

THE UKRAINIAN LABOR MARKET INVESTIGATION WITH THE USE OF SYSTEM DYNAMICS METHODS

The system analysis of the current conditions on the Labor Market in Ukraine shows the links between the main macroeconomic and other indicators, which characterize the state of the labor market. During the research, we developed the simulation model of demand and supply formation on the labor market in Ukraine. The scenario analysis, which was conducted on the basis of the model, showed the potential development prospects of the labor market development by different initial conditions and assumptions, and its impact on macroeconomic stabilization.

Keywords: labor force, labor market, employment, unemployment, simulation model, system dynamics

JEL classification: E240, J21, J23

Introduction and Research Problem

The dynamic processes on the Ukrainian labor market, its state, and development prospects play an important role in regulating of macroeconomic stabilization, reducing of social tension and discovering the measures for possible negative social-economic processes in the long-run and medium term. Accordingly, the system research of functional and development features of Ukrainian labor market become more topical. The search of adequate mathematical tools for complex nonlinear dynamic relationships evaluation and identifying the opportunities of labor market as an important social-economic subsystem in Employment regulation in Ukraine is crucial for job creation, preventing the unemployment, improving the competitiveness and investment attractiveness by strengthening of human capital on regional and state level, which is extremely important during crisis period, which is characterized not only by economic, but also by political instability. It should be noted that Labor market is influenced by many internal and external factors and can be observed either like separate complex system with a changeable structure or like subsystem of a more complex system with unclearly determined structure in dynamics. It stimulates the further research of adequate mathematical tools, including macro-models of labor market of different difficulty levels, the implementation of which would allow to build and explore scenarios of socio-economic development at different combinations of regulatory instruments of the labor market, analyze the consequences of changes in social policy, identify and prevent negative development trends eco-

nomy towards the attainment of macroeconomic stability depending on the state of the labor market, and investigate errors in the conduct of social policy prior periods for the purpose of adjusting the future.

Recent publications analysis. The labor market as a regulator of macroeconomic stability requires special attention. The problems related to research of theoretical and methodological foundation of nature and functioning of the labor market, its significance in the economic system, the specifics of state, the consequences of globalization processes, interconnections with other economics sectors, its influence on the formation of economic equilibrium take a great niche among all the research. Many Ukrainian and foreign scientists dedicated lots of their works to the analysis and research of labor market, its functioning and effective work, in particular, G. Bardsen, O. Blanchard paid much attention to the problems of Unemployment and its specifics. In their works, they used the methods of econometrics and statistical analysis. O. Blanchard and J. Gali constructed a utility-based model of fluctuations and draw its implications for the unemployment-inflation tradeoff and for the conduct of monetary policy [2, 2]. G. Bardsen, S. Hurn and Z. McHugh researched asymmetries in unemployment rate in Australia. They built the non-linear LSTAR model of the unemployment rate, which showed that changes in unemployment are a result of low output growth, increases in real interest rates, changes in productivity, and in competitiveness [1, 18]. A. Peichl and S. Sieglöckh [7] in their work used econometrics for modeling labor demand and supply. Their research was based on the calculations of labor demand elasticity, and the use of it for the

measurement of how a labor supply shift affects the gross wage. Then the labor supply effects were re-estimated, according to the given adjusted wages.

Ukrainian scientists such as G. Vdovina, O. Vorontsova, Yu. Virt, M. Oliskevych, I. Lukianenko, E. Prushkivska also paid attention to the research of supply and demand on Ukrainian Labor Market, and to the specifics of governmental policy in employment. In her work G. Vdovina determines the problems of labor supply and demand formation in Ukrainian labor market by using statistic analysis [13, 145], and O. Vorontsova emphasized on the importance of the human capital development [15, 231]. In their works M. Oliskevych and I. Lukianenko use econometrics instruments for modeling of the labor market. M. Oliskevych investigated the dynamic peculiarities of socio-economic processes and built the econometric model, which shows the dynamics of the labor force and helps to determine short-run effects of some factors on the growth rate of wages, and to conduct scenario analysis and make prognoses for the future behavior of the labor force [8, 1].

Econometric modeling enables to examine the structure of the labor market and determine the proportion of the main influence factors on its behavior. Another instrument for labor market modeling is system dynamics. Such researchers as D. Wheat, J. Sterman, made a great contribution to the system dynamics modeling improvement and in particular to the analysis and modeling of Labor Market. According to the changes in the economic and political situation in Ukraine, the labor market requires further analysis and research.

Unsolved parts of the problem. The analysis of research and articles of characteristics of labor market development in different countries showed that despite the big attention of Ukrainian and foreign researchers to labor market processes, they concentrated their attention on the wide spectrum of statistical data analysis of labor market formation, the analysis of changes in trends in key indicators of the labor market, and determination of human potential [13; 14; 15]. Thus, there is a lack of research aimed at adequate formalization and modeling of processes occurring in the labor market around the world. The modeling of the labor market as a separate nonlinear dynamic system and subsystem of more complex systems leads to the continuation of new searches in nontraditional modeling processes and prognoses of dynamic systems on the grounds of modern flexible mathematical tools, including methods of system dynamics. They are helpful for the research of complex nonlinear processes, which are common for the labor market, and for development

on their basis the simulation model of supply and demand on the labor market in Ukraine. The implementation of this model can be very useful for determination of medium-term and strategic areas of the labor market development in terms of increased risks and socio-economic instability.

Research goal and questions. The purpose of research is to build a generalized simulation model of a labor market in Ukraine by means of system dynamics, the implementation of which allows to analyze possible scenarios of changes in key indicators of the labor market and their relationships at various developments and unexpected situations, and determine the most effective strategic direction of the labor market taking into account internal and external risks to achieve financial stability and socio-economic development of the country. The main tasks for achieving the purpose: to investigate theoretical and empirical approaches to labor demand and supply formation, to justify the need for using economic and mathematical tools in determining the main factors affecting employment and the main indicators characterizing the labor market, to build the generalized model of Ukrainian labor market with system dynamics methods and diagnose its adequacy, conduct a scenario analysis of the labor market for the various possible developments and unexpected situations; determine the most effective strategic directions of Ukraine's labor market aimed at regulating the financial stability and economic development.

Main findings

In terms of significant social, economic and political challenges facing Ukraine nowadays, the effective functioning of the labor market is essential for stabilization of the macroeconomic situation and decrease in social tension in society. The productive employment is one of the basic conditions for solving the problems of implementation of human potential, creativity, and talent in their labor and for economic recovery as the basis of the social sphere [15, 230]. For most European countries, the productive employment is the top priority of economic and social policies and the fundamental basis of European integration. Ukraine's economy is characterized by such problems as low wages, a high proportion of youth unemployment, lack of jobs. Consequently, the problems of low investment appear, and a lack of a clear program of investment activity.

The total number of economically active population changes annually. Between 2002 and 2008 this number rose from 22232 thousand people to 22397 thousand people. Because of the crisis in 2008–

2009, the number of the economically active population declined sharply to 22051 thousand people. Because of difficult economic and political situation in Ukraine for the last 2 years, the amount of labor force declined sharply in the year 2014 – from 21980 thousand people to 21020 thousand people. According to the data given by State Statistics Service of Ukraine, the amount of working age population and the percentage of economic activity are also declining. It means that working age people for some reasons do not join the labor force. Instead of this they can go abroad and find a job there, which can cause a problem of illegal migration, or they can work in the shadow economy. Both of these factors have a negative influence on national economies. The dynamics of the labor force is showed in figure 1.

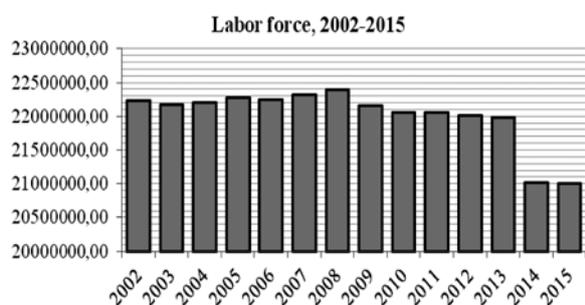


Fig. 1. The dynamics of labor force in Ukraine in 2002–2015

Source: State Statistics Service of Ukraine

The level of economic activity in 2002–2013 years increased from 62% to 65%, but in the period from 2014 to 2015, because of the difficult situation in Ukraine, the index fell sharply from 65 to 62.5%. The employment rate in 1995–2013 was ranging between 60-70% of the working population, and in 2013 its value reached 67%. In 2014 this index decreased to the level of 56,6%, and in 2015 it reached 56,9%. The dynamics of employment rate in period 2004 – 2015 showed on figure 2.

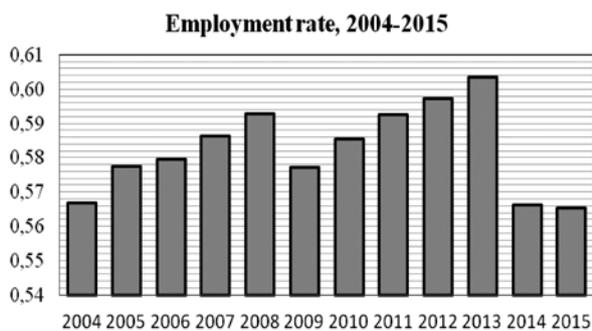


Fig. 2. The dynamics of employment rate in 2004–2015

Source: State Statistics Service of Ukraine

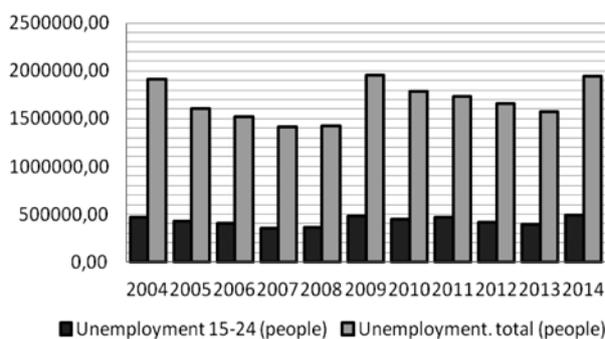


Fig. 3. The structure of unemployment in period 2004 – 2014

Source: State Statistics Service of Ukraine

The unemployment rate in Ukraine in the period from 2000 to 2008 decreased from 12% to 6.5%, but during the crisis in 2008-2009 increased to 9%. Between 2010 and 2013 there was a tendency of decreasing the unemployment rate to 7.5%, but in 2014 it rose to 8.07% due to large job reductions.

Another problem in Ukraine is a high proportion of unemployed among young people (Figure 3). Employers are reluctant to specialists without work experience, explaining that they need training expense.

The proportion of unemployed young people is on average 17%, which has a negative impact on productivity, and can reduce the number of working population due to the fact that young people are often more inclined to move abroad.

The state can pursue an active and passive employment policy. Active employment policy is a set of legal, institutional and economic measures that the state spends in order to reduce unemployment, training and re-training of the population, assistance in job search, career guidance, lending to small businesses, financial support for enterprises in the preservation of jobs, cash benefits to the unemployed and their families. Passive policy of the state is the registration of unemployed job seekers, an organization of granting unemployment benefits, the implementation of monetary and non-monetary forms of support for the unemployed and family members who are dependent on them. The market economy does not apply separately active or passive measures, and use them to advantage one or the other depending on the model of the economic system.

To determine which type of policy is the best to use at the certain stages of economic development, and which tools are most effective for balancing supply and demand in the labor market, it is necessary to carry out calculations for different possible scenarios based on economic and mathematical

models of the labor market of different difficulty levels.

For labor market analysis the system dynamics method was chosen as one, which allows describing quite simple the complex systems over time, depending on the structure elements and the interaction between them. The main features of using system dynamics are cause and effect relationships, feedback loops, delays, an influence of the environment etc [12, 26]. A system dynamics model presents the processes, which occur in the real world, in the form of three groups of variables: stocks (accumulative variable), flows, which determining stock changes over time, and converters – the parameters, which influence on flows. The method of system dynamics modeling belongs to the class of simulation modeling. A simulation model can be represented as a collection of many rules that define the processes of the system, its development and the transition from the current state to the other. The rules in the simulation modeling can be formulated in any form accessible to the computer, such as block diagrams, differential equations, diagrams, maps, states, machines, networks. Simulation models are usually less formal in comparison with analytical [12, 107]. After creating a model, this process continuing with numerous simulations and simulation tests. Simulation is the most common method of quantitative constructing scenarios of development of the simulated system that includes multiple mathematical approaches to the description of system behavior in different situations. During the simulations, the iterative process of refinement or rejection of the hypotheses is used to describe the system. This approach is essentially analogous to experiments in economics, sociology, ecology, solving the optimization and business planning. The imitation modeling is the powerful instrument for solving the problems when time and dynamics are very important. Scenarios based on computer simulations, built in several stages: direct development of the model, machine learning models, data collection, testing the model using data analysis scenarios. The simulation covers a wide range of methodological approaches to building models and methods of computer simulation.

The developed simulation model of the labor market in Ukraine based on the concept of a classical Keynesian model, has a block structure, and accordingly, con-

sists of two interconnected submodels describing the formation of supply and demand in the labor market.

The main assumption of the model is that the demand on the labor market is formed depending on the productivity of labor (*perceived labor's productivity*) and aggregate demand (*expected aggregate demand*) in the next period. According to this, the demand for labor force (*desired labor*) can be counted. In the model, the supply of labor is represented as the *labor force*, which is the sum of employed (*Employment*) and unemployed people (*Young Unemployment+Experienced Unemployment*). It is an assumption that people who join the labor force (*labor force joining rate*), are the young people without any working experience (*Young Unemployment*), and only after being unemployed they can get the job.

The built General Ukrainian Labor Market Model is conceptually related to the classic Keynesian models, has a block structure, and consists of 2 parts: the submodel of labor supply and the submodel of labor demand. The general scheme of interconnections between labor supply and demand is showed in Fig.4. According to the model, the demand for employment (*desired employment*) is an output from Labor Demand Submodel, which influences the number of vacancies in Labor Supply Submodel (*desired employment gap*). In turn, Labor Supply Demand has 2 inputs from Labor Demand Submodel. The Employment influences on GDP formation and the Unemployment rate, which is counted in Labor Supply Submodel has the influence on the formation of Nominal Wages.

The general scheme of the labor supply submodel is shown in figure 5.

The labor supply is determined by the number of economically active population and is represented as a group of 3 main stocks: *Employment*, *Young Unemployment*, and *Experienced Unemployment*.

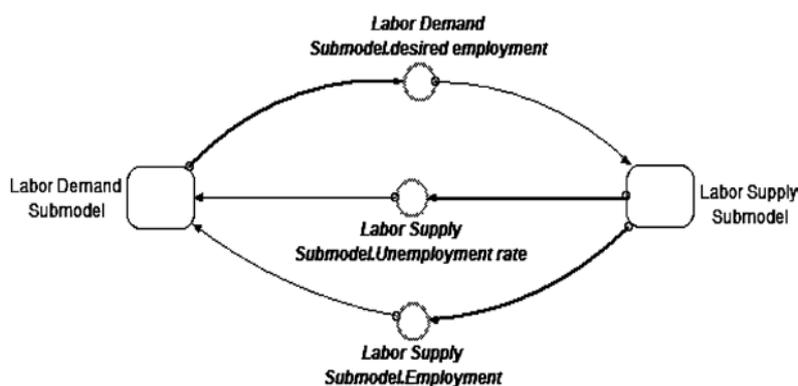


Fig. 4. The general structure of labor supply and demand

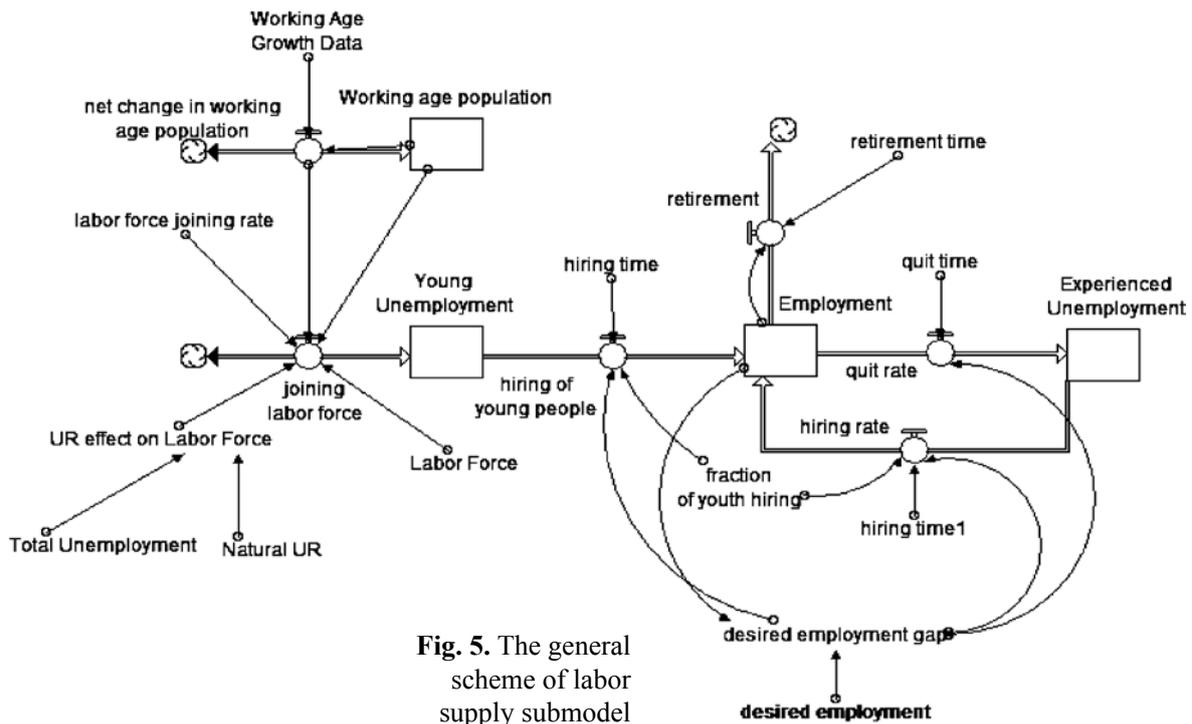


Fig. 5. The general scheme of labor supply submodel

The assumption is that people, who join the labor force, don't have any working experience, so they join the stock of **Young Unemployment**. The amount of Labor Force directly depends on the number of **Working Age Population**, and according to the statistics data, the amount of Labor Force is about 65 % of Working Age Population. That means that with the growing of Working Age Population, the number of Labor Force will also grow. From the other side, the

amount of Labor Force, or rather its structure, also has an influence on the forming of Working Age Population. With the high level of the unemployment rate, working age people do not want to join the labor force, and very often go abroad and stay there, which causes the decrease in fertility rate. By previous statistical analysis, it was determined that only 70 % of people who reach the working age join the labor force. The equation of joining labor force is:

$$\begin{aligned}
 \text{joining_labor_force} &= \text{net_change_in_working_age_population} * \\
 \text{labor_force_joining_rate} &+ \text{if}(\text{working_age_population} > \text{Labor_Force}) \\
 &\text{then}(\text{UR_effect_on_labor_force} * \text{Labor_Force} - \text{Labor_Force}) / \\
 &\text{Labor_Force_adj_time} \text{ else } 0
 \end{aligned}$$

where **net change in working age population** is a flow, which influences the stock of **Working Age Population**; **labor force joining rate** – is a coefficient of joining working age population to labor force that is equal to 0,7 (or 70 % according to the statistical data); **UR effect on Labor Force** is the impact of the unemployment rate influence on the amount of Labor Force: the higher unemployment rate, the less number of **Working Age Population** will join the Labor Force; **Labor Force adj time** –

the time that is needed to evaluate the amount of Labor Force.

The number of employed people in economics is dependent on a number of vacancies (**Desired employment**). If the economic need for workers reduces, some vacancies become less. It means that employers fire their employees, or shut the vacancies, and visa versa with the rise of demand for employees, a number of jobs is rising. Equation, which sets the formation of employed in economics is:

$$\begin{aligned}
 \text{Employment}_t &= \text{Employment}_{t-1} + \\
 &+ \int_{t-1}^t (\text{hiring_of_young_people} + \text{hiring_rate} - \text{quit_rate} - \text{retirement}) dt
 \end{aligned}$$

where **Employment** is a stock of all the employed people; **hiring of young people** is a flow of new employees of age 15-24 years; **hiring rate** is a flow of employees with

working experience, **quit rate** is the amount of workers who were fired, so they became experienced workers, and finally, **retirement** is a flow of people, who retired.

The number of vacancies (*desired employment gap*) has the impact on the number of unemployed people. The unemployed people in the model are divided into two categories: unemployed with working experience (*Experienced Unemployment*) and unemployed without working experience (*Young Unemployment*). The equation sets the number of young unemployment:

$$Young_Unemployment_t = Young_Unemployment_{t-1} + \int_{t-1}^t (joining_labor_force - hiring_of_young_people) dt$$

During the research, it was determined that the number of youth unemployment is about 17 % of total unemployment. It can cause the problem that young specialists due to the complexity of getting the job quit the labor force and are more frequent for moving abroad.

The flow of hiring of young people is equal to:

$$hiring_of_young_people = desired_employment_gap * fraction_of_youth_hiring / hiring_time$$

where *desired employment gap* is the number of vacancies, *fraction of youth hiring* is the percent-

age of vacancies, which are set for young people without experience, and *hiring time* is a period, during which a young person can find the job.

Experienced employment is a number of people, who have already got working experience, and this number is counted as:

$$Experienced_Employment_{t-1} = Experienced_Employment_t + \int_{t-1}^t (hiring_rate - quit_rate) dt$$

where *hiring rate* is the rate of joining experienced workers to employment, and *quit rate* is a number of people who are fired during the year.

According to the fact that gap is the net difference between the *Desired Employment* and *Employment*, it is assumed that *quit rate* is a net quit rate and it is positive only if the *desired employment gap* is negative.

The two submodels of the General model are connected according to the Cobb-Douglas Production Function. According to the labor demand submodel, which general scheme is shown in figure 6, the desired employment is counted as *Expected Aggregate Demand* divided by *Perceived Productivity*.

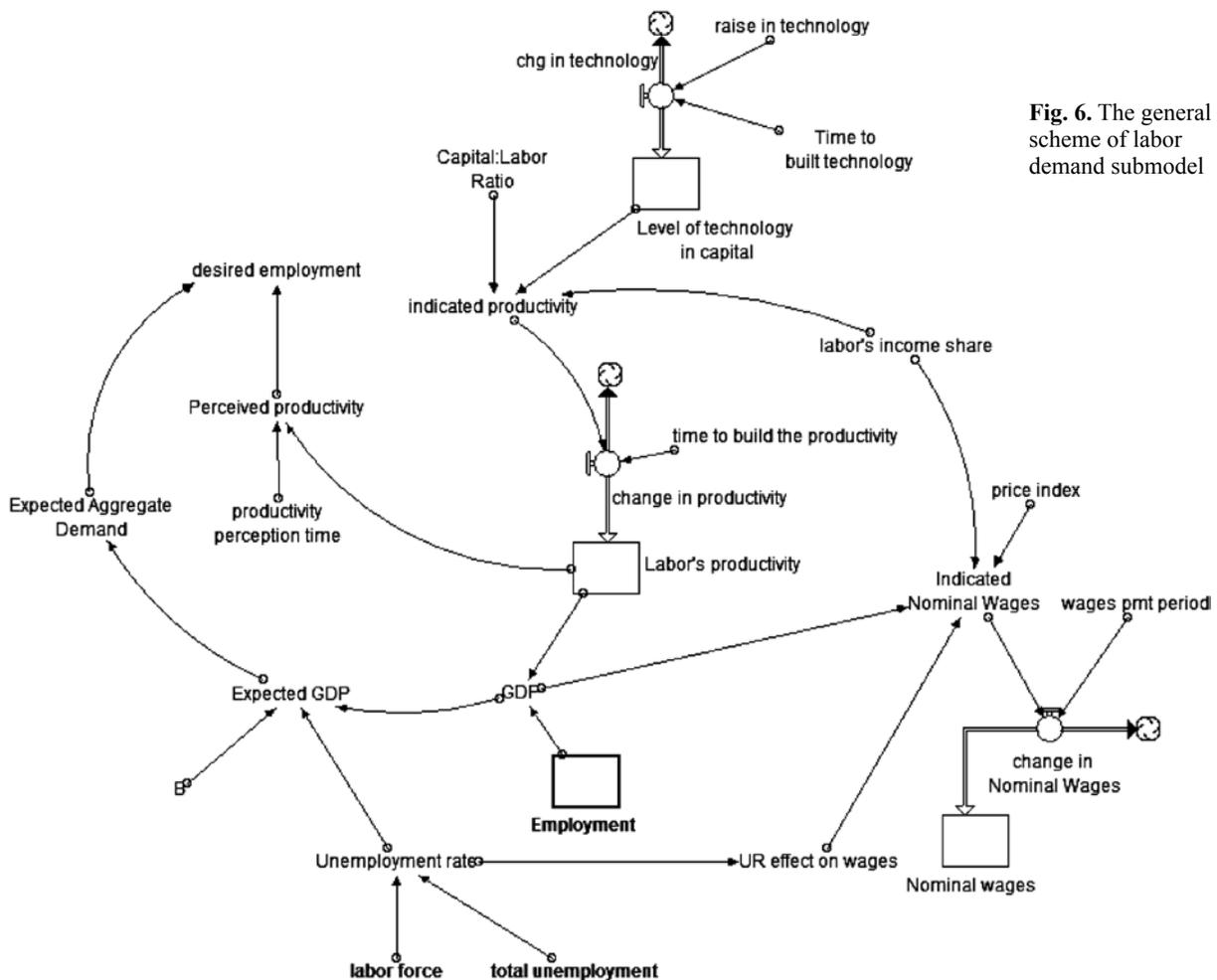


Fig. 6. The general scheme of labor demand submodel

One of the assumption of the model, the Aggregate Demand is equal to GDP. Expected GDP is determined according to the Okun's law and is

$$\text{Expected_GDP} = \frac{\text{GDP}}{1 - \beta \cdot \text{Unemployment_rate}_t - \text{Unemployment_rate}_{t-1}}$$

where β is a parameter in Okun's formula, which is equal to 2.5; the **Unemployment rate** is a share of Unemployment in Labor Force.

dependent on the Unemployment rate and GDP in the previous period. The equation for Expected GDP is:

The GDP is endogenous variable, which is equal to the multiplication of **Employment** (from Labor Supply Submodel) and **Labor's Productivity**. The Labor's Productivity is changing according to the equation:

$$\text{Labor's_Productivity}_t = \text{Labor's_Productivity}_{t-1} + \int_{t-1}^t (\text{change_in_productivity}) dt$$

where the change in productivity is equal to:

$$\frac{\text{change_in_productivity}}{\text{time_to_build_the_productivity}} = (\text{indicated_productivity} - \text{Productivity})$$

The indicated productivity formula is based on the Cobb-Douglas function. According to the equation, the indicated productivity is equal to:

$$\text{indicated_productivity} = (\text{Capital} : \text{Labor_Ratio})^{(1-\text{labor's_income_share})} \times \text{Level_of_Technology_in_Capital} \quad (1)$$

In this formula **Capital:Labor Ratio** is an exogenous variable, which was calculated from historical data of labor and capital. The **Level of technology in Capital** was counted from Cobb-Douglas function and then it was put in the model as an indicator with an exogenous rate of raise. It is the level of modernization of the whole Capital in Ukraine.

The stock of Nominal Wages is determined as the part of labor's income share in GDP and is dependent on the amount of GDP, price index, unemployment rate effect on wages. The unemployment rate effect on wages consists in the fact that employers will not spend money on hiring new workers if the level of salaries is very high. The equation sets this dependence:

$$\text{Nominal_Wages} = \text{GDP} \cdot \text{labor's_income_share} \cdot \text{price_index} \cdot \text{UR_effect_on_wages}$$

where **Nominal Wages** is the amount of nominal wage in GDP; **labor's income share** is the amount of the expenses on wages in GDP; **UR_effect_on_wages** is the parameter that shows the dependency between Unemployment Rate and GDP.

As it was mentioned above, the built General Ukrainian Labor Market Model consists of 2 parts: the submodel of labor supply and the submodel of labor demand. These two interconnected submodels describe the formation of demand and supply in the labor market. Key indicators in the General Ukrainian Labor Market Model are the number of employed people (**Employment**), the number of unemployed people (**Young Unemployment + Experienced Unemployment**), **Productivity**. These values are presented as stocks, changing by flows, which are influenced by dependent variables and constants. Equations define flows and

variables, and constants based on statistical data. The interconnection between submodels is carried out by related parameters such as **Employment**, formed in the labor supply submodel, which directly influences the **GDP** according to the production function, **Productivity**, which is formed on the basis of Cobb-Douglas Function, and influences the **Desired Labor**. The **Unemployment rate**, which is formed in labor supply submodel as a part of Unemployment in a **labor force**, has the influence on the formation of **Nominal Wages** and **Labor Force**.

Among the drawbacks of the built model are possible errors in determining the level of technology, the problem of the duration of Unemployment, which was not researched, and the problem of wage rigidity. The general scheme of the elaborated Ukrainian Labor Market Model is shown in figure 7.

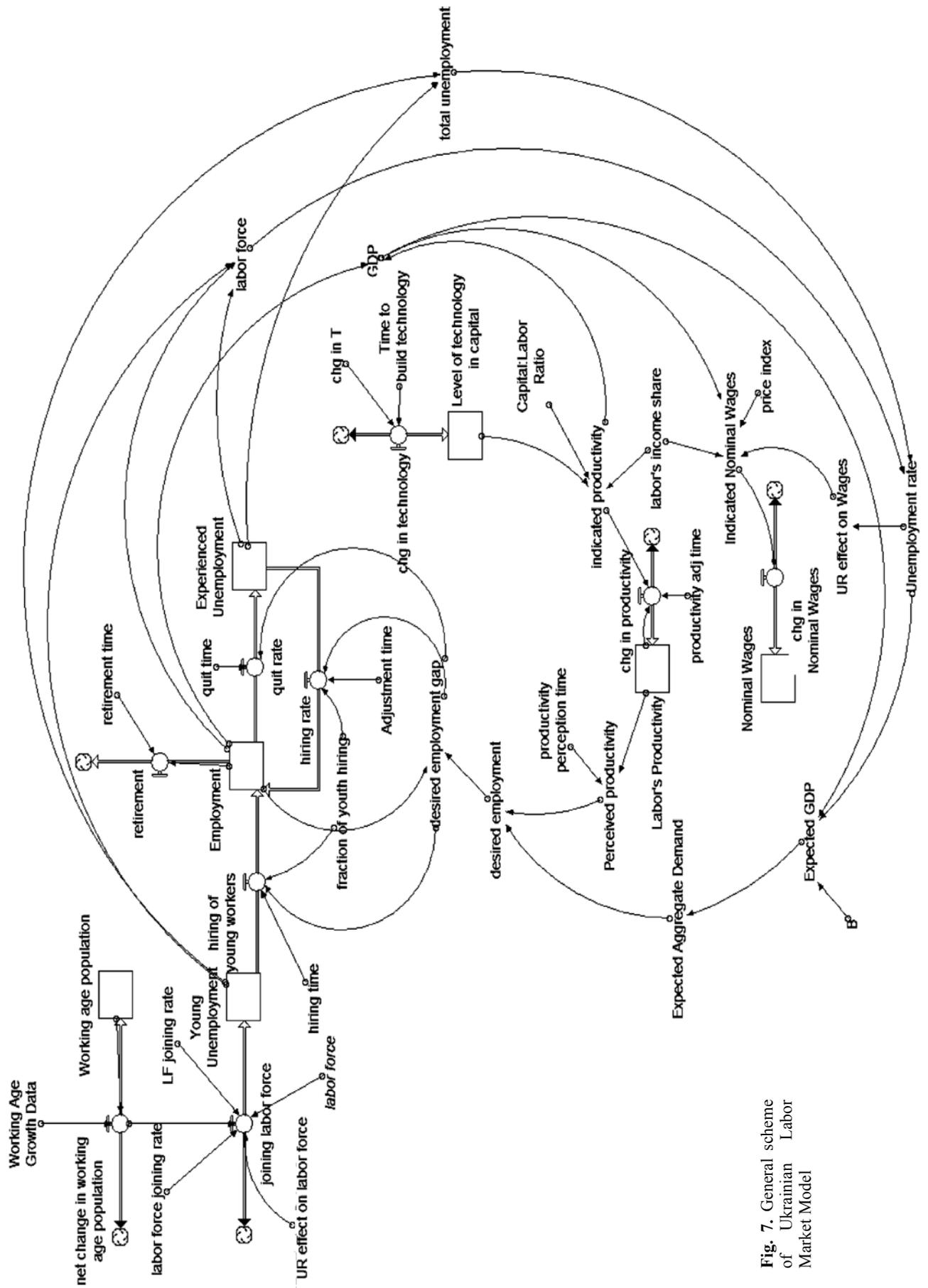


Fig. 7. General scheme of Ukrainian Labor Market Model

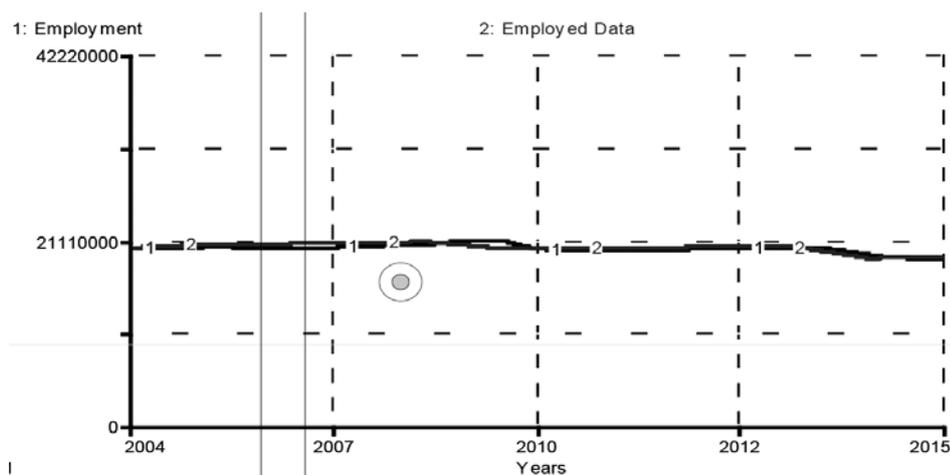


Fig. 8. Adequacy of simulated Employment to real Employment data

Source: built by authors in the iThink software

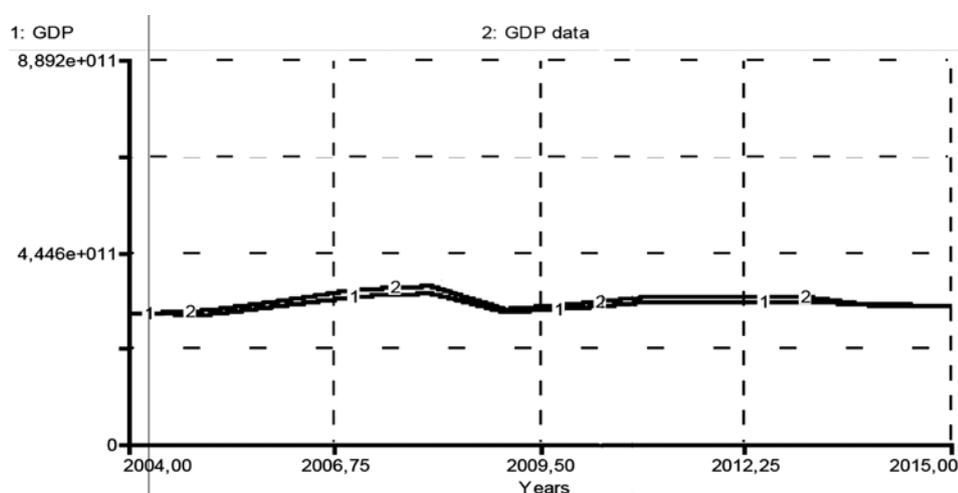


Fig. 9. The adequacy of simulated GDP to real GDP data

Source: built by authors in iThink software

For simulation of the designed model, which logically brings together labor supply and demand submodels, were used annual data for the period of 2004 – 2015 years. In the model, such data as GDP, Working age adults, Employment, Unemployment, Nominal Wages, and labor's income share were taken from State Statistics Service of Ukraine.

The primary criterion for adequacy of system dynamics model is the compliance of behavior between simulated and actual data for the main endogenous indicators in the retrospective period. The accuracy of the equations can be proven by checking the units of all the parameters in the model. If all the units within the model are consistent, it means that all the equations are accurate.

According to the model, the amount of the employed population in Ukraine depends on expected aggregate demand and on the labor's productivity. The graph on fig. 8 illustrates the conformity between the formation of simulated employment and real data.

This graph shows that the equation of the model describes the structure of employment in Ukraine with adequate accuracy.

The number of employed directly affect the level of GDP. For its simulations, Cobb-Douglas function was chosen. The GDP is counted as the multiplication of Employed population (**Employment**) and **Labor's Productivity**. The number of Employed population is counted endogenously in the model, and the **Labor's Productivity** is based on calculations of the Production function and is equal to (1). The **Capital:Labor ratio** is an exogenous variable, and the level of technology is calculated from production function, and is changing by exogenous rate of rising. Compliance of the built GDP and real data shown in Figure 9.

The changing of Nominal wages in the model depends on price index and level of unemployment, because, in cases of lower employment, employers pay more money to their employees. Adequacy of the equation of describing the formation of wages in real life is shown in figure 10.

The labor's income share in Ukraine is low in comparison with other countries. In 2015, this figure barely reached the mark of 0.5, while it varies between 0.6 - 0.65 in developed countries. The built system dynamics model allows conducting scenario



Fig. 10. The adequacy of simulated Nominal wages to real Nominal Wages data

Source: built by authors in iThink software

analysis, which will show how the situation on the labor market and in the economics will change with different values of labor’s income share, level of technology, and Capital to Labor Ratio. The results of the simulation showed that in spite of rising the Capital to Labor Ratio, the cumulative technology of capital is stable or even declining over time. It means that the part of innovative capital is very low.

The different scenarios for Technology level, Capital:Labor Ratio, and different labor’s income share, are listed in Table 1.

The results of scenario analysis are showed on the graphs below. The lines 1-4 accordingly represent scenarios 1-4. Scenarios 2-4 work from the period of 2008, and before this time the model uses

statistical data. The graphs on figure 11 show that the best scenario is when the labor’s income share is lower than 0,5 and Capital to Labor ratio and Technology are increasing. This result is caused by the fact that GDP is affected by productivity, and if the labor’s income share becomes very high, the productivity will decrease according to the equation of Cobb-Douglas function (as shown in Scenario 3, where labor’s income share is equal to 0,6). As a result, the GDP in 4th scenario is equal to 580 bln UAH in comparison with real 383 bln UAH. In the same time the increase in labor’s income share to 0,6 does not make any change in the end, which means that it makes sense to increase the labor’s income share only if the level of technology in capital is higher than in current state of economics.

Table 1. The Conditions of Scenario Analysis

Scenario Analysis				
	Technology	Capital: Labor Ratio	labor’s income share	Purpose
Scenario 1	historical change	historical change	historical change	No changes in Employment, GDP, Productivity and Nominal Wages
Scenario 2	+1% every year	increasing gradually with the rate from 1 to 1.03 in 7 years	historical change	The increasing in Capital:Labor Ratio will provide the chain raise in Cumulative Technology Level. According to equation, the productivity, GDP, and the wages will rise in spite of the fact that labor’s income share is not changing
Scenario 3	+1% every year	increasing gradually with the rate from 1 to 1.03 in 7 years	0.6	The technology and capital rise as in scenario 2. The rise in labor’s income share should increase the Nominal wages. But according to the formula the labor’s income share has negative influence on labor’s productivity, which can cause decrease in GDP
Scenario 4	+1% every year	increasing gradually with the rate from 1 to 1.03 in 7 years	0.4	The technology and capital rise as in scenario 2. The labor’s income share is lower than historical data. It means that the share of Nominal wages in GDP will become lower, but productivity will rise, so GDP will also rise

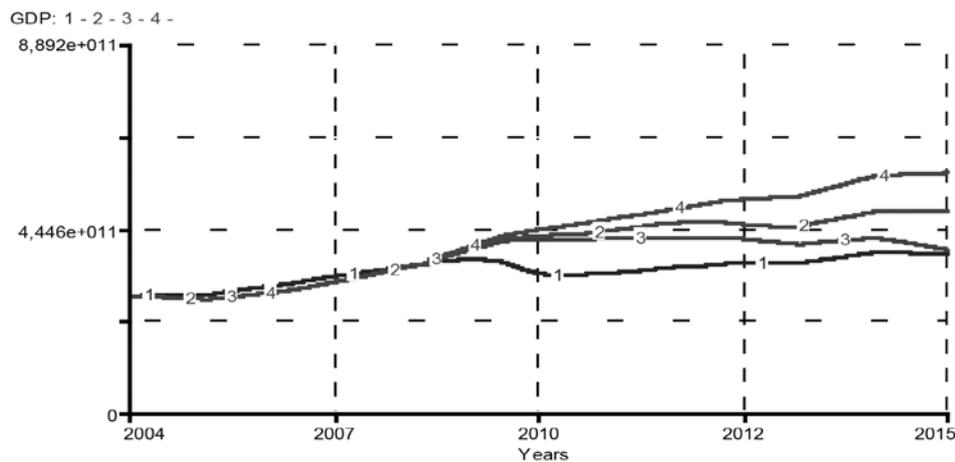


Fig. 11. The GDP formation according to the changes in technology level and labor's income share

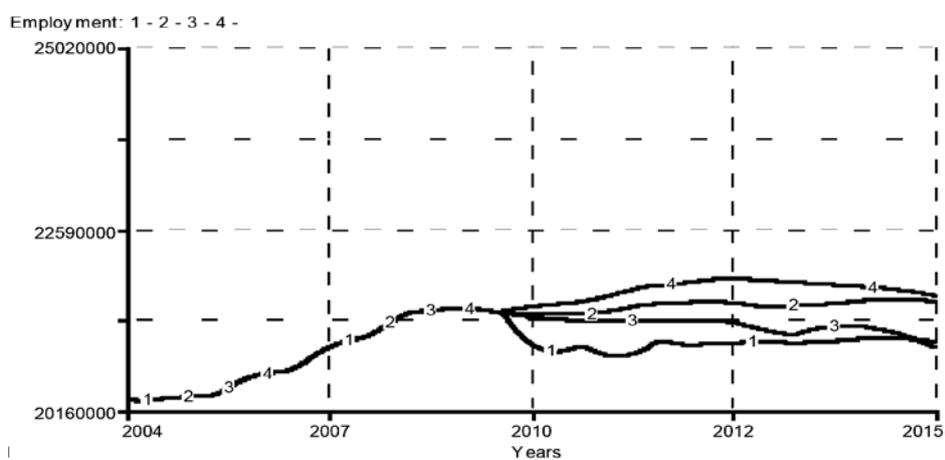


Fig. 12. The formation of Employment depending on technology level, Capital:Labor Ratio and labor's income share

The importance of increasing the productivity and as a result GDP, is that the Employment will also rise. The higher the technologies and productivity – the better product economics can produce. It means that the demand for Ukrainian production will grow and the need for labor will increase. The better scenario for employment is also the 4th, or the 2d if the labor's income share stays the same level as statistical data. The 3d scenario is possible only if the level of technology in capital and as a result Capital:Labor Ratio will grow faster than 1 % a year.

Conclusions and further research proposals

The effective functioning of the labor market is important for the stabilization of macroeconomic situation and for reducing social tension in society. The high attention should be paid to the reducing of unemployment among young people and to the increasing of labor's productivity. The productive employment is one of the primary conditions for the solution of problems of the human labor potential, creativity, and talent implementation, and growth of the economy as the basis for social development. In most European countries, productive employ-

ment is the top priority of social and economic policy and fundamental basis of European integration. The study showed that the main negative issues for Ukrainian labor market are reduce the number of economically active population, a high proportion of youth unemployment in total unemployment, low wages caused by the low level of technology in capital and as a result, low labor's productivity, which can cause the outflow of labor abroad, or employment in non-official sector of economics.

On the basis of the Ukrainian market simulation model was performed the scenario analysis, which revealed the basic tools for labor market development, and allowed to quantify the impact of major labor market indicators on macroeconomic stabilization of the Ukrainian economy, for example, the share of wages in production costs and the level of technology and capital to labor ratio in terms of GDP and Employment.

Further researches in this direction can be problems determining the duration of unemployment and the impact assessment of wage flexibility on labor productivity, the improvement of the model in the part of the determination of the technology level, and removing restrictions about the rigidity of wages.

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ДОСЛІДЖЕННЯ РИНКУ ПРАЦІ УКРАЇНИ ЗА ДОПОМОГОЮ МЕТОДІВ СИСТЕМНОЇ ДИНАМІКИ

Проведено дослідження сучасного стану ринку праці України з позиції системного аналізу, визначено взаємозв'язки між основними макроекономічними показниками та показниками, що характеризують стан ринку праці. За допомогою імітаційного моделювання розроблено модель механізму формування попиту та пропозиції робочої сили в Україні, проведено сценарний аналіз можливих перспектив розвитку ринку праці України за різних початкових умов та припущень, а також його впливу на макроекономічну стабілізацію.

Ключові слова: робоча сила, ринок праці, зайнятість, безробіття, імітаційна модель, системна динаміка.

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