METHODS FOR ASSESSING THE IMPACT OF STRUCTURAL INSTRUMENTS ON THE SUSTAINABLE DEVELOPMENT

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Abstract:
This paper aims to achieve a description of the macroeconomic models of assessment (Herom, Quest) by using a mix of techniques for modeling the economic development under the impact of EU funding. The Herom model is the Romanian version of the Hermin model and it was created to review the long term impact of the Cohesion Policy, policy sustained by public investment. This model is based on the "new" growth theory and on endogenous growth analysis. The first models of this type have been initiated on the premise that technical progress is exogenously determined and they are not situated under the control of economic policy. For this reason, it was difficult to analyze the long-term impact of EU Cohesion Policy in terms of assuming the productivity growth hypothesis.

Key words: *economic policies, income distribution, public investment, capital stocks, labor factor*

JEL classification: *F23*

THE HEROM MODEL

This model represents the HERMIN Romanian version of the model and it is based on the idea that HERMIN was originally developed for the less developed EU economies.

As a result, Charemza and Ţurlea showed that the mechanism of the HERMIN model that determines the salary between tradable and non-tradable sectors was different in Romania.

Moreover, long-term unemployment was particularly high for wage-bargaining process.

HEROM was developed with funding from the World Bank, the HEROM II variant being achieved in 2006.

Subsequently, the model has experienced many changes and adjustments due to the Romanian specialists to the best interests for the assessment of the impact of EU funds on economic development.

The advantages of the HEROM model are:

- it is a sector-type model and is highlighting the impact of economic policies on the sectors and on the sectoral changes;
- it is built on the standard structure of a market economy, as Romania will reach after a certain time;
- it is based on specific statistics of the Romanian economy;
- it is supported by the European Commission as a standard for new members of the pre-accession and post-accession stages.

The time periods for the construction and implementation of the HEROM model are identical to those used by the HERMIN model (2007-2013, 2014-2020).

In addition, the HEROM model also uses two scenarios: one in which structural funds are used under a 100% absorption rate, and the second where the post-accession

financial assistance is entirely absent, and the Community assistance is reduced to pre-accession funds existing at the end of 2006.

The HEROM model consists of three main blocks: the supply, which is treated separately for each of the four sectors, the absorption and the income distribution component. There is also a rule of balance of the system which closes the model in its set of behavioral equations and macro-economic identities, as follows:

The supply block in the HEROM model:

Tradable goods sector (manufacturing and mining).

Production = f_1 (global demand, domestic demand, competitiveness, the real unit cost of labor, t)

Employment = f_2 (production, expected relative price of factors, t)

Investment = f_3 (production, expected relative prices of factors, t)

Capital Stock = investment + (1-δ) capital stock$_{t-1}$

*Production price = f_4 (global price * exchange rate, unit labor costs, t)*

Wage rate = f_5 (price of production, the marginal tax rate, productivity, t)

Competitiveness = relative price of production national/world

The expected relative factor prices = f_6 (relative factor prices, relative prices of factors t-1)

*Repatriated profits of foreign companies = ct * total profits*

Domestic demand = f_7 (private consumption, public consumption, investment, t)

Property services sector

Production = f_8 (weighted domestic demand, t)

Employment workforce = f_9 (production, expected relative price of factors, t)

Investment = f_{10} (production, expected relative price of factors, t)

Capital stock = investment + (1-δ) capital stock$_{t-1}$

Price of production = cost of production margin during t and t-1

Salary inflation = salary inflation in the manufacturing sector

The expected relative price factors = f_{11} (relative price factors, relative price factors$_{t-1}$)

Weighted domestic demand = f_{12} (private consumption, public consumption, investment)

Agriculture Sector

Production = f_{13} (time trend)

Employment = f_{14} (time trend)

Capital stock = f_{15} (production, time trend)

Investment = capital stock - (1-δ) capital stock$_{t-1}$

Depreciation = f_{16} (nominal capital stock, t)

Government services sector

Production = real non wage consumption + salary element

Employment = exogenous

Real non-wage consumption = exogenous

Production price inflation = wage inflation

Salary inflation = salary inflation in tradable goods sector

Demographic sector and labor supply

Population growth = f_{17} (natural growth, migration, t)

Migration = exogenous

Labor supply = f_{18} (Population, labor participation rate, t)

Unemployment = labor supply - total labor employment

Labor turnout = f_{19} (economic growth rate, changes in unemployment benefit, time trend)

The absorption block in the HEROM model:

Consumption = f_{20} (available personal income, t)

Housing investment = f_{21} (available personal income, t)

Stocks = stock change + stocks$_{-1}$

Change in stock = f_{22}(stock$_{-1}$, production)
Exports = f_{26} (global demand of price competitiveness, customs duties, t)
Imports = f_{27} (domestic demand, price competitiveness, customs duties, t)
Net trade surplus = GDP at market prices - domestic demand
GDP on expenditure = private consumption + public consumption + net investment + stock change + depreciation + trade net surplus

The income distribution block in the HEROM model:

Income = manufacturing
Population disposable income = income + transfers - direct taxes
Net tax = indirect taxes - subsidies on products
Indirect taxes = f_{23} (consumption, time trend)
Subsidies for goods = f_{24} (production - A production - N, time trend)
Transfers = unemployment benefit + social transfers + transfers from abroad
Inflation unemployment = inflation non-agricultural income
Social transfers = f_{25} (population over 65, the consumer price index, t)
Balance of payments = net trade surplus + factors net income from abroad
*Public sector loan = public expenditure - tax rate * taxable*
*Public sector debt = (1 + interest rate) * debt$_{t-1}$ + loan*
*Interest on debt = (1 + interest rate PD) * (public debt + public debt$_{t-1}$)/2*
*Interest on debt = (1 + interest rate) * (external debt + external debt$_{t-1}$)/2*
*Retained profits = ct * total profits*
Reserve money (M2) = constant share of GDP (constant velocity of money)

THE QUEST MODEL

The QUEST model is a global macro-econometric model of neo-Keynesian type, able to analyze the effect of the whole EU cohesion policy. The model takes into account the consequences on the net donor economies due to the cohesion policy.

The QUEST model covers the Community economy and it is based on the same premises as HERMIN: a wise financial management and optimal investment plans. In addition, the model considers that the public investments are regarded as productive as the private ones, which does not reflect reality in many cases.

The QUEST model has several variants, each of them bringing additional performance in economic analysis.

According to Roeger and Veld, the QUEST II model is structured in three parts as follows:

- *households*: their consumption is influenced by the expected income LCI_t and existing savings at that time FW_t

$$C_t = (\theta + p)\left[LCI_t + FW_t\right]P_t / PC_t$$

where: θ - the time taken in the analysis, p - the likelihood of death until the planned time horizon.

The expected income level is determined by the formula:

$$LCI_t = \int_t^{\infty}\left[(1-tl)\frac{W_S N_S}{P_S} + \frac{TR_S}{P_S}\right]\exp\left(-\int_t^{S}(r_j + p)d_j\right)ds$$

where: $(1\text{-}tl)W_S N_S$ – the labor net income, plus other transfers to households sector, including unemployment benefits: TR_S.

The other component of private consumption, the financial wealth at the aggregate level, is determined as follows:

$$FW_t = MV_t + F_t + B_t,$$

that is by adding the market value of firms in the domestic economy MV_t, the net value of foreign assets F_t and the government deficit B_t.

The consumption function used in the model is:

$$C_t = (1-\lambda)(\theta + p)\left[LCI_t + FW_t\right]P_t / PC_t + \lambda YDIS_t$$

where: λ is the parameter that defines the constraint regarding the households liquidity.

- *business sector*: firms are operating in a market with monopolistic competition. GDP produced by private sector (Y_t) is represented by a collection of C.E.S. and Cobb-Douglas production functions, which have as inputs: capital (K_t), energy (E_t) and work factor (N_t):

$$YPOT_t = \left(\left[aK_t^{-\rho} + (1-a)E_t^{-\rho}\right]^{-1/\rho} T_{Kt}\right)^{(1-\alpha)} (N_t T_{Nt})^{\alpha}$$

where: T - indicate the use of capital stock, namely labor. Thus, potential output in the industrial sector is determined on the assumption of full use of production factors.

The optimization requires compliance with the following investment rule:

$$\frac{I_t}{K_t} = \frac{1}{\phi}\left(\frac{q_t}{(PI_t / P_t)} - 1\right)$$

where: q_t - the price of capital, PI_t/P_t - relative prices of goods investment reflected in the GDP deflator, ϕ - the cost parameter.

The labor factor is also represented by a Cobb-Douglas production function:

$$N_t = \left[(1-\eta)\frac{\alpha Y_t}{(W_t / P_t + (r_t + s)VC_t)}\right]^{(1-nl)} (N_{t-1})^{nl}$$

where: s - the rate for the classification of jobs, vc - travel costs, which are assumed to evolve in proportion to the real wage.

Coefficients that define the higher prices $1/(1+\eta)$ are taken from an OECD study and they take values between 1.15 in the U.S. and 1.26 for Japan. It assumes that the travel costs represent 10% of wage costs.

The energy application is similar to the labor demand. It is positively influenced by the production output and negatively by the relative prices and taxes on the energy sector:

$$E_t = (1-\eta)\frac{(1-a)(1-\alpha)Y_t}{(PE_t / P_t(1+te))^{1/(1+\rho)}}$$

where: α, ρ, η are structural parameters of the investment sector and they are estimated annually based on information obtained from each state.

- *government sector*: government current expenditures consist of: government interest payments deficit (i_tB_t), acquisition of goods and services (G_t), which includes government investment, payment of employees (W_tNG_t), net transfers to households (TRH_t), unemployed (BEN_t) and other transfers (OTR_t). These government expenditures are financed by taxes on income (TL_t), social security contributions (SC_t), taxes on industries (TC_t), energy (TE_t), VAT (VAT_t) and other resources (R_t):

$$\Delta B_t = i_t B_t + PC_t G_t + W_t NG_t + BEN_t + TRH_t + OTR_t - (TL_t + SC_t + TC_t + TE_t + VAT_t + R_t)$$

The total output is adjusted by including in the determination of total GDP (GDP_t) the government wages (W):

$$GDP_t = Y_t + W_t NG_t$$

where NG is the total number of employees in the public administration.

The QUEST III model was designed to assess the potential impact of the Structural and Cohesion Funds of the new Member States for 2007-2013.

The QUEST III model is based on a regional dynamic general equilibrium model, which includes human capital accumulation and endogenous technological changes. The model can be extended to consider the structural reforms in the EU

(Lisbon Strategy on Growth and Jobs) and to assess the Structural Funds intervention based on types of structural policies.

According to this model, the economy is composed of: households, firms that produce final and intermediate goods, a branch of research, a monetary and a fiscal authority.

The final goods sector produces differentiated goods that are imperfectly substituted by imported goods. The final goods producers use a mix of domestic and imported goods and three work factors: low, medium and heavily qualified.

The model itself consists of the following blocks:

The QUEST III public capital and final goods production block:

The productivity effect on the infrastructure investment:

$$Y_t = A_t^{(1-\alpha)\left(\frac{1}{\theta}-1\right)}\left(K_t^P\right)^{1-\alpha}\left(L_{Y,t}\right)^{\alpha}\left(K_t^G\right)^{\alpha_G} - FC_Y$$

where: $K_t^P = \sum_1^{A_t} x_{i,t}$,

where: $L_{Y,t}$ *- the aggregate employment factor;* $x_{i,t}$ *- intermediate goods;* FC_Y *- fixed costs in a Cobb-Douglas function with built-in technical progress;* K_t^G *- public capital stock investment;* α_G *- increased productivity as a result of the public capital stock investment;* Y_t *– the final output;* A_t *- the variety of intermediate inputs;* $\frac{1}{1-\theta}$ *- the elasticity of substitution;* K_t^P *- private equity, which satisfies the condition*:

$$K_t^P = \sum_1^{A_t} x_{i,t} = A_t x_t$$

The infrastructure public investment (I_t^G) *accumulated in the public capital stock* (K^G) *are:*

$$K_t^G = (1-\delta_G)K_{t-1}^G + I_t^G ,$$

where: δ_G *- the public capital depreciation rate (set at 4%).*

The infrastructure investments are proportional to the output:

$$I_t^G = \left(IGS_t + \varepsilon_t^{IG}\right),$$

where: ε_t^{IG} *- exogenous shock related to the government investment* IGS_t

The QUEST III research and development sector and intermediate goods production block

The intermediate goods production sector is made up of monopolistic firms that enter the market by acquiring licenses from households and by making an initial payment FC_A *to overcome the market entry administrative barriers.*

The capital inputs are hired from households at a rate equal to i_t^K*. In equilibrium conditions, the inverse of the demand function of domestic final goods producers is:*

$$px_{i,t} = \eta_t(1-\alpha)Y\left(\sum_i^{A_t}\left(x_{i,t}^j\right)^{\theta}\right)^{-1}\left(x_{i,t}\right)^{\theta-1}.$$

The profit maximization equation of the national firms producing intermediate goods is:

$$PR_{i,t}^x = \frac{\max}{x_{i,t}}\left\{px_{i,t}\,x_{i,t} - i_t^K P_t^C k_{i,t} - i^A P_t^A - FC_A\right\}.$$

If technology is linear, a unit of effective capital (k_i*) can be transformed into one unit of intermediate good:*

$$x_i = k_i$$

The intermediate goods producing firms' entry on the market will last as long as:

$$PR_{i,t}^x = PR_t^x = i_t^A P_t^A + r_t FC_t^A$$

The R & D sector uses skilled labor factor ($L_{A,t}$), according to the following production function:

$$\Delta A_t = \nu A_{T-1}^{*\varpi} A_{t-1}^{\phi} L_{A,t}^{\lambda},$$

where: ϖ - the multiplier effect due to the international stock of knowledge A^*; ϕ - the multiplier effect due to the national stock of knowledge A; ν - the R & D output efficiency; λ – the R & D output elasticity in terms of number of researchers L_A; $g_{A^{\varpi}}$ - the exogenous growth rate of world stock of knowledge, W^H – the R & D average salaries.

As a result, the research institutes must work to the condition:

$$\frac{\max}{L_{A,t}} \sum_{t=0}^{\infty} d_t \left(P_t^A \Delta A_t - W_t^H L_{A,t} - \frac{\gamma_A}{2} W_t^H \Delta L_{A,t}^2 \right)$$

The QUEST III human capital accumulation block

The $L_{Y,t}$ aggregate labor factor is comprised of three categories of qualifications:

$$L_{Y,t} = \left(\delta_L^{\frac{1}{\sigma_L}} \left(h_t^L L_t^L \right)^{\frac{\sigma_L - 1}{\sigma_L}} + \delta_M^{\frac{1}{\sigma_L}} \left(h_t^M L_t^M \right)^{\frac{\sigma_L - 1}{\sigma_L}} + \delta_{H,Y}^{\frac{1}{\sigma_L}} \left(h_t^H L_t^{HY} \right)^{\frac{\sigma_L - 1}{\sigma_L}} \right)^{\frac{\sigma_L}{\sigma_L - 1}},$$

where: δ_x - the x skil category labor factor; h_t^x - the effectiveness of human capital accumulation of x category qualification; σ_L - the elasticity of substitution between different work factor qualifications.

Following the simulation using QUEST III model, the next conclusions can be drawn:

- the government spending will significantly increase (including government investment) and a gradual accumulation of public capital will be achieved;
- the final goods producing sector productivity and output will increase;
- the R & D will support the cost savings and will encourage the new companies to enter the market;
- the increasing demand for manufacturing and innovation patents will increase the demand for the highly qualified employment factor.

Achieving these goals involves a longer period of time. In 2020, for example, the stock of knowledge will be 2% higher than today. The GDP will grow in the first two years of simulation with a slower rate than the demand growth. But the raise of the output will become increasingly large, while the effects related to the aggregate supply will boost, so in 2015, the output will improve by more than 4%.

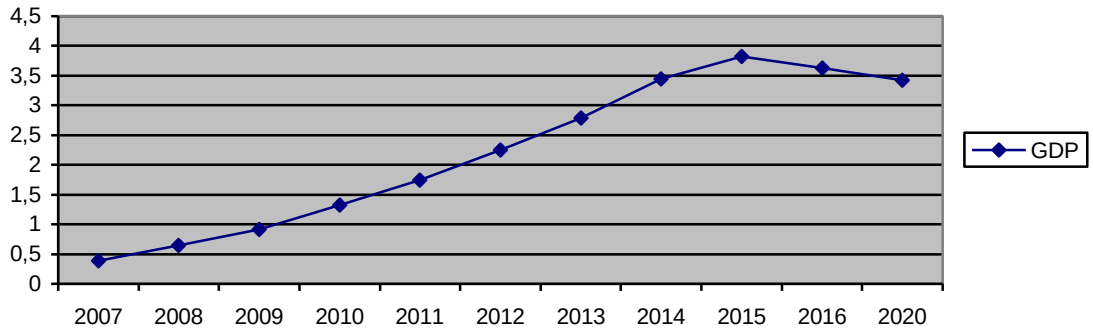

Figure 1: The evolution of GDP (%) according to the QUEST III simulation

The work factor will have a positive trend in the early years of the simulation, due to the effect of the demand growth, but thereafter the trend will become negative (see Figure 2).

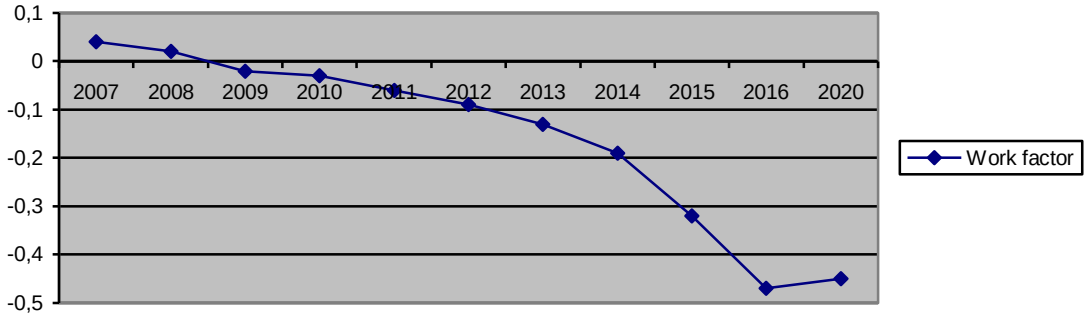

Figure 2: The evolution of the work factor (%) according to the QUEST III simulation

The consumption and investment will have a positive trend, although not significantly higher. The development of consumption took regard to the future growth of the income households (see Figure 3).

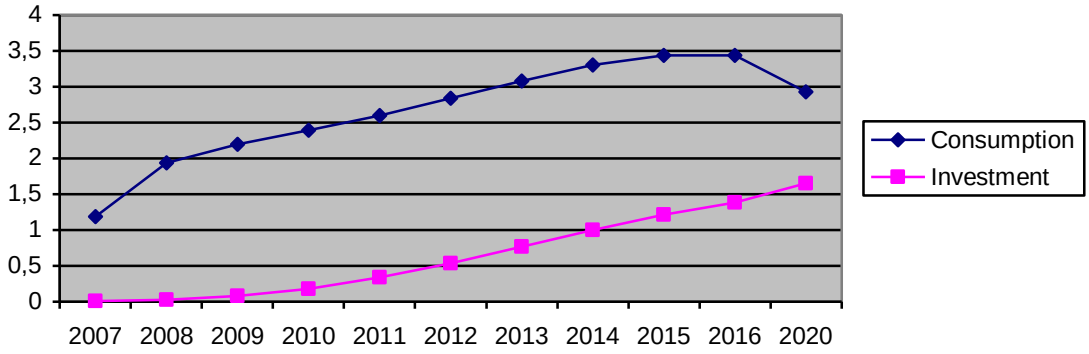

Figure 3: The evolution of consumption and investment according to the QUEST III simulation

In the case of small open economies, a significant part of the stimulatory effect of the demand is reflected in the increased imports. These imports will increase by more than 2% from baseline and contribute to the deterioration of the trade balance.

The public debt will remain relatively constant for the forecasted period, while the trade balance negative effect on GDP will mitigate (see Figure 4).

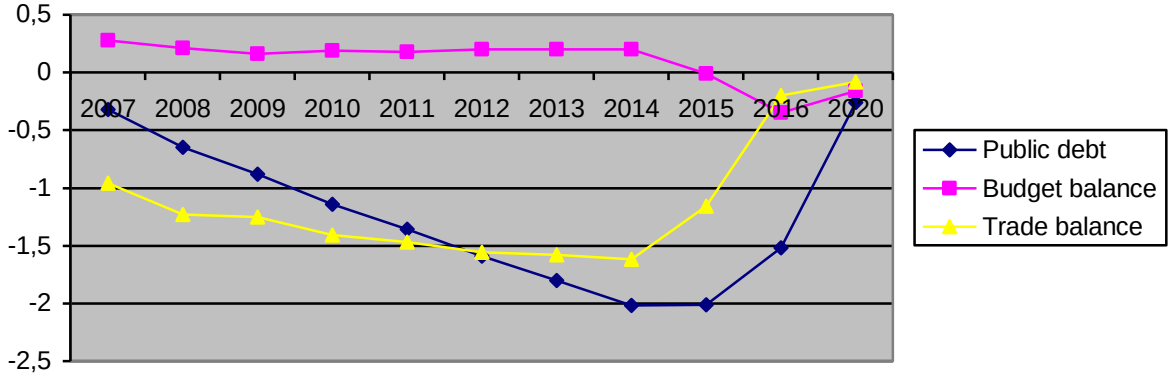

Figure 4: The evolution of public debt, budget balance and trade balance (% of GDP) according to the QUEST III simulation

CONCLUSIONS

The QUEST model is successfully used to highlight the effects of employment and economic growth factor on the Trans-European Transport Network (TETN). In the recent years, the QUEST II and III models were used to analyze the Cohesion Policy.

Many of the Cohesion Policy objectives are defined at the macroeconomic level. Moreover, the results of a macroeconomic model are consistent in terms of the requirements, in order to quantify the degree of compliance with the macroeconomic objectives of Cohesion policy.

A special feature of the above macroeconomic models is the ability to use statistical data in order to create an appropriate structure of the development model. When the models process long-term statistical series, econometric techniques must be used to restructure the model.

The HEROM and QUEST macroeconomic models type are dynamic and they can reveal changes in the long term impact of the economic policy in a superior manner to the one that compares differences between two equilibrium points.

However, these models also have weaknesses. A first such item is related to the fact that the models require a large amount of resources to use them. The quality of the databases provides sensitivity coefficients values, an element capable of restricting the use of models.

In addition, the quality of the model depends directly on the quality of the assumptions and used parameters, many of them being difficult to verify in practice.

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