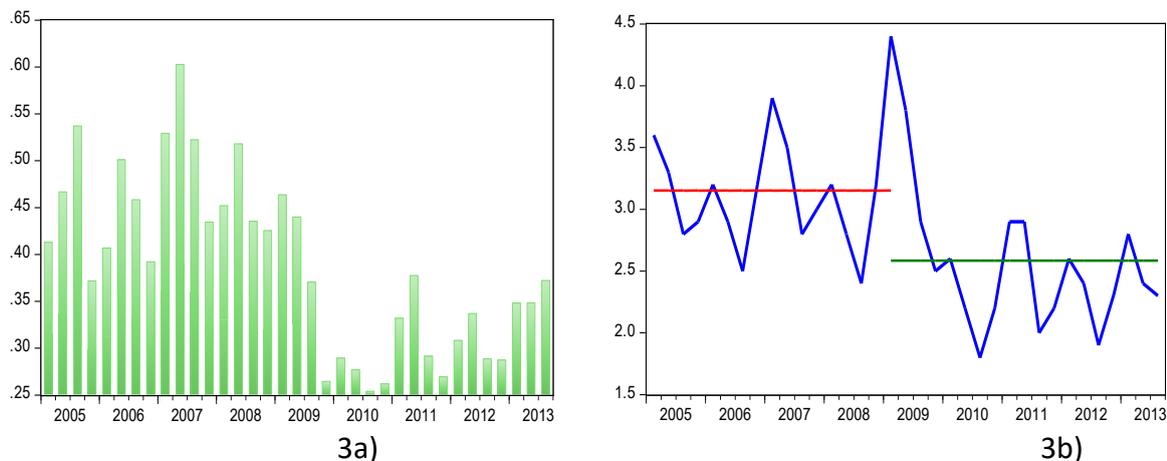


2a)           2b)

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

*Figure 2.* Changes in Average Wages, Unemployment Benefits and Related Changes in the Nominal Rate of Unemployment in Ukraine

Analyzing the results of simulations of the alternatives, we find that a slowdown in the growth of the value of unemployment benefits would result in a significant reduction in the number of unemployed persons (-3.4% in 2007, -4.7% in 2008, -5.8% in 2009, -7.1% in 2010, -8.5% in 2011, -9.9% in 2012, -11.1% in 2013) and in the unemployment rate (Fig. 2b). Note that the impact of changes in the *UNB* alternative on other labor market indicators is below 1 percent.

To implement the second scenario, we further explore the dynamics of the percent of unemployed who are registered in employment centers. Note that the unemployment variable *RUN* as defined by the ILO has increased starting from the beginning of 2009 (on average by 1.3% from 6.6% to 7.9%), while the unemployment rate *RUNOF* fell. As a result,

we have seen a dramatic decrease in the percentage of unemployed who applied for unemployment benefits (*RUNOF / RUN*) (Fig. 3a).
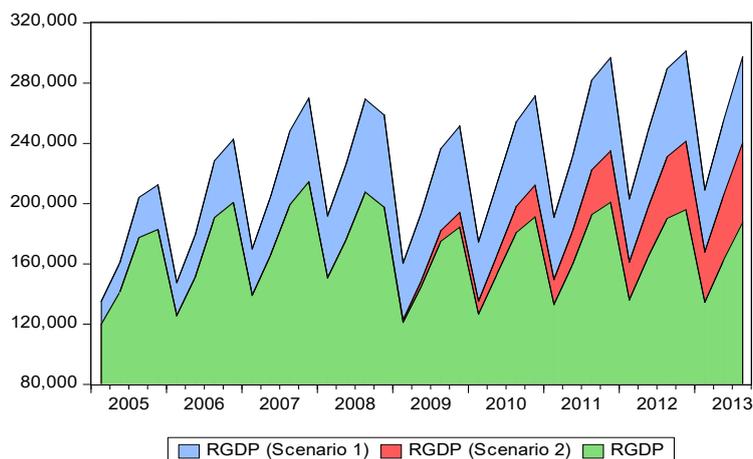


3a)                                            3b)

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

*Figure 3.*Dynamics of Percent Unemployed, who are Officially Registered and the Registered Unemployment Rate

Calculations show that during 2005-2008 only about half of the actually unemployed became registered in employment centers, while starting in 2009, this number fell to 30 percent. As a result of these processes on labor market dynamics, official unemployment experienced displacement from 3.15% to 2.58% (Fig. 3b). We used the developed model for an analysis of the effects on the performance of the labor market of the scenario in which the unemployment rate does not undergo negative shift. Simulation results show that these changes cause a drop in wages by an average of 1% in 2010, and this reduction remains stable for the next few years until 2013.

Separately we explore the effect of real GDP, which is an indicator of economic growth. Note that it has suffered a negative level shift due to the crisis that began in late 2008. In addition, the pace of its growth, which by 2008 was 1.8%, decreased in the following years by 1.3% and stood at 0.5%. We consider two alternative scenarios (Fig. 4). Under the first scenario, we assume that real GDP growth would be higher than the current in each period from 2005 to 2013 by 1 percent, and according to the second scenario, the real GDP, although it would incur negative shifts due to the crisis, would retain in the future a growth rate which was observed prior to 2009, though as evidenced by recent events in Ukraine, this is already practically unrealistic and a purely hypothetical exercise.

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

*Figure 4.*Growth of Real GDP under Alternative Scenarios

The average annual changes in labor market indicators as a result of playing out both scenarios for real GDP are shown in Table 2. Note that under both scenarios the impact would affect all labor market indicators. Constant although not significant increase in real GDP growth (1%) during 2005-2013 would result in significant additional increase in wages (23%), would increase employment (5.5%), would stimulate economic activity of the population (2.3%) and significantly reduce the number of unemployed (39%).

*Table 2.*
Deviation Scenario for RGDP from Baseline Scenario

| Variable | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|
| Scenario 1 | | | | | | | | |
| *AWAGE* (hryvnias) | 91.1 | 146.2 | 233.0 | 271.4 | 370.6 | 506.0 | 651.5 | 774.1 |
| *EMPL* (thousands people) | 395.3 | 549.6 | 639.2 | 458.3 | 568.5 | 755.2 | 932.9 | 1138.3 |
| *LF* (thousands people) | 139.1 | 254.8 | 283.9 | -39.0 | 20.8 | 183.3 | 332.2 | 523.0 |
| *RUN* (%) | -1.18 | -1.37 | -1.65 | -2.24 | -2.48 | -2.63 | -2.79 | -2.88 |
| *UNEMPL* (thousands people) | -256.2 | -294.8 | -355.3 | -497.3 | -547.6 | -571.9 | -600.8 | -615.2 |
| Scenario 2 | | | | | | | | |
| *AWAGE* (hryvnias) | — | — | — | 28.0 | 86.5 | 170.1 | 273.4 | 372.8 |
| *EMPL* (thousands people) | — | — | — | 35.4 | 103.2 | 212.2 | 338.8 | 491.8 |
| *LF* (thousands people) | — | — | — | -25.2 | -50.1 | -17.6 | 38.0 | 140.9 |
| *RUN* (%) | — | — | — | -0.27 | -0.68 | -1.03 | -1.37 | -1.62 |
| *UNEMPL* (thousands people) | — | — | — | -60.6 | -153.2 | -229.9 | -300.8 | -350.9 |

**Source:** evaluation of author

The research scenario in which there are no wage arrears showed insignificant effect on the dynamics of endogenous variables.

We use the estimated model for forecasting the future behavior of Ukrainian labor market indicators. To forecast the exogenous variables we apply the autoregressive moving

average models. Fig. 5 shows the forecasted behavior of the labor force and unemployment rate while maintaining the dynamics of the exogenous variables in the future and the dynamic variables predicted by the two possible scenarios of future behavior factors. The first forecast assumes that as a result of favorable economic policies real GDP growth in 2014 and 2015 increases by 1% compared to the expected. According to a second possible scenario (forecast 2) we assume a quarterly growth rate of inflation in 2014 and 2015 of 2% more than forecasted by its previous dynamics prior to 2014.



5a)                                          5b)
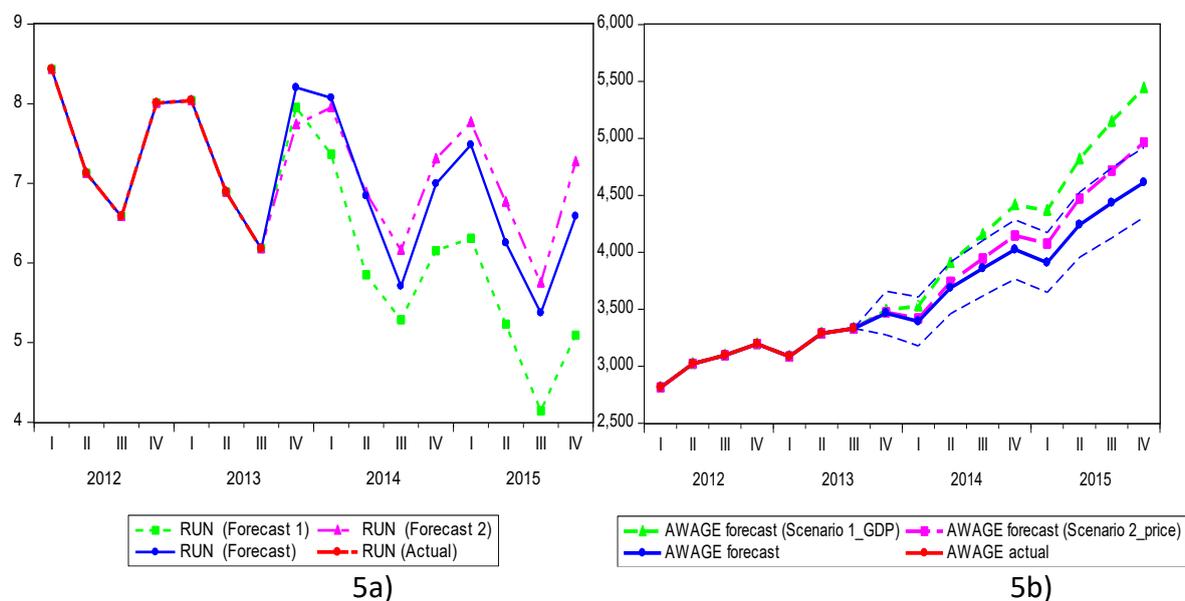
*Source:* Authors' elaboration

*Figure 5.* Forecasting of the Unemployment Rate and Average Wage

Application of the estimated complex models shows that if the growth rate of real GDP increases, it will increase the demand for labor force and improvements in all domestic labor market indicators. Higher prices, on the contrary, will have negative consequences and will be accompanied only by the growth of nominal wages and practically won't change the amount of labor force and employment.

## 5.  Conclusions

As a result of an empirical investigation of the relationship between macroeconomic indicators of labor market in Ukraine we have developed a complete dynamic econometric error-correction model, which is based on a simultaneous system of long-term equilibrium economic relationships, but also allows you to measure the short-term effects of several factors on the rate of change of average wages, labor force, employment and unemployment. Modeling shows that the higher the price level is, the higher are nominal wages, but they do not grow commensurate with the cost of living. Growth in real gross domestic product in both the long and short term causes the growth of real wages, stimulates growth of employment and reduces unemployment. The unemployment rate, which is defined by the ILO methodology, 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.

The constructed model makes it possible to analyze a variety of alternative scenarios of processes on the labor market in Ukraine. Analyzing modeling results we find that the slower

growth of the unemployment benefit and its agreement with the growth rate of average wages during 2002 – 2013 did not give rise to income inequality, but would result in a significant reduction in unemployment, while other labor market indicators almost would not be touched. Increasing in the growth rate of real GDP would result in higher employment, boost economic activity and lead to higher wages and welfare.

The developed model allows us to predict future behavior of macroeconomic indicators on the labor market under various alternative dynamics of factors, and its usage within the structure of overall integrated macro model of Ukraine will help to carry out a comprehensive analysis of socio-economic processes and forecast its developing prospects both in the short and in the long run terms.

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