

# 9 THE "DOBRESCU" MACROMODEL OF THE ROMANIAN MARKET ECONOMY\* -2005 VERSION - YEARLY FORECAST

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## Macromodel of the Romanian Market Economy\*\*\*\*\*

### Abstract

The macromodel estimates the short and medium-run economic implications for internal policies and of changes in the international context.

This new version of the Romanian macromodel incorporates the experience accumulated through the utilisation of its previous forms - either experimental (tested during 1991-1995) or operational (developed during 1996-2003). At the same time, it introduces some methodological and information improvements.

The most significant of them is the structural decomposition of economy, associated with input-output techniques. Output and absorption are divided into: a) agriculture, sylviculture, forestry, hunting, and fishing; b) mining and energy; c) manufacturing industry; d) constructions; e) transport, post and communications; f) trade and services. These can be easily translated into classical three-sector classification: primary (a-b), secondary (c-d), and tertiary (e-f).

Due to the relatively advanced stage of the transitional processes in Romania, the behavioural functions were accommodated - as much as possible - to the standard

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relationships. Unlike versions that used the statistical series beginning with 1980, the present one is based exclusively on information concerning the period 1989-2004. Therefore, we have considered more adequate to name this variant the macromodel of the Romanian market (not transition, as before) economy.

Since the input-output tables are defined yearly, the model contains only annual indicators. They are expressed in denominated local currency (RON). When there were several statistical sources for the same indicator, we preferred the data extracted or derived from national accounts.

The statistical series are relatively short and often fractured (because of the transforming processes of transition). It is known that ADF test of stationarity does not offer sure results in the case of limited number of observations. Nevertheless the series satisfying it were used, as a rule. The Granger causality test was computed for one, two, and three lags. The simplest methods of estimation were also preferred. The structural breaks in the evolution of some indicators have been attenuated by the inclusion of dummies. Obviously, all these circumstances weaken the stability of econometric coefficients that must be continuously updated. The main relationships are grouped in seven sections: input-output block; labour market, production function; domestic absorption, foreign trade, prices and exchange rate, and interest rate.

**Key-words:** model, input-output analysis, econometric relationships, simulations

**JEL Classification:** C5, E2-E6, H6

### ***1. The Model***

The version 2005 of the Romanian macromodel incorporates the experience accumulated through the utilisation of the previous forms. At the same time, it introduces some important methodological and informational changes.

The most significant of them is the structural analysis, associated with input-output techniques. The output and absorption are divided into six sectors, namely:

- a) agriculture, sylviculture, forestry, hunting, and fishing;
- b) mining and energy;
- c) manufacturing industry;
- d) Constructions;
- e) transport, post, and communications;
- f) trade and services.

They are computationally interconnected through input-output coefficients, derived from extended tables for 105 branches.

Due to the relatively advanced stage of the transitional processes in Romania, the behavioural functions were modelled - as much as possible - to the standard relationships. Besides, unlike the previous versions, that used the statistical series beginning with 1980, the present one is based exclusively on information concerning the period 1989-2004. We have considered, therefore, more adequate to name this variant **the macromodel of the Romanian market** (not transition, as before) **economy**.

The model contains only annual variables. The nominal indicators are expressed in denominated local currency (RON). Taking into account the great share of European



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Union in Romanian foreign trade, the export, import, and exchange rate series were transformed into euro.

The version 2005 is composed of 182 equations, out of which 62 are econometric estimations and 120 are accounting relationships (identities, technical definitions, equilibrium conditions). They may be grouped into the following main blocks (Table 1):

- input–output (I-O) coefficients,
- output,
- production factors and labour income,
- domestic absorption and foreign trade,
- prices and exchange rate,
- financial and monetary variables.

**Table 1**

#### **Econometric and accounting relationships of the macromodel**

Block	Econometric relationships	Accounting relationships (identities, technical definitions, equilibrium conditions)	Total
I-O coefficients	36	0	36
Output	1	48	49
Production factors and labour income	4	16	20
Domestic absorption and foreign trade	17	32	49
Prices and exchange rate	3	14	17
Financial and monetary variables	1	10	11
Total	62	120	182

The macroeconomic behavioural and input-output relationships do not run separately. They are integrated into a system of simultaneous equations. This organic combination of the aggregate indicators with the six sectors decomposition of economy represents the principal innovation of the new version of the Romanian macromodel.

#### **A. Main Behavioural Relationships**

Regarding behavioural relationships, the present version of the model has retained those specifications which:

- a) are concordant with the standard macroeconomic theorems;
- b) correctly describe the peculiarities of the Romanian market economy;
- c) generate plausible results in simulations.

The main relationships will be grouped in seven sections:

- input-output block;
- labour market,



- production function;
- domestic absorption,
- foreign trade,
- prices and exchange rate, and
- interest rate.

### **B. Input-Output Block**

This block operates with two categories of coefficients:

- input coefficients ( $a_{ij}$ ) implied in the determination of output, and
- those defining the final utilization of resources (more precisely its sectoral distribution).

1. For the adopted classification of economic activities (six sectors), 36 input coefficients have been computed.

The econometric estimations of these coefficients are based on several hypotheses.

- Despite the effects induced by the transitional transformations (changes in sectorial structure of economy, in relative prices, in technologies, etc), it is assumed that the input coefficients tend towards the long-run stable levels (likely the consolidated functional market systems).
- This tendency is conceived as an autoregressive adaptive process, the differences between actual coefficients and their long-run levels being influenced by the past deviations.
- For uniformity, the same specification is adopted for all coefficients.

$$\Delta a_{ij} = g_{ij} - h_{ij} * a_{ij}(-1) \text{ where } a^*_{ij} = g_{ij}/h_{ij}$$

2. The sectoral structure of imports will be defined using the parameters  $shm_i$  from input-output tables. The estimation procedure is the one used in the case of input coefficients.

3. The sectoral structure of the final utilisation of resources was estimated on the basis of corresponding shares computed from input-output tables. The procedure presented for the coefficients  $a_{ij}$  is again applied in this case. In order to observe the restriction  $\sum shu_i = 1$ , a corrective parameter is also introduced.

### **C. Labour Market**

Three major relationships (involved in the functioning of the labour market mechanisms) will be analysed:

- labour force participation rate,
- unemployment rate, and
- rate of labour income per employed person.

1. The labour force participation rate (prap) is determined as a ratio of labour force to population over 15 years.

The adopted specification retains one lag for prap and two lags for E, which seems to be concordant with relatively high inertia of labour market processes. Therefore:



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$$\text{prap} = c(96) * \text{prap}(-1) + c(97) * E(-2)$$

2. Concerning the labour market, the unemployment rate (ru) has been also examined. It is defined as follows:

$$\text{ru} = (\text{LF} - E) / \text{LF}$$

where: LF – labour force, million persons, and

E – employment, million persons.

The preliminary analysis showed a significant correlation of this rate with the rate of unit labour cost (rIULC). The following specification has been adopted:

$$\text{ru} = c(98) * \text{ru}(-1) + c(99) * \text{rIULC}$$

3. A labour income equation has been also examined.

$$\text{rLIE} = c(100) * \text{rLIE}(-1) + c(101) * \text{dru} + c(102) * \text{rCPI}$$

where: LIE – nominal labour income per employed person,

rCPI – is the rate of the consumer price index,

dru – is the variation of the unemployment rate. ( $\text{dru} = \text{ru} - \text{ru}(-1)$ ).

### **D. Production Function**

The starting point is an usual production function with capital and labour, expressed in yearly indices: Due to the already presented circumstances, the tangible fixed assets are used in their conventional acceptation (described in the first chapter). Therefore,

$$\text{IGDPc} = \text{IE}^\alpha * \text{ICKc}^{(1-\alpha)} * \text{ITFP}$$

where: IGDPc – index of gross domestic product at constant prices,

IE – index of employment,

alpha – elasticity of output with respect to labour,

ICKc – index of conventional tangible fixed assets at constant prices, and

ITFP – index of the total factor productivity.

Total factor productivity has been determined as an index by the relationship:

$$\text{ITFP} = \text{IGDPc} / ((\text{IE}^\alpha) * (\text{ICKc}^{(1-\alpha)})) \quad (\text{I.C.4.1})$$

As determinants of ITFP, the following factors will be taken into account:

- level of alpha itself;
- intensity of the investment process;
- demand pressure;
- effect of institutional changes.

The value of the alpha coefficient was computed using data from two sources, labour income from the I–O tables, adjusted by the household disposable income ( $\text{alpha} = \text{alpha}_1 + d * \text{alphax}$ ).

The dependency of ITFP on alpha is modelled with the help of the following relationship:

$$\text{ITFP} = (\text{alpha} - \text{alpha}^a) * \text{RV}$$

where the value of the coefficient a was obtained as  $a = 4.58235724$ .

Finally the behavioural equation for ITFP is the following:



$$ITFP=(\alpha-\alpha^{4.58235724}) * (c(105)+c(106)*rAIGFCFc+c(107)*rDDP(-1)+c(108)*maru(-1)+c(138)/t)$$

where: DAD – domestic absorption, current prices, billion RON,

rAIGFCFc = (IGFCFc(-1)\*IGFCFc)^(1/2)-1 and IGFCFc is the index of gross fixed capital formation in constant prices,

rDDP – is the rate of the domestic demand pressure,

maru=(ru(-1)+ru)/2 is a arithmetical moving average of the rate of unemployment.

### **E. Domestic Absorption**

In this block, three relationships were examined:

- consumption of households (including private administration),
- public consumption, and
- gross fixed capital formation.

1. Initially, we estimated econometrically the final consumption of households in current prices (CH), of the following form:

$$rICHc=c(109)*rYDc+c(110)*vIR+c(111)*rICHc(-1)$$

where: ICHc = CH/(CH(-1)\*CPI) - 1,

vIR = is the change in interest rate,

rYDc = YD/(YD(-1)\*PGDP) -1 is the rate of the index of the disposable income.

2. The public consumption (CG) is determined in relation to the general consolidated budget expenditures (BE) and government transfers (TR). The coefficient

$$ccg1=CG/(BE-TR)$$

was computed and estimated as a function of time:

$$ccg1=c(112)+c(113)/t$$

3. In the case of the Romanian economy, investments are correlated with three explanatory variables:

- disposable income,
- interest rate, and
- foreign capital inflows.

. The gross fixed capital formation will be, therefore, estimated as follows:

$$rIGFCF=c(114)*rYD+c(115)*vIR+c(116)*rIFDPIE$$

where: rIGFCF – is the rate of the index of gross fixed capital formation;

rIFDPIE – is the rate of the index of foreign direct and portfolio investment.

### **F. Foreign Trade**

Both export and import refer to all transactions (either with goods or services).

The equation for exports takes the following form:

$$rIXGSE=c(117)*rIWTc+c(118)*rIMGSE+(c(119)+c(120)/t)*rICOsdr$$

where: rIXGSE – is the rate of the index of exports expressed in euros,

WTc – is a measure of the total world trade,

rICOsdr – is a measure for the competitiveness.



Similarly, imports were defined as:

$$rIMGSE=c(121)*rIFC_c+c(122)*rIGFCF_c+(c(123)+c(124)/t)*rICOsdr$$

where:  $rIFC_c$  – is the rate of the index of final consumption in constant prices,

$rIGFCF_c$  – is the rate of the index of gross fixed capital formation in constant prices,

### **G. Prices and Exchange Rate**

We consider the gross domestic product deflator (PGDP) as a leading price index, which is obtained as:

$$PGDP=IGDP/IGDP_c$$

The consumer price index (CPI) and the price index of tangible fixed assets (PK) are, therefore, estimated in two phases: first as econometric equations and, subsequently, as components of the GDP deflator.

The CPI is estimated as a function of M2 and exchange rate:

$$rCPI=c(125)*rIM2+c(126)*rIM2(-1)+c(127)*rIERE$$

Similarly, the equation for the price of tangible fixed assets is:

$$rPK=c(128)*rIM2+c(129)*rIM2(-1)+c(130)*rIERE$$

Now, it is necessary to introduce an explicit connection of consumer price index and index of tangible fixed assets with the gross domestic product deflator.

Thus is why the above relationships will be completed with a corrective coefficient PRC, resulted from the assumed condition:

$$PGDP=shch*CPI+shgfc*PK$$

where:  $shch=CH/(CH+GFCF)$

and

$$shgfc=GFCF/(CH+GFCF)$$

Therefore,

$$shch+shgfc=1$$

In the case of the Romanian economy - besides the inertial effect - two factors were considered essential for the determination of the exchange rate: domestic inflation and foreign capital inflows.

$$rIERE=c(131)*rIERE(-1)+c(132)*dPGDP+c(133)*rINCINXE$$

where:  $dPGDP$  – is the difference in the current and last year's deflator of the GDP,

$NCINXE$  – is the sum of net incomes and current transfers together with foreign direct and portfolio investment.

### **H. Interest Rate**

The present version of the Romanian macromodel includes inflation and real output as explanatory factors for the interest rate through their cumulative expression – nominal GDP.

Considering the geographical structure of the commercial and financial flows that involve the Romanian economy, the short-term interest rate in advanced countries (STIRAE) has been considered relevant for the present analysis.

$$IR=c(134)*IR(-1)+c(135)*rIGDP+c(136)*rIM2+c(137)*STIRAE$$



## **II. The scenario of the model**

The macromodel starts from the statistical data of the previous years and several exogenous indicators, specific for the current year, which are separately established or extracted from other forecasts.

1. Among them, the expected index of disposable income ( $Y_D^{\text{exp}}$ ) plays a leading role.

The experience of Romania showed that, in order to minimise the already produced losses and the future potential losses induced by inflation, the economic agents and trade unions exert a considerable pressure towards obtaining certain increases in nominal income; many of them are beforehand negotiated and agreed. The probability to fulfil such expectations proved significant. The budget policy (main public revenues and expenditures) is also in advance defined. There are more and more credible methods to approximate the possible transfers from abroad.

The estimation of  $Y_D^{\text{exp}}$  deserves a special investigation. For the moment, we only consider it as given. Obviously, in the future, the situation may change substantially. The structure of the macromodel allows to switch to other - eventually more relevant - targets.

2. The public budget is estimated using the following exogenous coefficients:

- vato – ratio (to GVA) of the value added tax, excises duties and other similar indirect taxes;
- cd – ratio (to import of goods and services expressed in RON) of the custom duties;
- dtobr – ratio (to GDP) of the direct taxes and other revenues (excluding indirect taxes) of the general consolidated budget;
- shnit<sub>i</sub> – share of the sector i in total net indirect taxes,  $i=1,2,\dots,6$ ;
- ctr – ratio (to general consolidated budget expenditures) of the government transfers;
- obe – ratio (to GDP) of other expenditures (excluding government transfers) of the general consolidated budget;
- subp – ratio (to general consolidated budget expenditures) of the budget subsidies on goods.

Deliberately, the present version of the macromodel contains a compendious structure of the general consolidated budget. Its future improvements will considerably develop this section.

3. The monetary policy is represented by the broad money (M2), submitted to the control of the Central Bank.

4. The international environment is characterised by the following parameters:

- NOCAE - net incomes and current transfers, billion Euro;
- FDPIE – foreign direct and portfolio investment, billion Euro;
- IWTc – yearly index of world trade, volume;
- WTDsdr – world trade deflator, SDRs;
- STIRAE - short-term interest rate in advanced economies.





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These and other similar information may be obtained from the forecasts of the international financial institutions and of specialised research centers. As in the case of public budget indicators, the next versions of the macromodel could significantly extend the range of indicators regarding the international context (regional disaggregation, state of the foreign financial markets etc).

5. The number of population over 15 years (AP) – involved in the determination of labour force – is extracted from the demographic predictions. Finally - again exogenously - the rate of tangible fixed assets depreciation (dfa) is estimated.

### **A. Computational Hypothesis**

1. The exogenous variables were defined according to the following premises:

a) the inflationary expectations are significantly diminishing in time, so the index of the expected disposable income is decreasing to 1.1325 in 2007;

b) the re-monetization process of the economy continues, but the decrease in the money velocity is induced by the gradual normalization of price dynamics;

c) the foreign capital inflows are stationary or are increasing moderately, the value in bn. euros in 2007 is 4.75;

d) only the consolidated budget is considered, the revenue and expenditure evaluation coefficients are aligned (in ways which are specific to the macro-model) to the parameters from the last Economic Program for Pre-accession for the 2005-2007. For example, direct taxes and other budget revenues are considered around 19% of the GDP, transfers to the population account for to 45.5% of the budget expenditure ;

e) the depreciation of the fixed capital is 0.05, which corresponds to an average period of utilization of 20 years;

f) the external environment is relatively stable, no possible shocks coming from this direction were considered, short term interest rate in advanced economies is considered 0.018, the world trade deflator is around 1.034, and the world trade index, in volume, is 1.045;

g) the projections of the population above 15 years of age are according to the current demographic projections, the population above 15 years is considered in 2007 around 18.1 mln. people;

The sectoral structure of the net indirect taxes which results from input-output tables was kept in large.

2. The Romanian economy is subject in the 2005-2006 interval to some negative influences which have delayed effects of 1-2 years. The current structure of the macromodel is such that the influences are introduced on the basis of expert estimations of the total factor productivity. Therefore, the corresponding function from the system (ITFP) is multiplied by the following numbers which are less than one: 0.98 in 2005-2006. 0.985 in 2007.

3. The solutions obtained for the interval generate three inertial conditions which require special discussion:

- a significant increase in household consumption at the expense of investments;



- an appreciation, small at the beginning and explosive afterwards, of the RON exchange rate;
- a significant increase in the first years in the imports of goods and services with the severe deterioration of the trade balance;

These tendencies are inter-related.

There is a possibility that they result, at least partly from the basic function specification as well as the data series used in regressions. At least as plausible is the explanation that the evolutions are indeed the real behaviour of the Romanian economy. In the building of the present scenario using the 2005 version of the macro-model the second presumption is considered true.

From a technical point of view I have done the following adjustments:

3.1. during the entire interval, the household consumption equation was divided by 1.035, while the equation of the gross fixed capital formation was multiplied by the same quantity;

3.2. in the exchange rate equation I have introduced a corrective coefficient which maintains the appreciation of the RON in an economic sustainable interval;

3.3. the import equation is multiplied by 0.95 in 2005-2006 and by 0.975 in 2007.

The above coefficients were derived by repeatedly solving the model in order to get close to the main indicators from the simulations derived in the Pre-accession Economic Program.

The proposed technique should not be viewed only as a computational exercise. It is motivated by more profound rationale. If the macroeconomic management does not change, the probability of attaining the base scenario is reduced. The probability becomes acceptable only in the case that strong measures for producing the adjustment of the domestic demand, exchange rate and imports are adopted and become effective. In other words, the coefficients presented in 3.1, 3.2 and 3.3 should be considered not only as computational ingredients but also as milestones in designing the macroeconomic policy mixed for the period. Both the Government as well as the Romanian National Bank have frequently expressed their disponibility to act in this respect.

### **B. Simulation results**

The main indicators of the economic plausible solution of the system are presented in Table 2.

**Table 2**

#### **2007 Forecast 2007 Base Scenario**

Indicators	Symbol	2007
GDP, current prices, bn. RON	GDP	358.74
GDP index, current prices	IGDP	1.1298
GDP index, constant prices	IGDPc	1.0634
Household consumption index, constant prices	ICHc	1.0727
Gross fixed capital formation index, constant prices	IGFCFc	1.1294



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Indicators	Symbol	2007
Export of goods and services, bn Euro	XGSE	30.303
Import of goods and services, bn. Euro	MGSE	42.492
The deficit of the trade balance (% of GDP)	rNXGS	-0.1197
Labour force, mln. pers.	LF	9.4532
Employment, mln. pers.	E	8.7522
Unemployment rate	ru	0.0742
GDP deflator	PGDP	1.0625
Consumption price index	CPI	1.0682
Exchange rate, RON/EUR	ERE	3.5236
Revenues of the general consolidated budget (% of GDP)	br	0.3229
Expenses of the general consolidated budget (% of GDP)	be	0.332
The general consolidated budget deficit (% of GDP).	cbb	-0.0091
Money velocity	v	3.3216

Therefore, the reduction in the inflationary expectation induces a compression in the nominal GDP, the growth rate of the real output (IGDP<sub>c</sub>) is increasing. It is worth mentioning that the main resources of growth are the total factor productivity and the increase in the capital. As expected, the premise for this evolution is a significant des-inflation.

With respect to domestic demand, according to the hypothesis adopted, the dynamics of the gross fixed capital formation stays high, while the annual rate of household consumption tends towards 7%. In spite of all corrections (mentioned above) introduced into import, and exchange rate equations, the trade balance deficit remains troublesome (12% of GDP). This means that the issue of actively stimulating exports and maintaining import expansions within reasonable limits should be a major preoccupation for Government institutions and the National Bank of Romania.

## **Bibliography**

Emilian Dobrescu: "Macromodel of the Romanian Market Economy (Version 2005)", PHARE Programme RO2003/005-551.02.03 "Strengthening the capacity for analysis, macroeconomic forecast and elaboration of economic policies within the National Commission of Prognosis, the Ministry of Economy and Trade and the Prime Minister's Cabinet" – Romanian Center for Economic Policies; <http://www.cnp.ro/SiteNCP.pdf>

Emilian Dobrescu: "Integration of Macroeconomic Behavioural Relationships and the Input-Output Block (Romanian Modelling Experience)", Paper presented at the International Conference on Policy Modelling (Ecomod 2006), Hong Kong, June 28-30, 2006, <http://www.ecomod.org/files/papers/1564.pdf>.

Emilian Dobrescu: "*Macromodels of the Romanian Market Economy*", Editura Economica, Bucharest 2006, 326 pgs.

