Simulation of the Influence of Price Control Mechanism on Financial Flows Formation in the Macroeconomic System

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Abstract[1]

The article shows the features of the influence of price control mechanism of the goods market on the financial flows regarding the labour market. The cognitive model of the macroeconomic system regarding goods and labour markets is presented. The dynamic model of the labour market is included into the dynamic model of the macroeconomic system. The survey results for controlled and uncontrolled scenarios considering prformance of the macroeconomic system are discussed.

1. Introduction

Interest to the problems in the field of employment has sharply increased in the conditions of the global economic crisis. In this respect system research of non-balanced processes on macroeconomic labour market are held [1, 2]. The research is aimed, firstly, on the analysis of non-balanced processes arising in macroeconomic labour market functioning and, secondly, on the analysis of its influence on the price control mechanism of the goods market that consequently influence the dynamics of income and expenses formation in the system of macroeconomic turnover of financial flows.

The article presents the solution of the problem of cognitive and dynamic models development. The models are connected with macroeconomic system functioning in non-balanced conditions of goods and labour markets interaction. The article provides the survey of the dynamics of interconnected change of price and wage

levels in the system of macroeconomic turnover of financial flows.

The solution of the abovementioned problems is based on the conception of the system simulation and dynamic models of the reproduction process of the macroeconomic system developed earlier. The reproduction process in this context represents macroeconomic turnover of the financial flows.

2. The cognitive model of the macroeconomic system functioning under conditions of goods and labour markets

The cognitive model of the macroeconomic turnover developed earlier consists of four concepts namely macroeconomic agents which are real sector, households sector, financial sector and government sector. The connections in the model are defined as financial flows (solid lines).

Dynamic interrelation of the macroeconomic agents is supported by formation of the financial flows of different rate and direction. The flows form income and expenses of the macroeconomic agents. Apart from the financial flows the model involves information connections (dashed lines). The type of the connections is connected with the stocks. Each macroeconomic agent possesses the stock of the financial resources (shaded area of the concept). The information about the accumulated stocks is involved in control of the macroeconomic agent [3].

The conceptual framework of the system modeling and research of the labour market are the following.

1. Simulation and analysis of the labour market functioning is held on the basis of the Keynesian conception of employment regarding contemporary labour market theories [4].
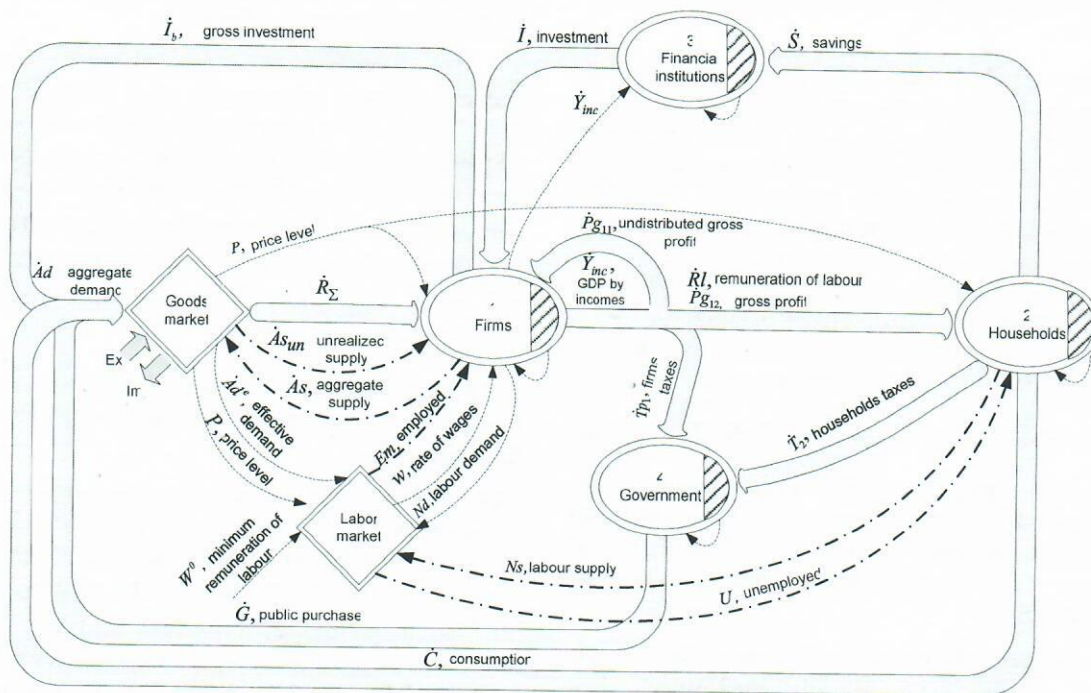
Fig. 1. The cognitive model of the macroeconomic system functioning regarding the goods and labour markets

2. Labour market functioning and the main characteristics such as demand, supply and wage rates are considered in dynamics and on non-balanced modes. The cognitive and dynamic models of the labour market functioning are included into the corresponding models of the macroeconomic system functioning regarding the goods market [5].

3. The labour market is the macroeconomic market formed as the result of the integration of the microeconomic labour markets. The aim of the integration is to reveal the main rules of the interactions of the demand for labour Nd and labour supply Ns and formation of the wage rates w.

4. The demand for labour Nd is the amount of labour resources that can be employed in order to produce gross domestic product at each possible wage rate [6]. The demand for labour Nd is a function of the real wage rates w, non-price determinant ΔNd_{nw} and time: $Nd = f(w, \Delta Nd_{nw}, t)$. The non-price determinants for labour are changes of the aggregate demand, labour productivity and other resources prices. The demand for labour Nd by nature is the stock. The demand for labour Nd is determined by the cost of marginal product of labour and according to the Keynesian theory is the derivative from the aggregate demand [6].

The cognitive model of the macroeconomic system functioning regarding the goods and labour markets shows the demand for labour Nd as an information connection (fig. 1).

5. The labour supply Ns is the amount of the labour resources that consent to participate in the production of the gross domestic product at each possible wage rates ceteris paribus. The labour supply is a function of the real wage rate w, the set of non-price determinants ΔNs_{nw} and time: $Ns = f(w, \Delta Ns_{nw}, t)$. Non-price determinants of labour supply include the prices level, money illusions associated with the assessment of the impact of price level growth on the real wage rate [4].

According to previously adopted assumptions only financial flows are simulated. The flows of goods of equal value and opposite direction are not considered. Thus, the cognitive model reflects the labour supply Ns and aggregate supply $\dot{As}$ (material flow) in the form of a special information communication (dash-dotted line). It should be noted that the labour supply is a reserve. The kind of reserve that is difficult to refill in the form of human capital.

6. Macroeconomic markets can be either in balanced or non-balanced states. The balanced state is characterized by equal values of the supply and demand. The conditions are idealized; achievement in reality is not possible. However, the notion of the balanced state is used in the study of trends in the processes on the set of non-balanced states. Such macroeconomic markets as goods market and money market are characterized by the self-regulation mechanism of supply and demand. For example, the goods market is characterized by the self-regulation mechanism of the rates of the material goods flow (aggregate supply) and the financial flow (aggregate

demand). The price level is the regulator aimed to restore the balance.

The labour market unlike the goods market is an exception. According to Keynes it is not based on the self-regulation mechanism [4, 6–8]. The labour market has no forces that balance the labour demand and labour supply. Therefore, the labour market is in sustainable non-balance state. It should be noted that labour supply as a rule exceeds over the labour demand: $Ns>Nd$. Ns is the amount of economically active population, Nd is the number of employed. The difference between the values mentioned is evaluated in percentage to the economically active population and determines the level of unemployment U: $U = \dfrac{Ns - Nd}{Ns} * 100\%$ [7]. Thus, the non-balanced states of the labour market are characterized by unemployment. Such states stable and correspond to the state of "quasi-equilibrium". Quasi-equilibrium does not prevent the other markets from being balanced.

7. The number of non-balanced states assumes the existence of the state of full employment. Full employment includes unemployment on the natural level Un: $U=Un$.

Natural unemployment consists of frictional and structural unemployment. The frictional unemployment is connected with the time lag in the objective processes of the mutual search of the employees required and the employers appropriate. The structural unemployment is determined by the variance in the structures of the labour demand and labour supply. The level of natural unemployment Un in different countries varies from 3 to 11 per sent [8]. The level of natural unemployment is of great significance from the point of the macroeconomic regulation. The reason is that decision making in the labour market regulation aimed on employment increase in the situation of the natural unemployment is not required. It can be explained by the fact that natural unemployment is considered as the reserve, the stock of the human resources that is required for the economics to provide reaction flexibility in solving different problems.

In the conditions of the full employment (at the level of natural employment) production of the gross domestic product (GDP) is on the potential level $\dot{Y}^*$. It should be mentioned that the potential GDP is the amount of the product that can be produced during the fixed period (rate) in conditions of the full usage of the resources (human and capital). The situation when the employment is below the natural level is defined as excessive employment. The excessive employment takes place in the situation of economics "overheating". The situation when the employment is above the natural level is considered as the situation of underemployment and is conducted with cyclical unemployment. In this case GDP is below the potential level. The decisions directed on the

increase of the GDP production rate and on the decrease of unemployment are to be made.

8. The number of non-balanced states of underemployment assumes the state of basic balanced state. The basic balanced state of the macroeconomic system is characterized by balanced goods market and quasi-equilibrium conditions of the labour market. The notion of the effective demand is used $\dot{Ad}^e$. The notion was developed by Keynes to define aggregate demand $\dot{Ad}$ when it is equal to the aggregate supply $\dot{As}$: $\dot{Ad} = \dot{As} = \dot{Ad}^e$ [4].

9. The characteristics of the dynamics of the interrelated functioning of the goods and labour markets are the following.

First, the goods market is the main influence on the labour market and is the reason of its changes. That is connected with the formation of the labour demand Nd. The labour demand depends on the effective demand $\dot{Ad}^e$ on the goods market. Besides, the labour market is influenced by the price level from the goods market. The price level P is the information that indicates about the decrease of the real wage rate w in the conditions of inflexibility of the nominal wage rate W: $w=W/P$.

The features of the response of the labour market to the conditions on the goods market are the delay and time lag in the change of labour demand as a result of a change in aggregate demand. Theoretical propositions of the Keynesian theory are that the labour market creates a "response" to changes of the goods market conditions only when the goods market is approximate to a new balanced state, to a new value of effective demand. $\dot{Ad}^e$. In the initial period of the disturbances on the goods market (in the form of shocks in aggregate demand or aggregate supply), when the macroeconomic system is non-balanced and is far from a new balanced state (the mismatch between supply and demand is large), labour market can not form a reaction. A kind of hysteresis effect occurs due to the manufacturers inability identify new needs in the workforce Nd, corresponding to a new future balanced demand.

The number of employed Em and unemployed Un are determined as a result of interactions of the labour demand Nd and labour supply Ns. The cognitive model shows the outlined relations as dashed lines (the information flows) and dash-dotted lines (the material flows) (fig. 1).

Second, the labour market influences the goods market indirectly through firms and households.

The labour market influence on the firms is information and is directed on the correction of the planed GDP on the basis of the information about the changes of the wage rate that characterize the future expenses. So, the wage rate increase leads to the increase of the expenses and to

the decrease of the aggregate supply. The decrease of the aggregate supply consequently leads to the additional influence on the goods market and inevitably influences financial income and expenses flows of all macroeconomic agents that form the financial flows turnover.

The labour market influence on the households includes change of the available income and consequently of the households stocks. In other words, the households react to the changes in the labour market by changes of the financial income flows, the financial stocks and the financial expenses on the consumption that influences aggregate demand on the goods market.

2. The flow diagram of the dynamic models of the macroeconomic system functioning under the conditions of goods and labour markets

The flow diagram of the dynamic model of the macroeconomic system functioning under the conditions of goods and labour markets (fig.2) shows six models. The models are connected by the flow (solid lines) and information (dashed lines) connections.

The first four models describe the macroeconomic agents: firms, households, financial institutions and government. The detailed description of the features of each agent and connections between them is given in [3].

Model A5 describes the goods market and consists of two blocks. The blocks form the dynamic price level $P(t)$ on the basis of the information about the aggregate demand and aggregate supply [5]. Model A6 describes the labour market and forms the demand for labour Nd on the basis of the information about the marginal labour productivity

$\dot{Y}'_N = \dfrac{d\dot{Y}}{dN}$. Besides, the model forms the labour supply Ns on the basis of the information about the amount of economically active population N_a and the nominal wage rate W^0. The nominal wage rate corresponds to the basic balanced state.

The natural unemployment Un is used to determine the excess of the current level of unemployment U over the natural. The financial flow of the remuneration for labour is formed in the process of the distribution of the GDP. The flow mentioned is corrected by the coefficient k_{rlc}. The coefficient is determined by the variable wage rate w.

The flow diagram of the dynamic model A6 describes the labour market (fig.3). The diagram consists of six dynamic submodels that are connected by the information connections. The connections are presented as solid lines.

Model A61 forms the sloping section of the curve of the demand for labour. Model A62 determines the effective employment N^e. The effective employment determines the limit of the demand for labour (the vertical section of the curve of the demand for labour). Model A63 forms the labour supply Ns and the current wage rate. The constructed segments of the curve of the demand for labour are the basis for the model A64. The model forms the common dependence of the demand for labour $Nd = f(w, \Delta Nd_{nw}, t)$. Model A64 also determines the employment rate Nd on the basis of the labour supply Ns and current wage rate W. Model A65 determines the coefficient of the correction of the remuneration for labour rate k_{rlc}. Model A66 determines the current level of unemployment U regarding the natural unemployment Un.
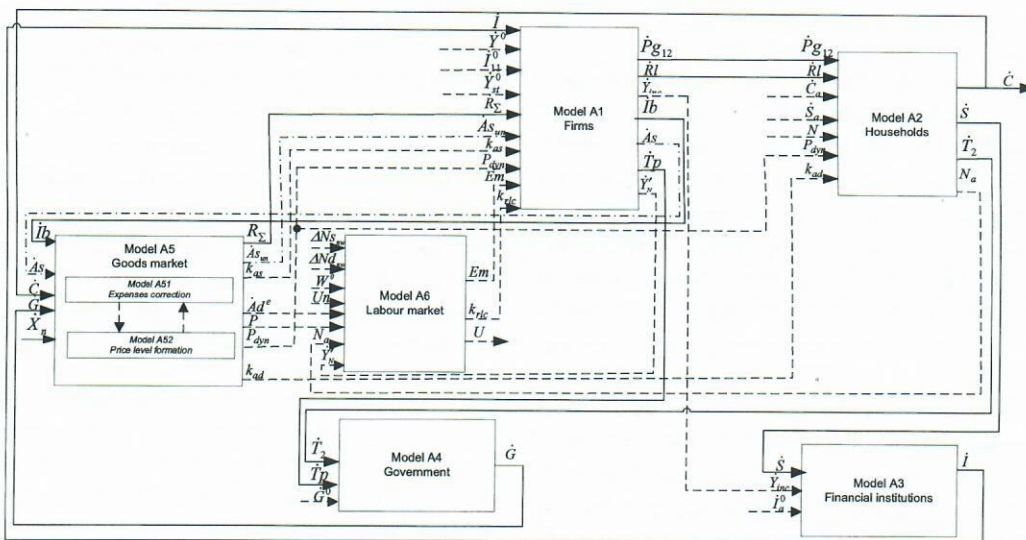

Fig. 2. The flow diagram of the dynamic model of the macroeconomic system functioning under the conditions of goods and labour markets
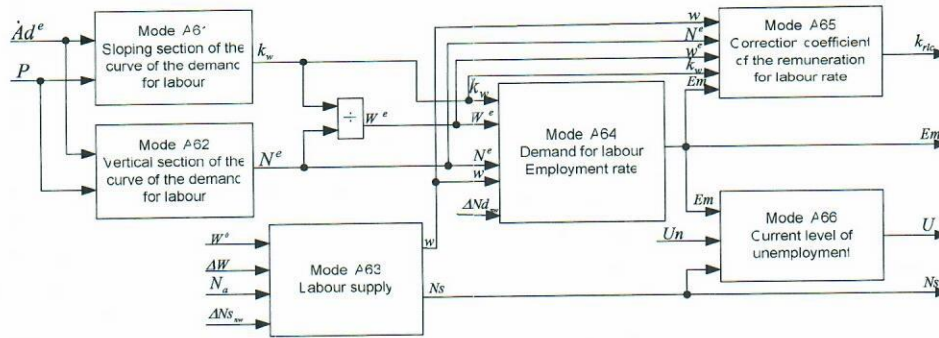
Fig. 3. The flow diagram of the dynamic model of the labour market

3. Survey of the dynamics of the macroeconomic financial flows turnover regarding non-balanced conditions of the labour market

Survey performed on the basis of the developed models reflects the influence of the non-balanced conditions of the labour market on the macroeconomic financial flows turnover. The results of the survey are presented in fig.4.

A month is determined as the unit of model time. Simulation is carried out for the medium term. Simulation time is 80 months. The following initial values of the planned rate of resources consumption are established: aggregate supply $\dot{A}s^0(t) = 10$; autonomous consumption $\dot{C}^0_a(t) = 2$; autonomous savings $\dot{S}_a(t) = 1,5$; autonomous investments $\dot{I}^0_a(t) = 0,5$; public purchase $\dot{G}^0(t) = 3$. The GDP is distributed regarding the following formation coefficients of: wages $k_{rl} = 0,4$, gross profit $k_{pg} = 0,4$, tax $k_t = 0,2$.

Scenario 1 is uncontrollable. At time t=14 flow disturbances in the household sector as a reduction in the rate of formation of autonomous consumption is assumed $\Delta\dot{C}_a(t) = -1$. The rate of consumption formation as a component of the formation rate of aggregate demand reduces the latter. As a result, firstly, is the reaction of the goods market. The reaction is non-balanced situation when aggregate supply exceeds aggregate demand ($\dot{A}s > \dot{A}d$). In such case the firms generate surplus products in the form of stock. The presented non-balanced situation causes the goods prices decrease at t=14,5. This leads to a reduction in production volume (aggregate supply $\dot{A}s$) at t=15. As a consequence tax revenues from firms reduce. The labour market is the last to respond on the changed formation rate of the aggregate demand. The formation rate of the aggregate supply decreased and, consequently, the number of jobs decreased. This case is equivalent to a sharp drop of the demand in the labour market at t=16 and the simultaneous

rise of unemployment U. It should be mentioned that the value of the demand for labour influences the planned rate of goods production by the firms. By the time t=32 balance in the goods market restores, though at a lower level. The balance value of the aggregate demand and aggregate supply is the value of the effective demand $\dot{Y}^e$.

The lower value of effective demand $\dot{Y}^e$ reduces the number of the employed workers required to supply it N^e. The interconnected changes in the formation rate of the aggregate demand in the labour market and the number of workers required to supply the effective demand reduce the minimum real wage rate. A significant reduction in the tax revenues from the firms and the households resulted in that the government constantly spends the stocks and at t=60 is forced to reduce the value of public purchases. This case leads to the considerable reduction of the stocks of all sectors excepting the financial institutions.

Scenario 2 is controlled. Control is to provide additional investment to the firms from the financial institutions at t=40. Increased investment by the financial institutions leads to an increase in gross investments, which are the component of the aggregate demand. Consequently, the formation rate of the aggregate demand $\dot{A}d$ increases. The increase in the formation rate of the aggregate demand leads to the goods market reaction as the price increase as a result of the deficit ($\dot{A}d > \dot{A}s$). The firms increased production. Thus increased the demand for labour Nd and reduced unemployment. Increased demand leads to the increase the households' income in the form of the salary and, consequently, increased taxes paid to the government. The tax value to the government also increases from the firms. The growth is explained by the increased production rates. Thus, the government keeps the value of the public purchase at the required level. However, the increase of prices on the goods market leads to the decrease in real income. This results in the reduction of the households' consumption. This case causes the interrelated decline of the aggregate demand, aggregate supply, demand for labour and increase of unemployment. As a result of the

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interconnected changes in the behavior of the sectors of the macroeconomic system the establishment of general macroeconomic balance at the initial level is observed. The decision making in the form of the additional investments by the financial institutions to the firms has favourably affected the behaviour of the entire macroeconomic system avoiding falling GDP.

Scenario 3 is controlled. At t=45 the disturbance in the form of the increase of the wage rate W is provided to the labour market. In this case, the firms are forced to increase expenses and reduce the demand for labour. That entails increased unemployment. However, a positive effect in the form of the revenue growth of the employed.
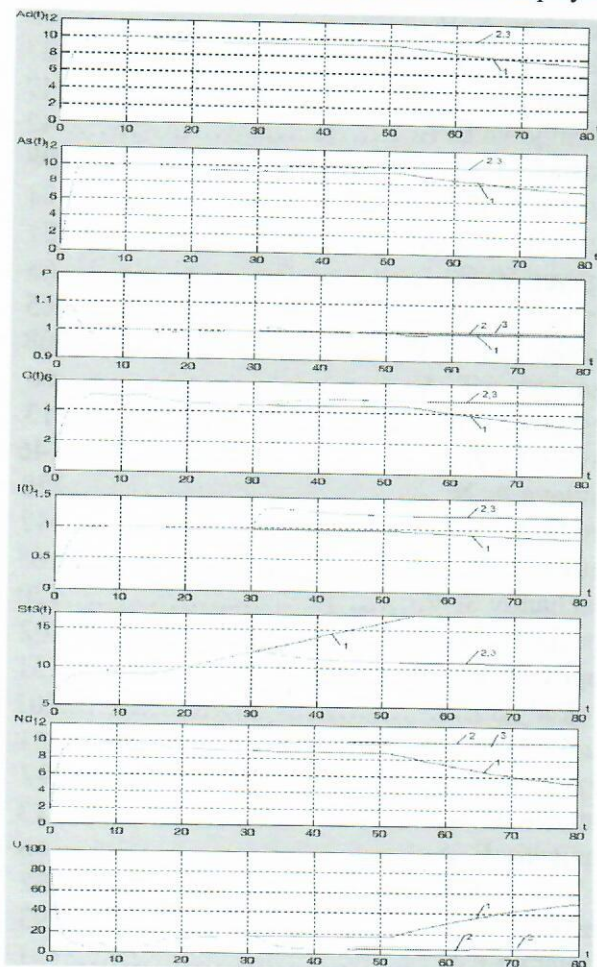

Fig.4. Survey of the firms, households, financial institutions and labour market

4. Conclusion

- The cognitive model of the macroeconomic system regarding the goods and labor markets is suggested. The model reflects the influence of the markets on the formation of the macroeconomic financial flows turnover. The role of the labour market in the macroeconomic system is the following. First, the labour market corrects the planned GDP rate on the basis of the information about the change in the wage rate. Second, the labour market corrects the current remuneration for labour rate in the process of the GDP distribution. Non-balanced conditions on the labour market are determined by the interrelated changes of the aggregate demand and supply on the goods market.

- The dynamic model of the labour market is to determine the features of the influence of non-balanced conditions of the labour market on the dynamic of the macroeconomic financial flows turnover.

- The survey showed the mutual influence of the income and expenses dynamics of the macroeconomic agents on the non-balanced conditions of the labour market. The controlled scenarios showed the possibility to decrease unemployment and increase the households' income as a result of the decisions to increase the components of the aggregate demand under the influence of the investments increase.

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