MODEL OF IMPACT OF HOUSEHOLD ASSETS ON LABOR PRICE: EUROPEAN EXPERIENCE

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ABSTRACT

This article deals with existing models of household behavior, based on the assumption of the possibility of employees to determine their own level of consumption and employment, depending on a given wage rate and accumulated assets. An alternative view is offered that the wage rate accepted by employees can be expressed through financial assets and employment. Based on this assumption, the model "financial assets – labor price" was developed, determining the impact of the volume of financial assets of households and the level of employment on the wage rate, the minimum acceptable for workers.

The model was tested in twelve European countries. The calculations confirmed the basic hypothesis of the study, namely the dependence of the level of wages on the volume of available assets and employment.

Keywords: wage rate, labor supply price function, employment rate, financial assets of households

PROBLEM DEFINITION

The mechanism of the labor market functioning can be described by means of different models, but all of them should be based on the theory of the interaction of supply and demand. Most often the models describing household behavior are based on the assumption that workers have the ability to set their own level of consumption and employment, depending on the amount of wages and accumulated assets. On the other hand, the wage rate at which employees agree to work can be expressed as a function of their financial assets and employment level.

ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

In many works, the function of labor supply is obtained as an optimal solution to the model of the household behavior. In the case of an

infinite lifetime, the behavior of the household is described by the utility function and the corresponding hourly budget constraint (1, 2):

$$U = \sum_{t=0}^{\infty} \beta^t u_t(c_t, l_t) \qquad (1)$$

$$c_t + a_{t+1} = (1+r)a_t + w_t l_t \qquad (2)$$

where t is the number of the time period, β is the discount multiplier ($0 < \beta < 1$), c is consumption, l is labor supply, a is household assets r, w is real interest rates and wages (Daolu, 2010). One example of the utility function is the additive function used in the paper of Gallen (2018):

$$u(c,l) = \log c - \alpha \frac{l^{1+\frac{1}{\phi}}}{1+\frac{1}{\phi}} \qquad (3)$$

with parameters α and ϕ (coefficient of Frisch elasticity) (Gallen, 2018).

Examples of some utility functions are given in article of Swanson (2018):

$$u(c,l) = \frac{\left[c^{\sigma}(1-l)^{1-\sigma}\right]^{1-\gamma}}{1-\gamma} \qquad (4)$$

according to Van Binsbergen, et al. (2012);

$$u(c,l) = \frac{c^{1-\gamma}}{1-\gamma} - \alpha \frac{l^{1+\sigma}}{1+\sigma} \qquad (5)$$

according to Rudebush and Swanson (2012)

$$u(c,l) = \frac{1}{1+\xi}\log c + \frac{\xi}{1+\xi}\log(\bar{l}-l) \quad (6)$$

according to Talarini (2000), where σ, γ, α, ξ are the function parameters.

A proper example of an additive utility function is given by Wickens (7):

$$u(c,l) = \frac{c^{1-\gamma}-1}{1-\gamma} + \ln(1-l) \qquad (7)$$

For the function of consumption type

$$c_t = w_t l_t + \bar{y}_t + ra_t \qquad (8)$$

where $\bar{y}_t$ is an exogenous income, labor supply determined by the equation (9) (Wickens, 2008):

$$l_t = 1 - \frac{c_t^{\gamma}}{w_t} \qquad (9)$$

A classical article by Prescott "Why Americans work much more than Europeans?" the following utility function is used (10):

$$U = \sum_{t=0}^{\infty} \beta^t \left(\log c_t + \alpha \log(100 - h_t)\right) \quad 10)$$

where h is the number of hours of labor offered on the market by one employee, 100 is the total amount of working time per week (including labor outside the market), α is a parameter. The Prescott model describes a typical firm by the Cob-Douglas production function (11):

$$y_t = A_t k_t^{\theta} h_t^{1-\theta} \qquad (11)$$

where k is the capital, θ is its share ($0 < \theta < 1$) in output A_t is the total productivity in the period t. The inter-temporal budget constraint in this model takes the form (12):

$$(1+\tau_c)c_t + (1+\tau_x)x_t = (1-\tau_h)w_t h_t + (1-\tau_k)(r_t-\delta)k_t + \delta k_t + T_t \qquad (12)$$

where w is a real wage, r is a rate-rental, δ is a rate-depreciation rate (disposal) of capital, x is investments, T is transfers, τ_c, τ_x, τ_h, τ_k are tax rates. According to this model, the author receives a key ratio (13), (Prescott, 2004):

$$h_t = \frac{1-\theta}{1-\theta + \frac{c_t}{y_t} \cdot \frac{\alpha}{1-\tau_t}} \qquad (13)$$

where $\tau = \frac{\tau_h + \tau_c}{1+\tau_c}$. Restuccia, and Vandenbroucke included parameter $\bar{c}$ into the utility function that is a subsistence minimum (Restuccia and Vandenbroucke, 2014). The authors of another study believe such a modification to be a key one, as it assumes dominance of the income effect over the substitution effect [11, p. 195]. In their study,

they used the following household utility function (14):

$$U = \sum_{t=0}^{\infty} \beta^t \left(\log(c_t - \bar{c}) - \alpha \frac{h_t^{1+\frac{1}{\phi}}}{1+\frac{1}{\phi}} \right) \quad (14)$$

Assuming that the household has a standard inter-temporal budget constraint and the output of a company is described by the Cobb-Douglas function with a share of capital θ, the authors determined the optimal number of hours worked (15):

$$h_t = \left(\frac{1-\theta}{\alpha \left(\frac{c_t}{y_t} - \frac{\bar{c}}{y_t} \right)} \right)^{\frac{\phi}{1+\phi}} \quad (15)$$

Analyzing data for many countries, Bick, Fush-Schundeln and Lagakos show that the average length of the working week is significantly higher in countries with the low income (Bick, Fuchs-Schündeln, & Lagakos, 2018).

Engler and Tervala (2018) include a real money supply into the utility function. In a somewhat simplified form, this function is described by the following equation (16):

$$U_t = \sum_{t=0}^{\infty} \beta^t \left(\log C_t + \frac{\chi}{1-\varepsilon} \left(\frac{M_t}{P_t} \right)^{1-\varepsilon} - \frac{l_t^{1+\frac{1}{\phi}}}{1+\frac{1}{\phi}} \right)$$

$$(16)$$

where C, P are the indices of consumption and of consumer prices, M is the nominal money supply, l is the labor supply, and $\chi\ \varepsilon$ are positive parameters. The offered budget constraint has the form of (17):

$$M_t + D_t = (1+i_{t-1})D_{t-1} + M_{t-1} + w_t l_t - P_t C_t + \pi_t + P_t T_t$$

$$(17)$$

where D are bonds; i, w are nominal interest rates and wages, π are the nominal income, T is the real value of government transfers. Hence,

the authors obtain the optimal values of consumption, labor supply and demand for money for a given household (18-20):

$$P_{t+1}C_{t+1} = \beta(1+i_t)P_t C_t \quad (18)$$

$$l_t = \left(\frac{w_t}{C_t P_t} \right)^{\phi} \quad (19)$$

$$\frac{M_t}{P_t} = \left(\chi C_t \frac{1+i_t}{i_t} \right)^{\frac{1}{\varepsilon}} \quad (20)$$

Michaud considers information factors of total unemployment, in particular, the speed of experience acquisition by current employers (Speed of Employee Learning) and the speed of information dissemination for potential employers (Speed of Diffusion of Information to Potential Employees) (Michaud, 2018).

This article deals with the existing models of household behavior based on the assumption of the possibility of employees to determine their own level of consumption and employment, depending on a given wage rate and accumulated assets. However, the very wage rate which workers accept can be seen as a function of their financial assets and employment. In this case, the wage rate is defined as the price of labor supply that depends on other variables. According to the theoretical tradition, the proposed model will be called the function "financial assets – labor supply price" (FA–LSP function). The proposed function complements the existing models and presents the able-bodied population as an active participant in the process of forming the market wage rate.

FORMULATION OF OBJECTIVES FOR THE ARTICLE

The aim of this study is to simulate the impact of household financial assets and employment on the minimum wage rate acceptable to workers. To achieve this goal, the following tasks were set:

- to determine the simplest analytical form of the function FA - LSP, satisfying certain theoretical requirements;
- to justify the conditions of application of the proposed function;

- to represent the function of FA–LSP in the form of econometric equations and to define its parameters.

From a theoretical point of view, there should be a link between the wage rate and the level of employment. This relationship can be described by an equation that must meet certain requirements. First, the number of employed persons cannot exceed the total working-age population. Secondly, there should be a negative relationship between the wage rate and the unemployment rate. Third, both parts of the equation must have the same dimension.

The simplest equation meeting these requirements is as follows (21):

$$\tau W\left(L_{\max} - L\right) = M \qquad (21)$$

where W is the average level of the nominal wage rate, $L_{\max}$ is the total value of the labor pool, L is the number of employed, M is the nominal value of household assets that can be converted into money (or already have money) τ is a constant having the dimension of time and characterizing a certain period during which workers can live in absolute unemployment ($L = 0$) at the expense of assets. According to this equation, the change in the price level does not affect the behavior of employees, as it proportionally changes the real wage rate and the real value of assets.

This equation can be considered in two ways. On the one hand, it determines the value of labor supply (22):

$$L_S = L_{\max} - \frac{M}{\tau W} \qquad (22)$$

From an economic point of view, this function describes a situation where employees cannot influence the formation of the wage rate. In this case, the increase in wages is likely to devalue the existing assets, therefore to increase them workers will work more. As assets accumulate, the existing wage rate will be perceived to be relatively lower and the supply of labor will decrease.

On the other hand, the proposed equation defines the function of labor supply price (23):

$$W_S = \frac{M}{\tau\left(L_{\max} - L\right)} \Rightarrow W_S = W_{\min} \cdot \frac{1}{1-l} \qquad (23)$$

where $W_{\min}$ is the lowest level of the wage rate (at $L = 0$), and l is the level of employment equal to $L / L_{\max}$. This function describes a situation where the formation of wages is determined by the struggle of workers and employers, and the number of employed clearly depends on the demand for the firm products.

Let us assume it in an idealized form. Suppose that workers require employers to pay a premium in $W_{\min}$ proportion to the level of employment. Thus, having received such allowance, they begin to demand an increase to this very allowance and so on, indefinitely. As a result, the process of forming the wage rate will take the form (24):

$$W / W_{\min} = 1 + l \cdot \left(1 + l\left(1 + l...\right)\right) = 1 + l + l^2 + l^3 = 1/\left(1-l\right) \qquad (24)$$

Let us now consider how the change in supply and demand will affect the wage rate and employment. For convenience, we present the proposed equation in the form of

$$\tau W\left(1 - l\right) = m \qquad (25)$$

where $m = M / L_{\max}$ is the amount of financial assets per labor pool.

If the wage rate and the level of employment are absolutely flexible, the labor market will permanently remain in a state of equilibrium. In this case, the change in demand for labor means a movement along the supply curve, which will be expressed in a positive correlation between W and l and no correlation with m .

The impact of changes in labor supply will depend on the nature of labor demand. In the case where production is described by the Leontief function, the demand for labor is absolutely inelastic. Between W and m there will be a positive correlation, and with l the correlation will be absent. If the production function can interchange production factors, the demand for labor is elastic in the wage rate. Then, due to the movement along the curve of

labor demand, the coefficients of the general correlation are supposed to have the following signs: $r_{Wl} < 0, r_{ml} < 0, r_{mW} > 0$.

Even more difficult situations are likely to arise in cases of inflexibility of the wage rate and the level of employment. Supply or demand shocks will make the labor market non-equilibrium. The nature of the rebalancing process will depend on the type of inflexibility and shock.

So, in the case of inflexibility of the wage rate, a reduction in demand for labor or a fall in the level m is certain to create unemployment expectations (wait unemployment). The number of employees hired will be determined by firms and therefore the market equilibrium will be restored in the process of moving along the labor demand curve ($r_{Wl} < 0$). On the contrary, an increase in the demand for labor or an increase in the level m creates a shortage of labor. The level of employment will be determined by households. As a result, the balance will be restored by moving along the curve of labor supply   ($r_{Wl} > 0$). In both cases, the direction and rate of rebalancing will depend on the difference in supply and demand ($L_D - L_S$), which will generate the Phillips curve.

It is clear that with the simultaneous change in both the value m and the demand for labor (and hence the value l), the signs of the coefficients of the general correlation can be different. In order to highlight the impact of W financial assets it is necessary to calculate the corresponding coefficient of partial correlation – $r_{mW|l}$.

If employment is inflexible, an increase in the demand for labor or a fall in the level m will lead to an excess of the price of demand for labor over the price of its supply ($W_D > W_S$). The actual wage rate will fluctuate within these limits, and the employment rate will rise. In case of a fall in demand for labor or the increase m employment will be reduced. However, this will occur as a result of a social conflict, since the problem of exceeding the price of labor

supply over the price of demand cannot be solved by purely market means.

From the above reasoning it follows that the function $W_S(m,l)$ itself will better describe the labor market of a particular country in two cases: 1) if the labor market is permanently in equilibrium; or 2) the wage rate is not sufficiently flexible and there is a labor shortage in the market. Given the direction of migration flows to developed countries, it can be assumed that the second case is being implemented in the long term.

The current state of developed countries is characterized by an increasing spread of populism and activity of trade unions. Therefore, of the two possible forms of the equation of workers ' behavior, it is logical to use the function of a labor supply price $W_S = W_S(m,l)$. However, its original form is too simplistic. Since $1/(1-l)$ is a dimensionless quantity, it can be brought to a power, resulting in a modified function (26):

$$W = \frac{M}{\tau L_{\max}} \cdot \left(\frac{1}{1-l}\right)^{\alpha} \tag{26}$$

where α is a dimensionless constant. For this function, the employment elasticity coefficient is:

$$\varepsilon_l = \frac{\partial \ln W}{\partial \ln l} = \alpha \cdot \frac{l}{1-l} \tag{27}$$

The average wage rate is an estimated value that can be represented as (28)

$$W = \frac{\Phi}{L} \tag{28}$$

where Φ is the amount (Fund) of wages paid to employees for a certain period of time (in this case – for the year).

METHODOLOGY

We present the proposed econometric model as (29)

$$\frac{\varPhi}{L} = \frac{1}{\tau} \cdot \frac{M}{L_{\max}} \cdot \left(\frac{1}{1 - L/L_{\max}} \right)^{\alpha} \qquad (29)$$

where $\varPhi$ is the annual wage fund; M is the financial assets of households of the year; L, $L_{\max}$ are respectively, the number of employees and the size of the working population. Relevant publicly available statistic data were used to determine these endogenous values.

Wages and salaries stand for the wages fund F (wages and salaries are the sum of remuneration paid to employees, including the values of any social contributions, income taxes, etc.)., payable to employees (UNSTATS, 2008). Unfortunately, this value is too high compared to the original theoretical model, because it includes taxes that must be paid by workers.

Other model variables (L, $L_{\max}$ and M) also needed some adaptation to the available statistics.

From a theoretical point of view, the value $L_{\max}$ should cover the entire working-age population, regardless of age, and the level of employment $L/L_{\max}$ should be determined for full-time. In practice, individual workers work part-time (or a week), and only persons between the ages of 15 and 64 are included in the labor force. With this in mind l, the full-time equivalent employment rate, will be considered.

Given the availability of statistics, M the nominal value of household assets that can be converted into money can be expressed in two ways. According to the first, direct one, this amount can be considered as the sum of cash and deposits of the population of a certain country in the corresponding year (D). This represents financial assets used to make payments or that may be included in money, broadly defined, which consist of currency, transferable deposits and other deposits (OECD, 2018). According to the second method, instead of the absolute value of financial assets, the amount of their growth can be applied ΔM namely, the amount of net household savings for several years ($\sum S$). Net savings of

households are expressed by the value of Saving, net of households and non-profit institutions serving households (Eurostat, 2018). In this study, we will calculate their sum for the previous 5 years, namely: $\Delta M_t = \sum\limits_{n=1}^{5} S_{t-n}$.

The disadvantage of both methods is the use of data, which also includes the assets of the richest segments of the population, which often do not participate in the competition for jobs. The exclusion of rich assets would significantly increase the accuracy of the model, but the lack of statistics makes this impossible.

The source of statistical data on wages and salaries and saving, net is Eurostat, and the source of employment and currency and deposits is OECD.Stat

The analysis of the FA–LSP function was carried out in two stages. At the first stage, the coefficients of the general correlation between the values $W = \varPhi / L$ (annual wage fund per employed person), $m = M / L_{\max}$ (financial assets of households per 1 able – bodied person) and $l = L / L_{\max}$ (employment level) - r_{Wl}, r_{ml}, r_{mW}, and private correlation (30):

$$r_{mW|l} = \frac{r_{mW} - r_{ml}r_{Wl}}{\sqrt{\left(1 - r_{ml}^2\right)\left(1 - r_{Wl}^2\right)}} \qquad (30)$$

It was logical to exclude countries $r_{mW|l}$ which had a negative value or far from +1. This can be explained, firstly, by the fact that in the model itself there W is m , a directly proportional relationship between the quantities. Secondly, the coefficient of partial correlation excludes only linear changes caused by the influence of the third value, while the proposed model is essentially nonlinear.

In the second stage, the original function was reduced to the standard form, which allows using the usual method of least squares. Namely, after elementary transformations the following form of the proposed function is obtained (31):

$$\frac{\varPhi}{M} = \frac{l}{\tau} \cdot \left(\frac{1}{1-l} \right)^{\alpha} \qquad (31)$$

Having taken the logarithms of the resulting function it is written down in in a standard form (32):

$$y = a_0 + a_1 x \qquad (32)$$

where $y = \ln\left(\dfrac{\varPhi}{M}\right) - \ln l$, $x = \ln\left(\dfrac{1}{1-l}\right)$,

$a_0 = \ln\left(\dfrac{1}{\tau}\right)$, $a_1 = \alpha$. For the purposes of the model $a_1 > 0$, and a_0 can have any sign.

The Excel function: LINEST was used to calculate the model parameters. The LINEST function calculates the statistics for a line by using the least squares method to calculate a straight line that best fits your data, and then returns an array that describes the line. To assess the significance of the effect of the equation parameters on the resulting value, t, the statistics were calculated. The Excel functions: TINV and FDIST were used t to determine the critical value F-statistics and statistics, respectively.

PRESENTATION OF KEY RESEARCH FINDINGS

On the first stage of the study, the correlation coefficients of the values W were calculated, m and l for the European OECD countries. Calculations were made for both options of determining the amount of financial assets: 1) as the amount of net savings for 5 years ($M \equiv \sum S$) and 2) as the amount of cash and deposits ($M \equiv D$). On the second stage of the study, the parameters of the model a_0 and a_1 ($a_1 \equiv \alpha$) were determined. In both cases, the quality of the model was significantly improved in the absence of a free term ($a_0 = 0$) and, accordingly, the value of the output factor 1 ($\tau = 1$).

Table 1: Parameters and indicators of statistical significance of the model

Country/ Indicator	Partial correlation coefficient $r_{mW|l}$	Coefficient value α	Determination coefficient (R^2)	F-statistics	Critical level F	Statistical significance (t)	The critical value of an indicator of statistical significance (t critical)
The first option (household assets are the sum of their net savings ($M \equiv \sum S$)							
France	0.94	1.02	0.98	970.51	4.59 E-19	31.15	2.08
Sweden	0.93	0.96	0.89	109.29	5.37 E-08	10.45	2.14
Luxembourg	0.93	1.38	0.99	1242.56	1.34 E-16	35.25	2.12
Slovenia	0.73	1.28	0.96	385.51	1.27 E-12	19.63	2.12
The second option (household assets - deposits and cash of the population ($M \equiv D$)							
Norway	0.81	0.786	0.98	860.0	1.59 E-18	29.3	2.080
Denmark	0.82	0.748	0.98	843.2	1.95 E-18	29.0	2.080
Finland	0.82	0.535	0.97	500.7	1.68 E-13	22.4	2.120
Sweden	0.91	0.684	0.95	261.0	6.78 E-11	16.2	2.131
Netherlands	0.88	0.379	0.78	74.4	2.41 E-08	8.6	2.080
Estonia	0.84	0.288	0.69	35.3	2.08 E-05	5.9	2.120
Luxembourg	0.78	0,191	0.62	25.6	1.15 E-04	5.1	2.120
France	0.92	0.193	0.61	32.3	1.22 E-05	5.7	2.080

First variant ( ). After separating the countries due to the lack of statistical data 14 countries remained, on the basis of statistical data of which the parameters of the function were calculated. Having eliminated the countries the coefficient value of private correlation of which had a negative value or a value far from +1, four countries were obtained, for which the

parameters of the model correspond to the economic meaning of the model (,), and the calculated values of the coefficients of determination - statistics and - statistics indicate a sufficiently high accuracy of the model and the significance of the impact of its parameters on the resulting value (Table 1).

Second option ($M \equiv D$). According to this option, model parameters, coefficients of partial correlation, determination, F statistics and t statistics for 22 countries were calculated on the basis of statistical data. After screening out 1) countries for which the value of private correlation $r_{mW|l}$ did not meet the initial hypothesis; 2) countries with the coefficient of determination of the model less than 0.6 and 3) countries for which the values of indicators F - statistics and statistics t below the table values receive 8 countries (Table 1).

For the three countries in the study group, namely France, Sweden and Luxembourg, it is possible to compare the model results with both options. Substitution of the calculated value of the coefficient α in the equation (33)

$$W = \frac{1}{\tau} \cdot \frac{M}{L_{\max}} \cdot \left(\frac{1}{1 - L/L_{\max}} \right)^{\alpha} \qquad (33)$$

for France, Luxembourg and Sweden, the hypothesis of the study was confirmed, namely the dependence of wages on the volume of available assets and employment (Fig. 1).

Despite the fact that in absolute value measurement Φ/L , $W(D)$ $W(\sum S)$ and significantly different dynamics designed according to the proposed model (33), wages

$$W(D) = \frac{1}{\tau} \cdot \frac{D}{L_{\max}} \cdot \left(\frac{1}{1 - L/L_{\max}} \right)^{\alpha} \qquad \text{and}$$

$$W(\sum S) = \frac{1}{\tau} \cdot \frac{\sum S}{L_{\max}} \cdot \left(\frac{1}{1 - L/L_{\max}} \right)^{\alpha}$$

nearly the same dynamics in the size of the

wage fund per worker (Φ/L). Simulation results for other countries shown in table. 1, are not visualized, but the dynamics $W(D)$ in these countries significantly repeats the dynamics Φ/L). It follows that the identified dependence makes it possible to predict the impact of changes in the volume of financial assets on the level of remuneration.

As noted, in both cases the calculations showed that τ it should be 1. Since the statistics data used were annual, according to the proposed model, this means that in the household view "black times" ($L = 0$) cannot last more than one year.

According to table 1, there is a pattern $M \equiv D$ for the option in the value of the parameter α: it consistently decreases in the line Norway-Denmark – Sweden – Finland – Netherlands – Estonia – France-Luxembourg.

Since the coefficient of elasticity ε_l is proportional to the parameter α, it can be interpreted as a positive relationship between the standard of living of the population and the degree of its social security and the elasticity of the wage rate for employment. In other words, in richer countries, with more active social policies, the impact of employment on wage rates is higher.
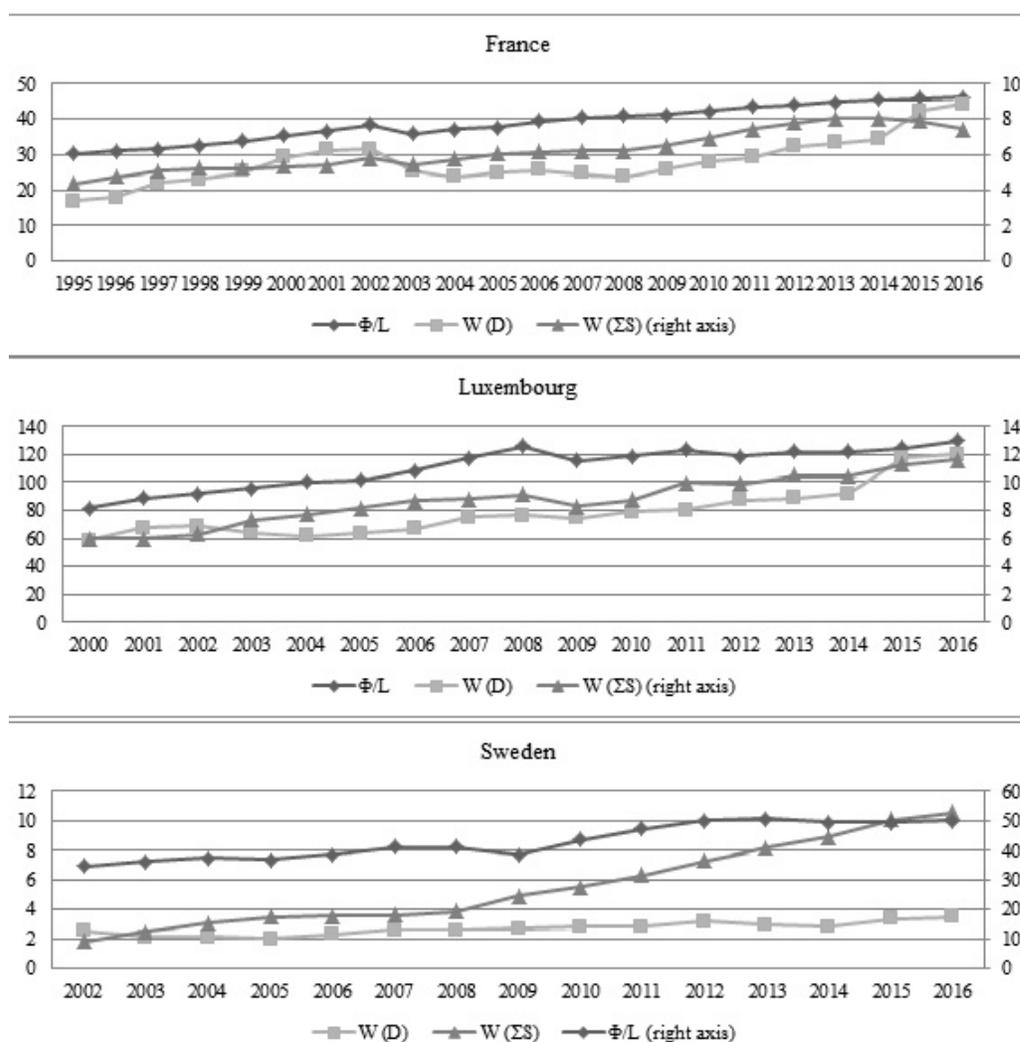
Figure 1. Dynamics of the wage fund per employee and the calculated values of wages, thousand EUR per person.

$^*\Phi/L$ is an actual wage fund per employee

$W(D)$ - the estimated level of remuneration calculated on the basis of the amount of cash and deposits

$W(\Sigma S)$ - the estimated level of wages calculated on the basis of the amount of net household savings

CONCLUSIONS AND RECOMMENDATIONS

The study was aimed at confirming the hypothesis of the impact of the level of financial assets of the population on the level of wages. The proposed model was tested in two ways. First, the assets of the population were taken as the amount of net savings of households, for the second it was the amount of cash and deposits of the population. Both variants confirmed the hypothesis for a number of countries from the study group. Improving the quality of the model and applying it to more countries is possible through the use of more suitable data (for example, data on savings without taking into account the savings of the richest people and the savings of other categories of people who do not affect the supply of labor).

Promising areas of research in this area are to determine the impact of labor mobility, government regulation and other aspects affecting the behavior of the employee and the acceptable level of payment).

The results of the research can be used to predict changes in the level of wages due to variations in the volume of financial assets of the population in the labor market.

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