MACROECONOMIC MODELING TO ANALYZE THE DEVELOPMENT OF INVESTMENTS IN ROMANIA IN THE TRANSITION

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ABSTRACT: *This article presents an analysis of developments in macroeconomic modelling, presents some models of economic growth on investment (Keynes), model underlining the importance of each model in hand, the innovative feature of the macroeconomic model and application modelling investment opportunity in our country.*

KEY WORDS: *Macroeconomic modelling, output, endogenous variables, exogenous variables, regressions, capital stock*

Macroeconomic modelling dates beginning after the Second World War in 1992 Charemza and Deadman are described in the paper "New Directions in Econometric Practice" assumptions that have been processed in defining key terms and classifications of macroeconomic modelling methodology.

Macroeconomic modelling (MEMs) is multi-dimensional, representing not only a science but an art. MEMs in a primary variant are defined as: a set of equations behavioural and institutional relations that structure the economy is based mainly on the behaviour of individual economic agents.

There are two types of macroeconomic models [2][4]:

- MEMs (Macro-Economic-Modelling);
- CGE (Computable General Equilibrium).

The MEMs provides information about the dynamic processes of adjustment and can be used short term and medium term is classified as [5]:

- a Model of Keynes-Klein (KK): consists in explaining the evolution variable order "request" in the context of macroeconomic fluctuations, addresses the problem of short-term instability's output and of hiring labour using policies stabilization;

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- a Model of Philips-Bergstrom [7][8](PB): is a demand-oriented model that uses differential equations to estimate the structural parameters of the stochastic model, the state of stability and asymptotic properties of the model are expressed in a continuous time, very difficult to enforce because of large scale models;
- a Model of Walras-Johansen (WJ): is mainly multisectoral excellence using non-linear differential log. The economy is composed of interrelated markets that reach an equilibrium level by maximizing the profit-oriented behaviour of producers and consumer actions in a competitive market.
- a Model of Walras-Leontief (WL): is such general equilibrium system, incorporating an input table output (IO) in which giving sectoral or aggregate value of final components may be obtained sectoral output,
- a Model of Muth-Sargent (MS): is based on rational expectations theory of evolution, are similar in terms of KK model dynamic, non-linearity, stochastic and variable time mesh. One important feature of this model is given of how expectations are formed, they are no longer depending on previous values of dependent variables, and the variables actually vary apparent expectations, which are obtained when the model is solved.

The future developments of the models were the WJ and WL CGE modelling. Neoclassical CGE models are based on optimizing behaviour of economic agents, their main objective is to conduct policy analysis to economic resources, international trade, production efficiency and income distribution sector [4].

The difference between MEMS and CGE models can be made with respect to time. CGE models generate values of endogenous variables only for the initial state of equilibrium, a new equilibrium after the shock is required. Do not submit information about the process of adjustment, but the image time instant of microeconomics. Recently, some models provide information on dynamic adjustment processes, which can be used short term (3 to 5 years) and medium term (5 to 7 years) [6].

The MEMs provides information on the dynamics of adjustment processes, used for short-term forecasts and medium term and to review policies.

There is variable apparent trend (technical progress), represented both macroeconomic models for discrete and continuous by deterministic functions of time, entering the appropriate equations macroeconomic models. The model can be introduced stochastic trends that may be apparent on those phenomena that are believed likely to influence the behaviour of endogenous variables.

About some physical models (models that led to the characterization of the Lorenz weather events) in Great Britain led to the evaluation of macroeconomic systems using model described by 18 differential not linear equations order 1 and 2, with 63 structural parameters, including vector β of the 33 long-term parameters, the vector γ of the 27 speed adjustment and the vector λ of the three trends.

Model equations as deterministic:

- adjustment of private consumption equation:

$$D^2 \log C = \gamma_1(\lambda_1 + \lambda_2 - D\log C) + \gamma_2 \log\left[\frac{\beta_1 e^{-\{\beta_2(r-D\log p)+\beta_3 D\log p\}}(Q+P)}{T_1 C}\right] \quad (1)$$

assumed that the excess growth rate of consumption over long-term growth rate of expected real income ($\lambda_1 + \lambda_2$) depends on the ratio between the partial equilibrium level of consumption and current consumption, the balance of consumption partly depends on real disposable income (Q+P)/ T_1, the real rate of interest r-Dlogp and the inflation rate Dlogp;

- equation of labour adjustment:

$$D^2 \log L = \gamma_3(\lambda_2 - D\log L) + \gamma_4 \log\left[\frac{\beta_4 e^{-\lambda_1 t}\{Q^{-\beta_6} - \beta_5 K^{-\beta_6}\}^{-1/\beta_6}}{L}\right] \quad (2)$$

implies that accelerate the pace of employment growth rate depends on the surplus labour supply λ2 over the current rate of increase in labour and the relationship between the balance part of the labour and the ratio of the partial equilibrium labour and the current workforce. β_5 quantify the importance of capital in production and decay rate of λ_1 is through technical progress, the amount of labour needed to produce a equations that refer to the given output in terms of a given capital;

- equations that pertain to the industry in the behaviour of the economy with firms and market structure:

$$D^2 \log K = \gamma_3(\lambda_1 + \lambda_2 - D\log K) + \gamma_6 \log\left[\frac{\beta_5(Q/P)^{1+\beta_6}}{r - \beta_7 D\log p + \beta_8}\right] \quad (3)$$

$$D^2 \log Q = \gamma_7 \log\left[\frac{\{1 - \beta_9(qp/p_i)^{\beta_{10}}\}(C + G_c + DK + E_n + E_0)}{Q}\right] \quad (4)$$

$$D^2 \log p = \gamma_9(D\log w/p) - \lambda_1) + \gamma_{10} \log\left[\frac{\beta_{11}\beta_4 T_2 w e^{-\lambda_{11}}\{1 - \beta_5(Q/K)^{\beta 6}\}^{-(1+\beta_6)/\phi_6}}{p}\right] \quad (5)$$

accelerate the pace of capital stock (equation 3) depends on the excess growth rate expected long-term ($\lambda_1 + \lambda_2$)'s output over the current rate of increase of capital stock and the ratio of marginal product of capital and the real interest rate plus a risk premium. The excess growth rate's output over the long term growth rate expected ($\lambda_1 + \lambda_2$) of sales units (equation 4) depends on the ratio between the balance part of the income and current level of income and the ratio of the partial equilibrium stocks and the current level of stocks.

Term $1-\beta_9(qp/p_i)^{\beta_{10}}$ is the ratio of total supply produced from domestic output, the term $1-\beta_9(qp/p_i)^{\beta_{10}}$ is the portion derived from imports (this term is used in (equation 8) of the adjustment equation for imports). Accelerating the growth of price level (equation 5) depends on the excess current growth rate of real wage above the rate of technical advances λ_1 and the relationship between partial equilibrium relationship between price level and current level of prices;

- wage adjustment equation:

$$D^2 \log w = \gamma_{11}(\lambda_1 - D\log(w/p)) + \gamma_{12} D\log(p_i - qp) + \\ + \gamma_{13} \log\left[\frac{\beta_4 e^{-\lambda_1 t}\{Q^{-\beta_6} - \beta_5 K^{-\beta_6})}{\beta_{12} e^{\lambda_2 t}}\right] \quad (6)$$

implies that the pace of nominal wage rate depends on the excess rate of technical progress than the current rate of real wage growth, the current rate of increase in the ratio of import prices in domestic prices and the rate of partial equilibrium level of labour supply to work; term D log (p_i/qp) highlights the pressure on higher wages to compensate for the loss of welfare caused by lower real exchange rate q;

- adjusting the interest rate equation

$$D^2 r = -\gamma_{14} Dr + \gamma_{15}[\beta_{13} + r_f - \beta_{14} D\log q + \beta_{15}\frac{p(Q+P)}{M} - r] \quad (7)$$

is the dynamic behaviour of long-term bond market, is a portfolio balance equation that takes into account the substitution between money, domestic bonds and foreign bonds. The term p(Q+P)/M represents the actual liquidity measure takes into account the increased use of plastic money card;

- import adjustment equation

$$D^2 \log I = \gamma_{16}(\lambda_1 + \lambda_2 - D\log(p_i I/qp)) + \\ + \gamma_{17}\log\left[\frac{\beta_9(qp/p_i)^{\beta_{10}}(C + G_c + DK + E_n + E_0)}{(p_i/qp)I}\right] \quad (8)$$

assumed that the excess growth rate of import volumes to the expected growth rate of long-term (λ_1+λ_2) the aggregate sales depends on the ratio between the actual balance of imports and part of the current value of imports and the ratio of the partial equilibrium stocks and their current value adjustment

- export adjustment equation

$$D^2 \log E_n = \gamma_{18}(\lambda_1 + \lambda_2 - D\log E_n) + \gamma_{19}\log\left[\frac{\beta_{16} Y_f^{\beta_{17}}(p_f/qp)^{\beta_{18}}}{E_n}\right] \quad (9)$$

determines that the excess growth rate of export volume to the expected growth rate in the long term ($\lambda_1 + \lambda_2$) of demand for exports depends on the ratio between exports and the balance part of their current level. β_{17} and β_{18} are external income and price elasticity of demand for British goods;

- equations for adjusting current actual external transfers F, real profits, interest rates, the dividends from outside P and real net foreign investment combined Ka, sizes which values can have both positive and negative;

$$D^2F = -\gamma_{20}DF + \gamma_{21}[\beta_{19}(Q+P) - F] \tag{10}$$

$$D^2P = -\gamma_{22}DP + \gamma_{23}\{[\beta_{20} + \beta_{21}(r_f - D\log p_f)]K_a - P\} \tag{11}$$

$$\begin{aligned} D^2K_a = &-\gamma_{24}DK_a + \gamma_{25}\{[\beta_{22} + \beta_{23}(r_f - r) - \\ &- \beta_{24}D\log q - \beta_{25}d_x](Q+P) - K_a\} \end{aligned} \tag{12}$$

- equation monetary adjustment issue in the ratio reversed p_i / qp (explained in equation 6)

$$\begin{aligned} D^2\log M = &\gamma_{26}(\lambda_3 - d\log M) + \gamma_{27}\log[\frac{\beta_{26}e^{\lambda t_3}}{M}] + \\ &+\gamma_{28}\log\left[\frac{E_n + E_0 + P - F - DK_a}{(p_i/qp)I}\right] \end{aligned} \tag{13}$$

- equation of exchange rate adjustment is the dynamic behaviour of the foreign exchange market

$$\begin{aligned} D^2\log q = &\gamma_{30}D\log(p_f/qp) + \gamma_{31}\log[\frac{\beta_{27}p_f}{qp}] \\ &+\gamma_{32}D\log\left[\frac{E_n + E_0 + P - F}{(p_i/qp)I}\right] + \\ &+\gamma_{33}\log[\frac{E_n + E_0 + P - F - DK_a}{(p_i/qp)I}] \end{aligned} \tag{14}$$

accelerating the exchange rate depends on the rate of decrease in real rates instead Dlog (p_f / qp), the relationship between real exchange rate expected in stationary state conditions and the current real exchange rate and balance of payments surplus ratio and the real value of imports;

- equation expressing the value of stocks

$$DS = Q + (p_i/qp)I - C - DK - DK_a - E_n - E_0 - G_c \tag{15}$$

- equations outlining the apparent trend variables (variable trend productivity (μ_1), variable labour trend (μ_2), variable trend to use plastic money and credit (card) (μ_3)

$$D\mu_1 = \lambda_1 \tag{16}$$

$$D\mu_2 = \lambda_2 \tag{17}$$

$$D\mu_3 = \lambda_3 \tag{18}$$

Both endogenous variables (C - private consumption real, En - real exports of goods not oils products, F - foreign real current transfers, I - the import volume, K - private fixed capital not residential Ka - cumulative net real foreign investment, L - labour employed, P - real profits, interest rates and dividends from abroad, P - price level, Q - real net output, q - the rate, r - interest rate, w - wage levels, S - stocks) and exogenous variables (d_x - variable notional currency control, M - currency issued, E_o - real export oil, G_C - real government consumption, P_F - prices in major industrialized foreign countries, p_i - the price of imports, r_f - interest rate abroad, T_1 - total tax policy variable defined by Bergstrom, T_2 - variable indirect tax policy, Y_f - real income of the major industrialized foreign countries, t - time) varies depending on time.

Exogenous variables satisfy the following equilibrium conditions:

$d_x = 0$ (not exchange control)

$E_0 = E_0^* e^{\lambda_1+\lambda_2}$ (export of petroleum products has a growth rate equal to $\lambda_1 + \lambda_2$)

$G_c = g^*(Q+P)$ (real government consumption is a constant proportion of real output)

$p_f = p_f^* e^{\lambda_4 t}$ ` (principally prices in industrialized countries has a growth rate equal to)

$r_f = r_f^*$ (foreign interest rate is constant)

$T_1 = T_1^*$ (total tax policy variable is equal to 0)

$T_2 = T_2^*$ (indirect taxation policy variable is equal to 0)

$Y_f = Y_f^* e^{((\lambda_1+\lambda_2)/\beta_{17})t}$ (foreign real income increase by constant rate equal to $(\lambda_1 + \lambda_2)/\beta_{17}$)

where $g^*, p_f^*, p_i^*, r_f^*, T_1^*, T_2^*, \lambda_4$ are constant.

In these circumstances, it was shown that C (t)... q (t) is amended to rate steady equilibrium conditions. The system defined by the 18 equations is not autonomous because the time variable was defined as an exogenous variable. To study the system dynamics around the equilibrium point, and fireworks were made amendments by defining a set of mathematical variables new form y_i (t):

$1'.$ $y_1(t) = \log\{C(t)/C^* e^{(\lambda_1+\lambda_2)t}\}$

$2'.$ $y_2(t) = \log\{L(t)/L^* e^{\lambda_2 t}\}$

$3'.$ $y_3(t) = \log\{K(t)/K^* e^{(\lambda_1+\lambda_2)t}\}$

$4'.\quad y_4(t) = \log\{Q(t)/Q^* e^{(\lambda_1+\lambda_2)t}\}$

$5'.\quad y_5(t) = \log\{p(t)/p^* e^{(\lambda_3-\lambda_1-\lambda_2)t}\}$

$6'.\quad y_6(t) = \log\{w(t)/w^* e^{(\lambda_3-\lambda_2)t}\}$

$7'.\quad y_7(t) = r(t) - r^*$

$8'.\quad y_8(t) = \log\{I(t)/I^* e^{(\lambda_1+\lambda_2)t}\}$

$9'.\quad y_9(t) = \log\{E_n(t)/E_n^* e^{(\lambda_1+\lambda_2)t}\}$

$10'.\quad y_{10}(t) = \log\{F(t)/F^* e^{(\lambda_1+\lambda_2)t}\}$

$11'.\quad y_{11}(t) = \log\{P(t)/P^* e^{(\lambda_1+\lambda_2)t}\}$

$12'.\quad y_{12}(t) = \log\{K_a(t)/K_a^* e^{(\lambda_1+\lambda_2)t}\}$

$13'.\quad y_{13}(t) = \log\{M(t)/M^* e^{\lambda_3 t}\}$

$14'.\quad y_{14}(t) = \log\{q(t)/q^* e^{(\lambda_1+\lambda_2+\lambda_4-\lambda_3)t}\}$

$15'.\quad y_{15}(t) = \log\{S(t)/S^* e^{(\lambda_1+\lambda_2)t}\}$

where: C*, L*, K*, Q*, w*, r*, I*, E*, F*, P*, K*, M*, q* are functions of the vector (β, γ, λ) of the 63 parameters of equations 1 to 18 and additional parameters: g*, p_f*, p_i*, r_f*, T_1*, T_2*, Y_f*, λ_4.

It is a continuous time macroeconomic model applied to the United Kingdom, was used a sample contains quarterly data; the model generated a plausible long-term behaviour. Innovative design feature is that it incorporates the stochastic trends which are apparent trend variables like technical progress that are not directly observable, but known to have a strong influence on observable variables present in this model.

Parameters were estimated using the algorithm Bergstrom [3], as demonstrated for the first time the feasibility of using this algorithm in estimating the macroeconomic model. A typical feature of these models is that the estimated parameters are unstable region on the border with a stable region [1].

Conclusion. Because the model of 18 equations can be applied in Romania, was required: a suitable analytical evaluation of equation and system variables a database corresponding to the parameters of equations can be taken. This can not be designed for a transition period due to constraints in the evolution of the phenomenon of investment in Romania.

In Romania, a first assessment of practice macro modelling investment highlights seven main categories of variables, most commonly used form regressions: the existing capital stock and utilization of production capacity, output, employment and other indicators designed to offer (egg costs), demand, financial resources that could be supported investments; interest.

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