

ECONOMETRIC MODELLING OF REGIONAL LABOUR MARKET INDICATORS IN UKRAINE

The article deals with econometric models of relationships between the regional macro indicators of labour market of Ukraine's economy. They describe behaviour of average monthly salary, number of the employed and the unemployed in different oblasts of the country. The estimation of the elaborated models has been conducted on the basis of the real information, the degree of factors influence has been defined, the statistical analysis of the results has been carried out.

Keywords: labour market, econometric model, panel data, fixed effects, salary, unemployment.

Introduction and the analysis of the last publications. In the conditions of unstable economic environment in Ukraine topical is the study of macroeconomic interrelations on the labour market that represents the peculiarities of the socio-economic phenomena of the national economy. Regional labour-markets in Ukraine are distinguished by differentiation, imbalances in development, structural changes and investment possibilities. The modern tendencies of such differences predetermine the topicality of mathematical modelling in economics of labour market indexes behaviour on the basis of regional observations.

Considerable contribution to the research of theoretical and applied issues of domestic labour market development and its regional features is made in the works of S. Babych, D. Bohynia, T. Holubeva, Ju. Horodnichenko, O. Hrishnova, I. Lukyanenko, K. Petrenko, K. Sultan, L. Semiv, T. Umanets and others. However, econometric models of labour market for panel data of regions in Ukraine that will give an opportunity to improve economic strategies of employment are insufficiently developed.

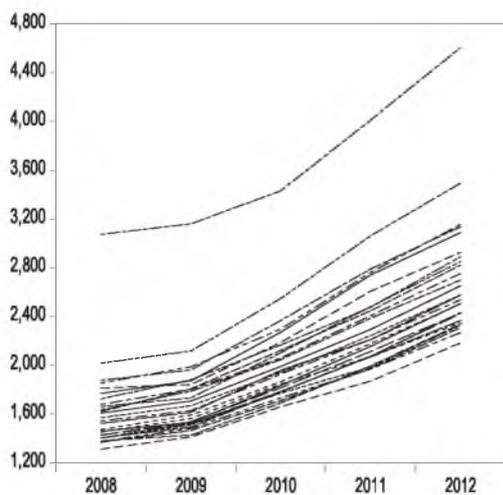
The aim of the research. The aim of the article is empiric research and econometric modelling of interrelations between the indexes of domestic labour market that takes into account the peculiarities of socio-economic development of regions in Ukraine.

The main results of the research. Labour-market is one of the elements of market economy that has a special socio-economic significance, as characterizes not only the interests of employer and employee, but also represents transformations and phenomena that take place in society. A block of labour market is an inherent constituent of structural macroeconomic models of Ukraine that gives an opportunity to model and analyse economic de-

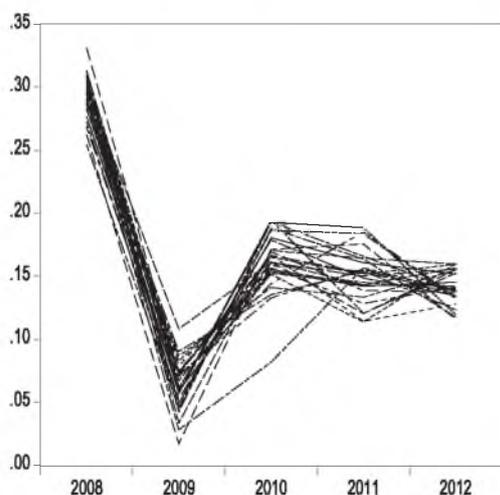
velopment of the country [5, p. 52]. Simultaneously, the problems of demand and supply balance of labour force, dynamics of population economic activity and unemployment rate have a regional specific, and that is why in labour market research special attention should be paid to the development of econometric models that would take into account regional indexes behaviour.

We will characterise socio-economic development of regions in the country on the basis of available statistical panel database of regional labour-markets indexes for five years for the Autonomous Republic of Crimea, 24 oblasts of Ukraine, Kyiv and Sevastopol. To achieve the aim of the research we have conducted the modelling of salary, nominal employment and unemployment and analysed the influence of factors that determine them. According to the data of State Statistics Service of Ukraine an average monthly salary grew in all regions during the investigated period, however, its level and growth rate differed. In particular, we observed the highest level in Kyiv (from 3074 UAH to 4607 UAH), Donetsk Oblast (3496 UAH in 2012) and Dnipropetrovsk Oblast (3138 UAH in 2012) that twice exceed the lowest level in Ternopil Oblast (1313 UAH in 2008), Chernihiv Oblast (1370 UAH in 2008) and Kherson Oblast (1375 UAH in 2008) (fig. 1).

Simultaneously, employment growth rates were the highest in Sumy Oblast (4.3 % in 2011), Rivne Oblast (3.7 % in 2011) and Ternopil Oblast (2.1 % in 2010), and the lowest in Donetsk Oblast (-7.7 % in 2008), Chernivtsi Oblast (-7.6 % in 2009) and Poltava Oblast (-6.7 % in 2009). The unemployment rate determined by methodology of International Labour Organisation (IOL) ranged from 1.6 % (for Chernivtsi Oblast in 2008) to 15.5 % (for Kyiv in 2009). In the structure of regions in Ukraine and intertemporal dynamics



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2

Fig. 1. Dynamics of: 1) an average monthly salary; 2) salary growth rates in the regions of Ukraine

the registered unemployment rate was the lowest in Kyiv (0.4 % in 2008) and the highest in Ternopil Oblast (5.9 % in 2008).

To assess the interdependences at the labour market of Ukraine we have combined time series data for 27 regions of Ukraine for 4 years in one sample. The empiric data that are the basis for the modelling are panel, i.e. they simultaneously combine time series and spatial sample. Such observations are considerably richer information sources comparatively with cross section spatial data or with separate time series; however, their modelling requires rather difficult specifications. Besides, while constructing an econometric model it is impossible at once to define which type of model will better represent the necessary dependence. As a result of research, assessment and comparison of different types of interrelations we have chosen regressions:

$$\log(AWAGE)_{rt} = a_r + \alpha_1 \log(GDP)_{rt} + \alpha_2 RUOF_{rt} + \alpha_3 RUNEM_{rt} + \alpha_4 \log(WARR)_{rt} + \alpha_5 \log(P)_{rt} + \alpha_6 \Delta \log(P)_{rt} + \alpha_7 \log(UNEMPL)_{rt} + \alpha_8 \log(AWAGE)_{r,t-1} + u_{rt}, \quad (1)$$

$$\log(EMPL)_{rt} = b_r + \beta_1 \log(RGDP)_{rt} + \beta_2 \log(AWAGE)_{rt} + \beta_3 \log(LF)_{rt} + \beta_4 \log(WARR)_{rt} + \beta_5 \log(UNB)_{rt} + u_{rt}, \quad (2)$$

$$\log(UNEMPL)_{rt} = c_r + \gamma_1 \log(RGDP)_{rt} + \gamma_2 \log(AWAGE)_{rt} + \gamma_3 \log(LF)_{rt} + \gamma_4 \log(WARR)_{rt} + \gamma_5 \log(UNB)_{rt} + u_{rt}, \quad (3)$$

where

- a_r, b_r, c_r – fixed effects of r -region;
- $AWAGE_{rt}$ – average monthly salary per capita of r -region per annum t (UAH);
- $RGDP_{rt}$ – real gross regional product of r -region per annum t in fixed prices of 2007 (million UAH);
- $WARR_{rt}$ – arrears in salaries in r -region per annum t (million UAH);
- LF_{rt} – economically active population of r -region per annum t (thousand people);
- $EMPL_{rt}$ – employed population of r -region per annum t (thousand people);
- $UNEMPL_{rt}$ – unemployed population of r -region per annum t (thousand people);
- $RUNEMPL_{rt}$ – unemployment rate (defined by methodology of ILO) of r -region per annum t (%);
- $RUOF_{rt}$ – registered unemployment rate of r -region per annum t (%);
- CPI_{rt} – consumer price index in regions of r -region per annum t ;
- UNB_{rt} – average unemployment benefit per annum t (UAH);
- u_{rt} – random variable;
- $r = 1, \dots, 27; t = 1, \dots, 5$.

The use of logarithms variables in empiric modelling is predefined by economic theory that states the concavity of theoretical economic correlations and also by statistical properties of rows under investigation. The coefficients of these log-linear models determine elasticity by corresponding factors and show by how many percent dependent variable changes at the increase of factor by 1 % on condition that all other factors remain constant. Table 1 is a summary of the regression results of models (1) – (3). We can see that the adjusted – R^2 values for all three regressions are very high. The value of F- statistics states the adequacy of the assessed models.

Model (1) defines the influence factors on average monthly salary that is an important indicator of demand for goods and services in the economy. According to economic theory the model includes

Table 1. Regression results for equations (1) – (3)

Method: Panel Least Squares	Model 1		Model 2		Model 3	
	Dependent Variable					
	log (<i>AWAGE</i>)		log (<i>EMPL</i>)		log (<i>UNEMPL</i>)	
Variable	Coef.	t-Stat.	Coef.	t-Stat.	Coef.	t-Stat.
Const	4.270	4.23** (0.000)	-1.749	-2.78** (0.007)	0.474	0.086 (0.932)
log (<i>RGDP</i>)	0.235	3.70** (0.001)	0.046	2.38* (0.020)	-0.525	-2.25* (0.027)
log (<i>AWAGE</i>)			0.168	3.12** (0.003)	-1.550	-2.59* (0.012)
log (<i>LF</i>)			0.910	13.2** (0.000)	1.213	1.47 (0.144)
log (<i>UNEMPL</i>)	-0.356	-2.75** (0.008)				
<i>RUOF</i>	-0.029	-4.50** (0.000)				
<i>RUNEMPL</i>	1.387	1.278 (0.208)				
log (<i>P</i>)	0.495	3.17** (0.003)				
Δ log (<i>P</i>)	-0.946	-2.73** (0.009)				
log (<i>WARR</i>)	0.004	0.87 (0.386)	0.002	1.05 (0.297)	0.028	1.03 (0.306)
log (<i>UNB</i>)			0.143	1.71 (0.092)	1.863	3.92** (0.000)
log (<i>AWAGE</i> _{<i>t-1</i>})	0.309	2.94** (0.005)				
Trend			-0.047	-4.36** (0.000)		
R-squared	0,996		0,999		0,970	
Adjusted R-squared	0,994		0,999		0,958	
F-statistic	444,51		10239,71		79,92	
Prob (F-statistic)	0,000		0,000		0,000	
Jarque-Bera statistic	1,34		30,32		1,489	

Notes: exact significant levels in brackets; * denotes rejection of the hypothesis at the 0.05 level; ** denotes rejection of the hypothesis at the 0.01 level.

price level ($\log(P)$) and inflation rate ($\Delta\log(P)$), calculated on the basis of regional consumer price indexes, real gross regional product ($\log(RGDP)$), unemployment rates in regions ($\log(UNEMP)$, *RUNEM*, *RUOF*) and arrears in salaries ($\log(WARR)$). In addition to a significant constant, seven out of nine independent variables in m1 are significant. The modelling shows that the higher price level is, the higher nominal salary is, however, it doesn't grow proportionally to the cost of living. Price elasticity of salary is less than 1 and accounts for 0.49. Besides the increase of inflation rate has negative significant influence on the level of employees' income. Salary directly depends on the increase of the real gross regional product, the level of which is the indicator of regional economic development, and its increase by 1 % predetermines the increase of salary by 0.23 %. The increase of the number of the unemployed causes the fall of average salary and the elasticity of such influence accounts for -0.35. It al-

so should be noted that unemployment rate defined by methodology of ILO (i.e. people, who actively looked for a job, tried to organize their own business or expected answers for the proposed job) is not a significant influence factor on salary in the regions of Ukraine, whereas the increase of registered unemployment rate significantly diminishes nominal salary level. Besides, the increase of salary has an adaptive character that is stated by the significance of the coefficient α_8 . It can be interpreted as a parameter of partial adaptation to some desirable salary level. The assessed value reveals that the actual increase of salary equals in average 69 percents from the difference of desirable salary level and its value in a previous period.

The assessment of parameters of models (2) and (3) determine the degree of influence of real gross regional product, level of economically active population in the region, average salary, arrears in salaries and unemployment benefit on

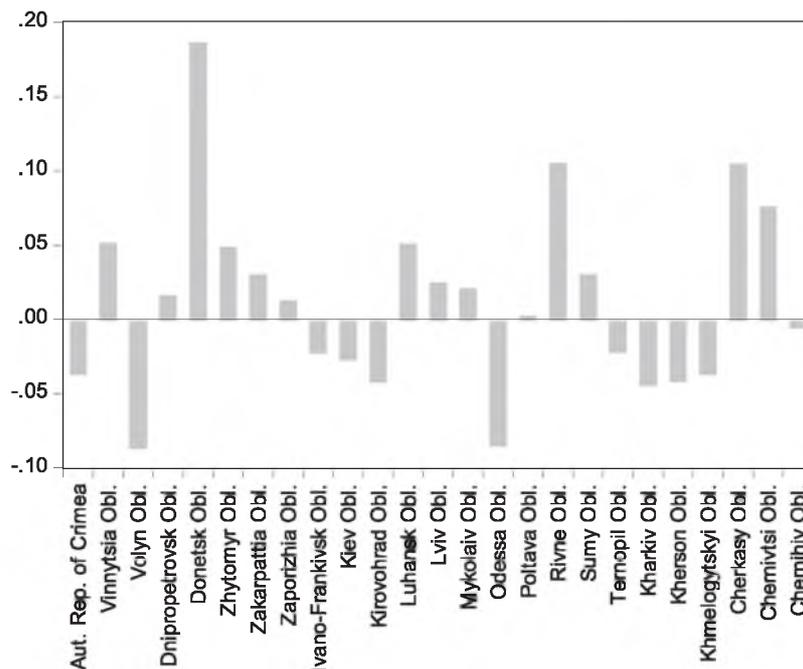


Fig. 2. Differences of salary in regions in comparison with its average value in Ukraine in percentage terms

the number of the employed and unemployed. The analysis of the results of the modelling proves that the increase of salary predetermines the increase of the number of the employed and the decrease of the number of the unemployed and the effect of its influence on unemployment ($\gamma_2 = -1.55$) is considerably higher than the effect of its influence on employment ($\beta_2 = 0.17$). The increase of economically active population proportionally increases the number of the employed and does not influence the number of the unemployed. In particular, the increase of economic activity of population by 10 % causes the increase of the number of the employed by 9.1 %. The increase of unemployment benefit does not have statistically significant influence on the number of the employed however, it significantly increases the number of the unemployed, the increase of unemployment benefit by 10 % results in the increase of the number of the unemployed by 18.6 %. The real output stimulates the number of the employed and diminishes the number of the unemployed. Besides, a degree of its influence on the unemployment decline is considerably higher. The corresponding elasticity coefficients account for 0.05 and -0.52 respectively.

It should be noted that arrears in salaries variable is statistically significant in none of the models, and that is why its dynamics has an influence neither on the average salary nor on the number of the employed and unemployed.

Introduction of different values of a_r, b_r, c_r to the specification of models (1)–(3) gives an opportunity to take into account the fact that dependences of sal-

ary, number of employed and unemployed on factors that influence them, can be different for different regions of Ukraine. Simultaneously, the slope parameters $\alpha_p, \beta_p, \gamma_j$ are identical for all objects and all periods of time. The statistical testing show meaningful differences between the fixed effects of regions in all models (Cross-section $F_{AWAGE} = 9.36^{**}$, $F_{EMPL} = 12.55^{**}$, $F_{UNEMPL} = 14.30^{**}$).

The fixed effects of oblasts a_r, b_r, c_r measure the influence of non-measurable factors that influence the dependent variable of the corresponding model and depend on management quality of the oblast, level of socio-economic development, location of region and other factors. Since each of the models contains the common intercept, the calculated values of fixed effects for every region characterize differences in the corresponding intercepts. In particular, the value of a_r measures differences in the logarithms of salary in r -region in comparison with its average value in Ukraine.

Fig. 2 presents the value of these differences in percentage terms. It is seen that at the identical values of model factors, namely, gross regional products, unemployment rates, price levels and inflation rates, the salary in Volyn and Odessa oblasts is considerably lower comparatively with its average level in Ukraine, and in Donetsk, Rivne, Cherkasy and Chernivtsi oblasts (other terms being equal) the salary significantly exceeds its average level.

Conclusions. Modern experience of market economy development in Ukraine testifies to the topicality of the research of national labour sector and its regional characteristics that determine

the peculiarities of the socio-economic phenomena in our country. As a result of empiric research of interrelations between the macro indexes of labour markets in the regions of Ukraine on the basis of real information three logarithmic linear econometric models that describe behaviour of average monthly salary, number of the employed and the unemployed in 27 regions of Ukraine for four years has been assessed and analysed. The evaluations of the developed models parameters determine the degree of influence of gross domestic product, the level of economically active population, unemployment rate

defined by methodology of ILO, registered unemployment rate, arrears in salaries, price indexes, inflation and unemployment benefit. The peculiar feature of the developed models is that for different regions the different values of fixed effects, that represent influence of factors specific for them has been assessed. The conducted statistical analysis of the results certifies to adequacy of selected specifications. The constructed models give an opportunity to carry out the analysis of economic processes common to the regional labour markets, and provide effective policy of population employment.

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ЕКОНОМЕТРИЧНЕ МОДЕЛЮВАННЯ РЕГІОНАЛЬНИХ ПОКАЗНИКІВ РИНКУ ПРАЦІ В УКРАЇНІ

У статті досліджено низку економетричних моделей взаємозв'язків між регіональними макропоказниками ринку праці економіки України, які описують поведінку середньомісячної заробітної плати, кількості зайнятих і безробітних у різних областях країни. На підставі реальної інформації проведено оцінювання розроблених моделей, визначено ступінь впливу чинників, здійснено статистичний аналіз отриманих результатів.

Ключові слова: ринок праці, економетрична модель, панельні дані, фіксовані ефекти, заробітна плата, безробіття.

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