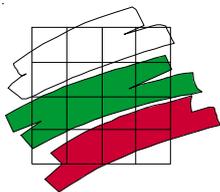


WORKING PAPER SERIES

THE AEF MODEL: A MEDIUM TERM ANNUAL MODEL OF THE BULGARIAN ECONOMY



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ANALYSIS AND FORECASTING**

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1. Introduction

This paper describes the model of the Bulgarian economy designed, formulated and constructed within the Bulgarian Agency for Economic Analysis and Forecasting. The model is an annual model, although some of the parameters are estimated on the basis of quarterly information. Its main feature is that it is based on an integrated set of financial and national accounts. It contains both, the determination of product demand and supply, labour demand and supply in the real sector of the economy and a rather detailed monetary sector. The latter describes the main financial relations between the central bank, private banks, government and the private and foreign sectors.

In spite of the incomplete statistical information and the general difficulties in modelling financial flows, the inclusion of a monetary sector was considered extremely important from the outset. The main reasons being that monetary developments played a significant role in recent Bulgarian economic developments and because it was considered not realistic to formulate a model with uncontrollable open ends. This choice implies an important role for monetary variables in the model. In this paper the effects of the inclusion of monetary relationships will be illustrated with separate simulations with the real and monetary blocks of the model and by comparing those with the results of the model in which both sectors are integrated.

Another choice made from the beginning is that the model should be able to describe both supply and demand in the markets distinguished. The inclusion of a rather detailed supply side was considered important because the main changes in an economy in transition like the Bulgarian economy are taking place in the supply side of the economy. As will be shown below some experiments have been tried with the different specifications of the supply side of the economy. Those experiments varied from Cobb-Douglas type of technology to a vintage approach. Up to now the CES production approach appears to give the most sensible results in terms of overall model solutions.

The model has as far as data allowed been estimated econometrically. This especially applies for the demand side of the model and the monetary sector. On the other hand the parameters of the supply side has been derived indirectly, simply because the data did allow elaborated econometric tests on the supply side of the economy.

The plan of this paper is as follows. After a brief discussion of the used statistics and estimation of parameters in section 2 the general structure of the model will be explained in section 3. Section 4 contains a description of the real sector of the model. The real sector is rather conventional, though incidentally some elements are treated in an unusual way, as will be shown below. Rather than only focusing on annual forecasts the model was also required to show desirable dynamic characteristics. This implies that it should at least produce a stable long-term solution. This is more or less guaranteed

by applying rather strict neo-classical rules for behavioural equations regarding product supply and demand and labour supply and demand. Short-term aberrations are allowed in cases of over-capacity in the product market or in cases of excess supply or demand in the labour market.

Similarly excess supply or demand indicators are used in the relation between money markets and the real sphere. Several demand items include monetary supply variables indicating that demand is larger if liquidity in the economy is larger. The latter is reflected in a proxy for excess liquidity. As a result the monetary and real sectors are not only linked through interest rates as is traditionally the case, but also through these proxies for over or under liquidity of the economy.

2. Statistics and Estimation of Parameters

As mentioned in the introduction the main principle of the modelling activity is that it should be based upon a full and consistent set of national accounts. Preferably it should not have uncontrollable open ends. Such a principle requires a full and consistent set of national accounts. Such accounts are available for Bulgaria, but unfortunately at an annual basis only and for a very limited period of time. As a result it is virtually impossible to econometrically estimate the parameters on the basis of this information. An additional complication regarding data availability is related to the relatively hectic economic fluctuations during the period 1997-1998, a period characterized by double-digit inflation rates and a considerable economic recession. For these reasons data before 1998 can hardly be used, also seriously limiting the scope for estimations.

Given this situation it has been decided to estimate (a limited set of) the parameters on the basis of quarterly information. In practice this meant that at best 16 observations were available and for quite a number of variables even less. For the parameters that could not be estimated either because of the limited number of observations or because the data were simply not available the parameters were 'guestimated'. These guesses are based upon theory and from what is known from empirical studies in other, often, comparable countries.

3. The general structure of the model

The model contains seven more or less interdependent blocks. The *first block* represents the supply side of the economy. It contains a two-level CES production function. The first level describes the relation between GDP production capacity on the one hand and efficiency units of the total capital stock and labour on the other hand. The second level aggregates private sector and public sector capital stocks to total capital stock. Utilization rates are derived through minimizing short-term costs with given production, labour and capital stocks. Planned capacity is related to (expected) sales and to

the difference between foreign prices and cost per unit of output of domestic production. This difference can be seen as an indicator of profitability.

The *second block* provides a rather conventional determination of effective domestic demand. Consumption expenditure is explained by disposable income of households. In addition a so-called spill-over effect from the monetary sphere is included. This effect represents over- (under-) liquidity of households. Total investment is divided into government investment and private investment. Government investment is assumed exogenous in values and can be treated as a policy variable. Since prices of government investment are determined endogenously within the model government investments in constant prices are treated endogenously. The changes in private investment are dominated by the flexible accelerator mechanism, in which desired capacity and expected capital costs determine the planned capital stock; an additional determinant is the utilization rate. Here as well as in the case of private consumption excess money supply (demand) represent, in addition to the interest rates that play a role in capital costs, monetary influences. Changes in stocks are related to sales and the lagged stock (flexible accelerator). Also prices of commodity imports (speculation) and the utilization rate (precaution) play a role.

The *third block* describes the trade relations with abroad. World trade (that is total world imports weighted by the relative share of Bulgarian exports to the various world regions), relative prices and home pressure of demand explain exports of goods. Exports of services are determined endogenously as well, and its main determinants are world imports and relative prices. Total imports are divided into two categories: imports of goods and imports of services. Imports of goods are explained by total domestic sales, relative prices (domestic versus import prices) and a variable representing home pressure of demand. The latter reflects that imports tend to increase relatively fast when domestic demand is in excess of domestic supply. Imports of services follow disposable income corrected for different price developments domestically and abroad.

Wages and prices are determined in the *fourth block*. Domestic cost per unit of output, that is the sum of capital- and wage costs, and import costs determine market prices (consumption, investment, etc.). In a few of these price equations such as in the case of private consumption indirect taxes play a role as well. Here it should be mentioned that through prices cost per unit of output play an extremely important role in the model. It is the main determinant of prices and through them of the competitiveness of the Bulgarian economy. The costs per unit of output are determined through cost minimization under the assumption of an exogenous public sector capital stock. As a result the productivity per unit of private owned capital and labour declines if the capital stock of the public sector lags behind. In some policy simulations this effect is quite significant such as in the case of increasing government investments.

The GDP deflator is determined on the basis of the definitional relationship.

The private wage rate equation implies full compensation of consumption prices, compensation of labour productivity, a complete shifting of the burden of taxes and premiums for social security to employers and a Phillips-curve effect reflected by the unemployment rate. The government wage rate follows the private wage rate with some time lag.

The *fifth block* contains private labour demand and supply. Labour demand is related to the desired capacity and labour costs developments in comparison with overall cost developments. Labour supply is based on an endogenous participation rate, on which the differences between real wages and alternative income has a positive and labour market tension has a negative impact. In some versions of the model labour supply is based on population growth only.

Block six describes the government sector. Social benefits follow wage rate developments. Total premiums follow the social benefits corrected by government payments. The shares of premiums paid by employers and employees depend on the unemployment rate. Taxes are endogenous. The expenditures in current prices are exogenous as well as government employment.

Money supply and demand are determined in the *seventh block*. The main feature is a money multiplier model, in which the main inputs for money supply are the surplus (deficit) on the current account and the surpluses (deficits) on the financial accounts of the balance of payments. In addition the behaviour of the private banks is explained through shifts in its portfolios has an impact on supply. Money demand follows behaviour of the public regarding its optimum portfolios. The monetary sub-model determines the various interest rates that on their turn have an impact on several domestic demand categories. The major spill-over from the real to the monetary sector is total domestic demand reflecting the transaction motive of the public. The channels through which the monetary variables have an impact on the real sphere are the interest rates and a variable reflecting over- or under-liquidity of the economy.

4. Real sector

4.1. Block 1: Supply side

Planned capital stock and labour demand are derived on the basis of a long-run cost minimalization model where a two-level CES production function serves as the planning relation between expected long-run output, desired labour input and desired capital stock. From the same model a cost function is derived, which will be used for the determination of planned capacity and prices, the latter being more fully discussed below. Next equations are derived for utilization rates, which reflect possible short-run deviations from the optimal levels.

It is assumed that the optimal combination of capacity and factor inputs can be described by a two-level CES production function with constant returns to scale. The first level determines production on the basis of total capital and labour, whereas at the second level the private and public sector capital stocks are aggregated to total capital. The production factors labour and capital are measured in efficiency units under the assumption that both labour and capital efficiency follow a continuous function of time, representing technical progress and working hours. Since public sector capital is exogenous in the optimisation problem marginal productivity declines with increasing private sector capital stock and constant public sector stocks. This declining marginal productivity is reflected in the cost per unit of output that increase if the public sector capital stock grows at a slower rate than the private sector capital stock.

Expectations are determined on the basis of distributed lags of the relevant variables. User cost of capital follows the definition of Jorgenson, in which the price of investment and the real interest rate plays a role next to the rate of depreciation.

As mentioned from this optimisation problem also an overall cost function can be derived, which is used in the determination of prices and planned capacity, assuming that imperfect competition between domestic and foreign producers prevails in product markets, with firms anticipating a log-linear aggregate demand function.

The above system of equations determines the long-run solution of the model. There may however be a number of reasons that in the short-run actual values deviate from the long-run equilibrium values of the model. These deviations give rise to shifts in the utilization rates of labour, capital and overall capacity.

Actual capacity is determined through a short-run production function in which labour and capital stock are considered constant. Assuming that firms minimize costs of over- and under-utilization and assuming that that these costs are a linear function of the wage bill and total capital costs an expression for the overall utilization rate of capacity can be obtained.

$$\begin{aligned}
 \text{capstarpc} &= 1.0 * P(L) * \text{adapc} + \text{coef}(1) * P(L) * (\text{cpupc} - \text{padapc}) \\
 \text{Kastpc} &= \text{capstarpc} - \text{coef}(2) * P(L) * (\text{pkpc} - \text{cpupc} - \text{coef}(3)) + \text{coef}(4) * (\text{BRPC}(-1) - \text{adapc}) \\
 \text{Kpr} &= (\text{kast}^{\text{coef}(5)} * ((1 - \text{coef}(6)) * \text{kpr}(-1))^{\text{coef}(6)}) \\
 \text{Kg} &= (1 - \text{coef}(8)) * \text{kg}(-1) + \text{ig} \\
 \text{Kpc} &= (1 - \text{coef}(9)) * \text{kprpc} + \text{coef}(9) * \text{kgpc} \\
 \text{Cappc} &= \text{coef}(10) * (\text{emplprpc} + \text{parprodfn}(3)) + \text{coef}(11) * (\text{kpc}(-1) + \text{coef}(4)) \\
 \text{Qy} &= 100 * y / \text{cap}
 \end{aligned}$$

4.2. Block 2: Aggregate demand

This section describes four components of aggregate demand, namely consumption, business investments and changes in stocks.

Consumption demand

Consumption demand consists of private and government consumption. The value of government consumption is assumed exogenous.

Private consumption (constant prices) is determined by disposable income of households, where the relevant elasticity has been taken as unity. In addition to income variables consumption is stimulated in cases of over-liquidity in the economy reflected by begin-of-period (re-defined) base money in relation to total sales.

$$\text{Cnipc} = \text{Coef}(10) * (\text{dihpc} - \text{pcnipc}) + \text{coef}(11) * (\text{BRPC}(-1) - \text{ADAPPC})$$

Private investment

The theoretical basis for the two major factor demand equations (productive private investment and employment of wage earners) is the CES production model described above combined with efficient allocation assumptions. Ideally these assumptions lead to mutually consistent desired levels of the capital stock and the labour stock that would enter the specifications for business investments and employment.

The equation for “productive” business investment is based on a partial adjustment model in which gross investment is proportional to the gap between desired level of the capital stock, which on its turn based on the structural demand for output of firms, and the utilization rate. Theoretically the desired level of the capital stock depends on desired capacity and relative costs (capital costs and wage costs).

$$\text{Ipr} = \text{kpr} - \text{kpr}(-1) + \text{coef}(7) * \text{kpr}(-1)$$

Inventories

A stock adjustment model in which the level of inventory formation is proportional to the gap between planned and actual stocks explains inventory formation.

4.3. Block 3: Foreign Trade

Exports of goods & services

The volume of exports of goods depends on world imports. The relevant elasticity is pegged to unity, assuming that, ceteris paribus, Bulgaria maintains a constant market share in the world commodity imports. In addition, a low rate of utilization tends to influence the volume of exports favourably reflecting that exports compete with domestic demand ('home pressure of demand). Relative prices are included to allow for the effect of shifts in price competitiveness between Bulgarian and foreign suppliers.

The equation for exports of services contains total trade of goods, that is the total of Bulgarian commodity imports and exports. Further relative prices are included.

$$\begin{aligned} \text{expgpc} &= \text{mwpc} + \text{coef}(12) * P(L) * (\text{pexpgpc} - \text{pmwpc}) + \text{coef}(13) * (\text{qy} - 100) \\ \text{expspc} &= \text{coef}(14) * \text{tradepc} + \text{coef}(15) * P(L) * (\text{pexpgpc} - \text{pmwpc}) \end{aligned}$$

Imports of goods & services

Imports of goods are primarily explained by total sales, divided into inventories and other sales. Furthermore price competitiveness of foreign versus domestic suppliers is represented by a relative price term. The price elasticity is pegged at 0.5, which is the same as above in the determination of domestic production. Supply factors are allowed for by means of the utilization rate in the Bulgaria economy. Rising capacity utilization imply more imports (home pressure of demand).

Imports of services is determined by disposable income with an elasticity of unity and relative prices reflecting competition between foreign and domestic suppliers.

$$\begin{aligned} \text{impgpc} &= \text{adapc} + \text{coef}(16) * P(L) * (\text{pimpgpc} - \text{padapc}) + \text{coef}(17) * (\text{qy} - 100) \\ \text{impspc} &= \text{coef}(18) * (\text{dihpc} - \text{pcnipc}) + \text{coef}(18) * P(L) * (\text{pimpspc} - \text{padapc}) \end{aligned}$$

4.4. Block 4: Wages and Prices

Prices

The prices of the main expenditure categories are essentially explained from cost per unit of output and from the price of total imports. In addition the prices of commodity exports and of exports of services are further related to the relevant (exogenous) competitors' price. The price of government consumption is assumed to depend on the wage rate and the price of total sales. On top of these costs

indirect taxes are added as an additional explanatory variable in some of the price equations. Discrepancies between demand and supply are represented by the utilization rate, which has been added to some of the equations. The GDP deflator is based on the definitional relation between GDP in current and constant prices.

All price equations are linearly homogeneous in the explanatory price variable.

$$\begin{aligned}
 Pcnipc &= (1 - nettax(-1) / adap(-1)) * (cpupc + (impdsp(-1) / adap(-1)) * (pimpdspc - cpupc)) + (nettax(-1) / adap(-1)) * (nettaxpc - adappc) + coef(19) * (qy - 100) \\
 Piprpc &= Coef(20) * pypc + (1 - coef(20)) * pimpdpc \\
 Pigpc &= Coef(21) * pypc + (1 - coef(21)) * pimpdpc \\
 Ppgc &= Coef(22) * padpc + (1 - coef(22)) * wrdpc \\
 Pexpdpc &= Coef(23) * pexcompdc + (1 - coef(23)) * cpupc \\
 Pexpspc &= coef(24) * pexcompdc + (1 - coef(24)) * cpupc \\
 Cpupc &= w_lab * P(L) wrdpc + w_kpr * P(L) * pkpc - coef(4) - (1 / coef(3)) * w_kpr * coef(25) * (kgpc(-1) - kprpc(-1)) \\
 Pipcstar &= 0.25 * pipc + 0.75 * pipcstar(-1) \\
 realint &= rlbu - pipcstar \\
 pkpc &= pipc + (pi(-1)/pk(-1)) * (realint - realint(-1)) \\
 pk &= (1 + .01 * pkpc) * pk(-1)
 \end{aligned}$$

Wages

In the model a distinction is made between the wage rates of the private sector and the public sector. The elasticity of the private sector wage rate with respect to the price of private consumption is set at one. Wage earners benefit for 100% from labour productivity increases. It is further assumed that wage earners are able to shift the burden of social security contributions and direct taxes on wage income to employers. Finally the unemployment rate is added to represent the Phillips-curve mechanism. The overall model results appear to be extremely sensitive for the way the Phillips curve mechanism is specified. In case it is included as a level the model generates an 'equilibrium unemployment' rate of about 17%, which seems, although about equal to the current rate in Bulgaria, to be quite high for the long run. If the unemployment rate is included in deviation from a moving average the model shows a declining rate to approximately 10% of the labour force. In the policy simulations presented later the latter specification is applied. Although ideally this question should have been solved empirically the statistics do not allow a final answer.

The public sector wage rate is linked to the wage rate of companies. We assume that in the long run public sector wages follow completely the wages paid in the private sector.

$$\text{Wrprpc} = \text{coef}(25) * \text{P(L)} \text{pcnipc} + \text{coef}(26) * \text{P(L)} * (\text{ypc} - \text{emplpc}) + \text{coef}(27) * (\text{ur} - .250 * (\text{ur}(-1) + \text{ur}(-2) + \text{ur}(-3) + \text{ur}(-4))) + \text{coef}(28) * \text{presshpc} + \text{coef}(29) * \text{presscpc}$$

4.5. Block 5: Labour market

Total employment is divided into dependent and exogenous independent employment, the latter comprising self-employed workers. Government employment is exogenous as well. Unemployment follows from its definition.

It is assumed that the actual level of private sector employment is partially adjusted to the desired level, which is determined on the basis of the optimisation procedure described above.

The supply of labour is determined by the size of the working-age population, which exogenous in the model. With the elasticity fixed at unity the equation basically explains the percentage change in the participation rate of the active population in the labour force. In addition the supply of labour is related to the unemployment rate to allow for the so-called discouraged worker effect. The wage rate as well as real income per head is included. In an alternative version of the model labour supply is only related to the developments in the working-age population.

$$\begin{aligned} \text{Empl} &= \text{emplpr} + \text{emplg} \\ \text{Lfpc} &= \text{popu_15pc} \\ \text{Lastpc} &= 1.0 * \text{capstarpc} - \text{coef}(4) * \text{P(L)} * (\text{wrprpc} - \text{cpupc} - \text{coef}(3)) - \text{coef}(3) \\ \text{Emplpr} &= \text{last}^{\text{coef}(30)} * \text{emplpr}(-1)^{(1 - \text{coef}(30))} \\ \text{U} &= \text{Lf} - \text{empl} \\ \text{Ur} &= 100 * \text{U} / \text{lf} \end{aligned}$$

4.6. Block 6: Government

The basic principle of the social security system is that benefits are related to wages and unemployment. The price component is reflected by the wage rate whereas the volume is represented by number of unemployed people. Premiums for social security are determined on the basis of total benefits, whereas the difference between total premiums paid and benefits received is covered from the government budget.

4.7. Policy simulations with real sector only

As an illustration and with a view to learn about the main mechanisms and about its dynamic features the real sector of the model has been used to simulate a number of changes in exogenous and policy

variables. The results are presented in the tables below. They start with assuming changes in the external world: an increase in world trade and world prices. Costs per unit of output are to a large extent determined by wage rate developments. In order to show its importance the impact on the main economic variables have been estimated under the assumption that the wage rate change is permanently 1% point lower than is projected through the wage rate equation (see Table 4.3).

In virtually all countries and Bulgaria is no exception the role of the government is discussed. The model distinguishes a few policy variables, such direct and indirect taxes, and government investment and consumption expenditures. Tables 4.4 to 4.9 show the results as calculated with the model if taxes and expenditures are increased with 1% of GDP. The section ends with a simulated increase in private sector investments which could materialize if Foreign Direct Investments accelerate.

The main conclusions from these simulations are that the model results are extremely sensitive for the specification of the wage rate equation. In particular the way in which the Phillips curve is specified is important. In general economic literature presents two different approaches. First, the wage rate change depend on the change of unemployment, and secondly it is explained by the level of the unemployment rate. The latter is often specified in deviation from an 'equilibrium unemployment rate' or 'natural unemployment'. The baseline projection shows that in case the wage rate changes are among others explained by the level of the unemployment rate it stabilizes at an unemployment rate of about 17%. In case wages are explained by the change in unemployment the model projects an 'equilibrium unemployment' of about 10%. On the basis of these calculations the latter has been preferred. It is obvious that the different hypotheses should be tested empirically but the current statistics in Bulgaria do not allow such econometric tests.

The wage rate equation is also important from another perspective. The specification is based on the assumption that wage earners and employers negotiate about net wages rather than about gross wages. Net wages are defined here as wages excluding taxes and contributions to social security. The result is that the wage rate equation includes terms reflecting the burden of taxes and social security contributions. These terms explain that the wage rate increases when taxes (and/or social security premiums) are raised up to a moment that the negative unemployment effect dominates this effect (see table 4.4).

Several assumptions have been applied for the specification of the production function, from a Cobb-Douglas function to a vintage approach. The model appeared to be extremely sensitive for cost and price fluctuations if the supply side was based on Cobb-Douglas technology. For that reason this approach was rejected. An alternative used was the vintage approach. Especially in a situation of structural unemployment as is the case in Bulgaria at the moment a production function based on vintages seems to be the most appropriate. However, such an approach requires a lot of reliable

information about the history on investments, which by far not available for Bulgaria. For these reasons although from a theoretical point of view this approach might have been preferable to base the supply side on CES production function with a substitution elasticity of .25.

Since the supply side of the model basically follows the neo-classical paradigm it is no surprise that overall costs per unit of output play an important role. This is even more important in small open economy such as Bulgaria. Both exports and imports are next to other variables determined by the differences between domestic and foreign prices. The elasticities are 'guestimated', also because it was not possible to quantify them econometrically. Another important feature of the supply side is that the total capital stock, which determines next to labour determines total capacity, is composed of private and public sector capital. Private sector investments and through them private sector capital is determined endogenously based on cost minimising and profit maximising behaviour. In this procedure the public sector capital stock is considered exogenous. As a result the level of the public sector stock in comparison with the overall capital stock is introduced as an explanatory variable in cost per unit of output. In other words if growth of government investment lags behind overall growth the marginal productivity of capital (and labour) declines, which has a positive effect on costs per unit of output. This phenomenon is clearly illustrated in the tables that present the increase of government investment and government consumption (Tables 4.6 and 4.7). In the case government increase its investments GDP growth is significant higher than when government expands its consumption expenditures.

The dynamics of the model seems to be sound. With growth of all external variables set at zero the model generates in the long run GDP growth, which is equal to the sum of the exogenous determined technical progress (assumed at 2% per annum) and population growth (assumed at 0% per annum). Prices stabilize in this situation at 0% per year. In the short run however the model generate some cycles depending on level of capacity utilization and on the level of unemployment. In the end the model generates a capacity utilization rate of 100%, which is assumed to be the optimum.

Table 4.1: World trade + 1% permanent					
	2003	2004	2005	2010	2015
<i>Cumulated as % of baseline</i>					
GDP	0.12	0.58	0.94	1.12	1.47
Production Capacity	0.02	0.09	0.23	0.80	1.20
Private Consumption	-0.03	0.15	0.60	1.79	3.08
Disposable Income Households	0.33	1.42	2.87	10.69	19.54
Exports G&S	0.35	1.64	2.45	3.68	4.67
Investment	-0.07	0.05	0.36	1.12	1.70
Wage rate	0.23	0.93	2.17	9.60	17.69
Deflator private consumption	0.42	1.13	2.20	9.14	16.66
GDP deflator	0.22	0.88	1.95	9.42	17.76
Employment	0.02	0.11	0.27	0.89	1.36
<i>Absolute difference from baseline</i>					
Unemployment	-0.02	-0.09	-0.23	-0.77	-1.18
Current account BoP, % GDP	-0.02	0.30	0.40	0.47	0.46
Government Deficit, % GDP	-0.09	-0.33	-0.57	-1.14	-1.27

Table 4.2: World prices + 1% permanent					
	2003	2004	2005	2010	2015
<i>Cumulated as % of baseline</i>					
GDP	0.71	0.81	0.86	1.29	1.77
Production Capacity	0.26	0.40	0.53	1.07	1.64
Private Consumption	0.84	1.15	1.41	2.68	4.13
Disposable Income Households	1.56	2.24	2.90	6.36	10.31
Exports G&S	1.90	2.19	2.43	3.67	4.75
Investment	0.78	1.07	1.31	2.39	3.58
Wage rate	1.05	1.64	2.23	5.24	8.63
Deflator private consumption	0.64	1.07	1.52	3.77	6.27
GDP deflator	0.86	1.42	2.00	4.96	8.31
Employment	0.29	0.43	0.57	1.06	1.59
<i>Absolute difference from baseline</i>					
Unemployment	-0.24	-0.37	-0.49	-0.93	-1.40
Current account BoP, % GDP	0.31	0.31	0.31	0.35	0.29
Government Deficit, % GDP	-0.34	-0.42	-0.48	-0.66	-0.71

Table 4.3: Wage rate -1% permanent					
	2003	2004	2005	2010	2015
<i>Cumulated as % of baseline</i>					
GDP	0.10	0.41	0.91	3.33	5.65
Production Capacity	0.07	0.26	0.60	3.11	5.58
Private Consumption	-0.10	-0.25	-0.27	0.70	1.75
Disposable Income Households	-0.49	-1.25	-1.87	-3.23	-4.32
Exports G&S	0.24	1.03	2.16	6.40	9.89
Investment	0.07	0.27	0.61	3.35	5.49
Wage rate	-1.24	-2.76	-4.24	-9.35	-13.69
Deflator private consumption	-0.33	-1.05	-1.79	-4.17	-6.26
GDP deflator	-0.49	-1.49	-2.53	-6.04	-9.06
Employment	0.08	0.30	0.71	3.52	6.15
<i>Absolute difference from baseline</i>					
Unemployment	-0.07	-0.26	-0.63	-3.20	-5.70
Current account BoP, % GDP	0.03	0.15	0.33	0.72	1.10
Government Deficit, % GDP	-0.01	-0.04	-0.15	-0.92	-1.55

Table 4.4: Direct Taxes Households + 1% GDP permanent					
	2003	2004	2005	2010	2015
<i>Cumulated as % of baseline</i>					
GDP	-0.32	-0.99	-1.24	-0.92	-1.17
Production Capacity	-0.14	-0.40	-0.74	-1.14	-1.22
Private Consumption	-0.55	-1.35	-1.79	-2.17	-2.43
Disposable Income Households	-0.70	-0.82	-1.43	-2.51	-2.80
Exports G&S	-0.31	-0.83	-0.91	0.57	0.64
Investment	-0.25	-0.74	-1.27	-1.39	-1.41
Wage rate	1.62	1.72	1.21	-0.06	-0.23
Deflator private consumption	0.42	0.79	0.53	-0.43	-0.47
GDP deflator	0.67	1.24	0.94	-0.36	-0.41
Employment	-0.16	-0.46	-0.84	-1.18	-1.21
<i>Absolute difference from baseline</i>					
Unemployment	0.14	0.40	0.75	1.07	1.12
Current account BoP, % GDP	0.31	0.49	0.58	0.86	0.82
Government Deficit, % GDP	-0.76	-0.62	-0.50	-0.51	-0.49

Table 4.5: Indirect Taxes + 1% GDP permanent					
	2003	2004	2005	2010	2015
<i>Cumulated as % of baseline</i>					
GDP	-0.19	-0.55	-0.56	-0.18	-0.21
Production Capacity	-0.02	-0.10	-0.20	-0.28	-0.28
Private Consumption	-0.49	-1.12	-1.31	-1.21	-1.28
Disposable Income Households	-0.39	-0.68	-0.99	-1.49	-1.83
Exports G&S	-0.02	0.01	0.17	0.98	1.09
Investment	-0.14	-0.35	-0.58	-0.45	-0.45
Wage rate	0.20	0.17	-0.21	-0.76	-1.03
Deflator private consumption	0.63	0.59	0.36	-0.31	-0.60
GDP deflator	0.59	0.64	0.37	-0.47	-0.80
Employment	-0.03	-0.12	-0.23	-0.26	-0.24
<i>Absolute difference from baseline</i>					
Unemployment	0.02	0.10	0.20	0.23	0.23
Current account BoP, % GDP	0.25	0.44	0.56	0.66	0.62
Government Deficit, % GDP	-0.87	-0.78	-0.75	-0.80	-0.78

Table 4.6: Government Consumption + 1% GDP permanent					
	2003	2004	2005	2010	2015
<i>Cumulated as % of baseline</i>					
GDP	0.46	0.49	0.35	0.19	0.25
Production Capacity	0.07	0.18	0.29	0.28	0.29
Private Consumption	0.35	0.79	0.86	0.78	0.89
Disposable Income Households	0.81	1.23	1.51	1.61	1.75
Exports G&S	-0.12	-0.43	-0.83	-1.24	-1.29
Investment	0.24	0.52	0.78	0.36	0.40
Wage rate	0.21	0.74	1.08	1.24	1.35
Deflator private consumption	0.12	0.42	0.72	0.88	0.93
GDP deflator	0.41	0.77	1.15	1.42	1.51
Employment	0.08	0.20	0.33	0.26	0.28
<i>Absolute difference from baseline</i>					
Unemployment	-0.07	-0.17	-0.29	-0.23	-0.25
Current account BoP, % GDP	-0.43	-0.66	-0.78	-0.80	-0.85
Government Deficit, % GDP	0.69	0.63	0.63	0.75	0.79

Table 4.7: Government Investment + 1% GDP permanent					
	2003	2004	2005	2010	2015
<i>Cumulated as % of baseline</i>					
GDP	0.70	0.90	1.15	3.01	5.20
Production Capacity	0.08	0.37	0.70	2.42	4.56
Private Consumption	0.30	0.70	0.93	2.46	4.24
Disposable Income Households	0.70	0.79	0.85	0.66	0.25
Exports G&S	-0.18	-0.21	0.06	2.52	5.60
Investment	7.53	8.18	9.12	14.33	19.74
Wage rate	0.24	0.74	0.90	1.34	1.68
Deflator private consumption	0.13	0.02	-0.16	-1.86	-3.94
GDP deflator	0.04	-0.14	-0.37	-2.56	-5.19
Employment	0.09	0.22	0.38	0.97	1.62
<i>Absolute difference from baseline</i>					
Unemployment	-0.08	-0.19	-0.34	-0.88	-1.50
Current account BoP, % GDP	-0.50	-0.75	-0.84	-1.18	-1.48
Government Deficit, % GDP	0.52	0.50	0.47	0.32	0.16

Table 4.8: Government Investment & Direct taxes Households + 1% GDP					
	2003	2004	2005	2010	2015
<i>Cumulated as % of baseline</i>					
GDP	0.32	-0.20	-0.19	1.99	3.62
Production Capacity	-0.07	-0.07	-0.11	1.19	3.02
Private Consumption	-0.32	-0.83	-1.11	0.15	1.40
Disposable Income Households	-0.14	-0.32	-0.95	-1.77	-2.13
Exports G&S	-0.47	-0.97	-0.72	2.73	5.09
Investment	7.27	7.37	7.69	12.65	17.17
Wage rate	1.84	2.36	1.92	1.33	1.69
Deflator private consumption	0.54	0.74	0.24	-2.06	-3.62
GDP deflator	0.64	0.93	0.31	-2.72	-4.81
Employment	-0.08	-0.28	-0.53	-0.19	0.39
<i>Absolute difference from baseline</i>					
Unemployment	0.07	0.24	0.46	0.16	-0.35
Current account BoP, % GDP	-0.15	-0.16	-0.14	-0.33	-0.64
Government Deficit, % GDP	-0.31	-0.23	-0.11	-0.19	-0.32

Table 4.9: Government Investment & Indirect taxes + 1% GDP					
	2003	2004	2005	2010	2015
<i>Cumulated as % of baseline</i>					
GDP	0.49	0.31	0.56	2.72	4.61
Production Capacity	0.05	0.25	0.47	2.08	4.01
Private Consumption	-0.22	-0.50	-0.48	1.17	2.68
Disposable Income Households	0.25	0.01	-0.25	-0.55	-0.88
Exports G&S	-0.19	-0.18	0.25	3.01	5.43
Investment	7.41	7.85	8.52	13.66	18.31
Wage rate	0.43	0.87	0.63	0.80	1.16
Deflator private consumption	0.76	0.60	0.18	-1.80	-3.56
GDP deflator	0.61	0.45	-0.07	-2.62	-4.90
Employment	0.06	0.09	0.13	0.73	1.35
<i>Absolute difference from baseline</i>					
Unemployment	-0.05	-0.08	-0.12	-0.64	-1.20
Current account BoP, % GDP	-0.25	-0.30	-0.28	-0.63	-0.96
Government Deficit, % GDP	-0.36	-0.30	-0.27	-0.39	-0.49

Table 4.10: Government Consumption & Direct taxes Households + 1% GDP					
	2003	2004	2005	2010	2015
<i>Cumulated as % of baseline</i>					
GDP	0.08	-0.60	-0.97	-0.67	-0.85
Production Capacity	-0.08	-0.25	-0.50	-0.82	-0.86
Private Consumption	-0.25	-0.72	-1.13	-1.30	-1.44
Disposable Income Households	-0.02	0.16	-0.24	-0.83	-0.91
Exports G&S	-0.41	-1.18	-1.58	-0.69	-0.78
Investment	-0.05	-0.32	-0.67	-0.85	-0.87
Wage rate	1.81	2.37	2.13	1.25	1.25
Deflator private consumption	0.53	1.15	1.13	0.47	0.54
GDP deflator	1.03	1.88	1.90	1.12	1.22
Employment	-0.09	-0.29	-0.58	-0.85	-0.85
<i>Absolute difference from baseline</i>					
Unemployment	0.07	0.25	0.50	0.74	0.75
Current account BoP, % GDP	-0.06	-0.04	-0.04	0.15	0.11
Government Deficit, % GDP	-0.17	-0.12	0.01	0.12	0.14

Table 4.11: Investment + 10 %					
	2003	2004	2005	2010	2015
<i>Cumulated as % of baseline</i>					
GDP	1.07	1.80	1.93	0.97	3.39
Production Capacity	0.12	0.62	1.40	4.86	7.74
Private Consumption	0.44	1.36	2.11	2.76	5.55
Disposable Income Households	1.06	3.05	5.53	15.95	26.17
Exports G&S	-0.28	-1.38	-3.61	-15.02	-20.79
Investment	11.62	21.96	31.78	68.25	92.28
Wage rate	0.37	1.97	4.15	13.64	22.32
Deflator private consumption	0.20	1.38	3.39	13.43	20.37
GDP deflator	0.05	1.29	3.56	15.03	22.59
Employment	0.14	0.42	0.79	0.51	-0.12
<i>Absolute difference from baseline</i>					
Unemployment	-0.12	-0.36	-0.69	-0.45	0.11
Current account BoP, % GDP	-0.79	-1.66	-2.57	-4.41	-4.46
Government Deficit, % GDP	-0.24	-0.59	-0.92	-1.38	-1.33

5. Monetary sector

5.1. Introduction

This section presents the main structure of the monetary sector of the model of the Bulgarian economy. It gives a set of equations describing the behaviour of the relevant actors in the process of the supply and demand of money. As a theoretical starting point for the demand for money we use the portfolio balance approach as developed already by Tobin, Gurley and Shaw in the 1960s. For the supply of money the analysis is based on a money multiplier model for an open economy. For this reason base money will be redefined. As a result the balance of payments and the behaviour of the Banking Sector with regard to their net foreign assets will play a central role in the monetary model. The build-up of this section is as follows. First, we will discuss briefly the theoretical framework that will be used for the monetary sector. Next we will present the financial accounts because they will act as the analytical framework for the analysis. In section 5.4 the monetary model for an open economy will be presented which has been applied in the Bulgarian context. Section 5.5 deals with modelling the behavioural equations for the demand and supply of money whereas in section 6 the links between the monetary and the real sector will be discussed. The paper ends with a complete version of the monetary model and some policy simulations.

5.2. Theoretical Framework

Our starting point for the monetary block is a money multiplier model for an open economy. In this model the quantity of money is defined by the contributions made by the central bank, the banking system, the foreign and private sector. For obvious reasons the behaviour of the central bank is supposed to be exogenous. On the other hand behavioural equations have been developed for the latter three categories.

The behavioural relations for the supply side of the monetary block concern the unborrowed reserves of the banking sector (in this case the sum of free reserves and required reserves), the net foreign assets of the banking sector, and the net capital imports of the private sector. The demand side of the monetary block is dealt with in a disaggregated manner. In this way we distinguish behavioural relations for the public demand of currency and of demand and time deposits. As the monetary block contains several interest rates, some term structures have been included, in which the long-term interest rate and the interest rate on time deposits are linked to the call money rate.

It should be emphasized that the monetary block has an outstandingly open character. As has been said, both the contributions to the supply of money on account of the net foreign assets of the banking system and the interest-sensitive international capital flows of the private sector are endogenous. Moreover, we should bear in mind that once the monetary block has been linked with the real block the money supply is also endogenous because of the current account of the balance of payments.

In giving concrete form to the behavioural relations mentioned, we have looked for links with accepted theoretical notions such as the portfolio balance approach and the wealth adjustment theory. On that account the equations contain scale variables, relative prices and risk factors. Moreover, the equations of the banking system contain a number of instruments of monetary policy, including discount rate policy, required reserve policy, liquidity reserve policy and, more or less, direct credit control policy, namely in so far as loan ceilings lead to compulsory deposits. A stock adjustment or partial adjustment equation acts as a basic specification. We may sketch this in outline by saying that changes in the various stocks are dependent on the discrepancy between the desired stock in the current period and the actual stock in the initial period. In turn, the desired stock is a function of the risk factors, relative prices, etc., which have already been mentioned. For the net capital imports of the private sector we base ourselves on the so-called 'flow theory' for international capital flows.

Finally, it should be noted that elements from the dis-equilibrium analysis also underlie the monetary block. As is known, this analysis deals with situations in which the prices fail to effectuate a complete clearing between supply and demand in markets. Often this analysis is only concentrated on dis-equilibrium situations in the real sector. In monetary analysis this theme is often dealt with in a step-

motherly fashion. Nevertheless it is possible to identify distinct similarities between credit rationing (relatively rigid prices, etc.) and the dis-equilibrium analysis concerned with the real sector.

On the whole, we have tried to synthesize elements from the equilibrium analysis with those of the dis-equilibrium analysis in the framework of the monetary block. This implies that in the event of an autonomous disturbance of the equilibrium between money supply and demand, tendencies will arise towards a new equilibrium through both price adjustments and non-price induced quantity adjustments (in this case undesired inventory changes in the monetary sector). These quantity adjustments are called '*buffers*', which are approximated by the growth rate difference between base money and nominal expenditures. These buffers are determining elements in the demand for and the supply of money. For example, when base money grows faster than nominal expenditures a part of the evolving „excess supply“ of base money will temporary be hoarded by the private sector in demand and time deposits, and by the banking system in free reserves and net foreign assets. As a result the demand for money increases whereas the supply of money decreases.

To recapitulate, we classify the theoretical conception underlying the monetary block as the *monetary sector in quasi-equilibrium*. The term ‘quasi’ denotes that though an equilibrium between demand and supply of money *ex post* arises, apart from the price mechanism this equilibrium is also brought about by the buffer mechanism (in this case non-price quantity adjustments). We assume that the buffers that arise on account of the latter mechanism are regarded as undesirable by the market participants in the long run. However, in the short run it may be attractive to accept a temporary sub-optimal position.

5.3. Financial Accounts

The financial accounts of the Central Bank, the Government, the Banking Sector, the Foreign Sector and the Private Sector act as the analytical framework for any monetary analysis. Below they are presented in an aggregated form. In the next section these accounts will be rearranged into a monetary model for an open economy. It is, however, important to note that the financial accounts refer to **stocks** whereas the national accounts for the real sector refer to **flows**. In linking the real and monetary sectors of the economy this can have important policy implications. The current account of the balance of payments, for instance, is the result of imports and exports (flows!) whereas the national foreign reserves are stocks, i.e. the cumulated balance of payments surpluses and deficits of the past. Hence, the level of the balance of payments implies a **permanent** change in foreign assets and as a result also in the money supply.

Central Bank	
Assets	Liabilities
G	CH
SK _{cb}	R

Government	
Assets	Liabilities
	SK + SL
	W _o = - (SH + SL)

Banking sector	
Assets	Liabilities
R	D
FA	T
(SK + SL) _b	FL
L	RL

Foreign Sector	
Assets	Liabilities
FL	G
S BOP	FA

Private Sector	
Assets	Liabilities
CH	L
D	W _p
T	
(SK + SL) _p	
K	

In which:

- G = international reserves of the Central Bank
- SK_{cb} = short term government securities in the Central Bank
- RL = borrowed reserves of the Banking Sector (discounts, loans and pawnables)
- Ch = currency in circulation
- R = reserves
- SK = short term government securities
- SL = long term government securities
- FA = foreign assets
- (SK + SL)_b = short term and long term government securities in the Banking Sector
- L = credits provided by the Banking Sector
- D = deposit money
- T = time and savings deposits
- FL = foreign liabilities
- S BOP = cumulated (cum) balance of payments surpluses or deficits¹
- (SK + SL)_p = short term and long term government securities in the Private Sector
- K = physical capital stock
- W = wealth

¹ Note that the monetary accounts contain **stocks** whereas the balance of payments, like the other parts of the real sector are **flows**. Note also that the cumulated balance of payments surpluses and deficits are accumulated in the (gold) and foreign currency reserves of the Central Bank and in the net foreign assets of the Banking Sector.

The reserves of the Banking Sector can be subdivided as follows:

RE	=	excess reserves (R – RR)
RF	=	free reserves (RE – RL)
RR	=	required reserves (by policy of the Central Bank)
RU	=	unborrowed reserves (RF + RR)

5.4. A Monetary Model for an Open Economy

The main items of the balance sheets of the sectors above can be rewritten in the following set of equations:

$$\begin{aligned}
 Br + RL - NBA &= Ch + R \\
 Ch &= c M2 \\
 R &= k (D + T) \\
 RL &= b (D + T) \\
 NBA &= a (D + T) \\
 T &= t M2 \\
 M2 &= Ch + D + T
 \end{aligned}$$

Endogenous: RL, NBA, Ch, R, M2, D, T

Exogenous: Br, c, k, b, a, t

The analytical solution of this model gives the following equation for the amount of money in the economy:

$$M2 = [1 / ((k + a - b) (1 - c) + c)] Br$$

The next step is to endogenize parts of the money multiplier (k, a etc.) and the redefined base money (Br). Before doing so we will explain first the used redefinition of base money. The traditional definition of base money can be found on the balance of the Central Bank viz.:

$$B (= \text{base money}) = G + SK_{cb} + RL = Ch + R$$

(note that the left hand side of this equation contains the sources of base money and the right the uses of base money)

By definition the national stock of foreign assets (G_n) is equal to the sum of the stock of foreign assets of the Central Bank (G); the national IMF position (IMF) and the net foreign assets of the Banking Sector ($NFA = FA - FL$).

$$G_n = G + IMF + NFA$$

In addition, the change in the national stock of foreign assets is according to the balance of payments definition the sum of the current account of the balance of payments (F) and capital account (NCI , i.e. net capital imports of the so-called non-monetary (private) sectors).

$$G_n = F + NCI + G_n(-1)$$

Substitution of equation 11) into 10) gives:

$$G_n - IMF - NFA + SK_{cb} + RL = Ch + R$$

As a rule the government owns the national IMF position. Any improvement in this position is financed by handing over short-term government securities to the central bank or by decreasing the current account of the government with the central bank. This implies that any (positive) change in the national IMF position has an automatic impact on the claims of the central bank on the government. In order to construct a policy (exogenous) variable for the central bank the following correction should be made:

$$SK_n = SK_{cb} - IMF$$

In which SK_n is the open market variable of the central bank i.e. short-term government securities corrected for IMF transactions.

Next, base money can be redefined as follows:

$$Br = G_n + SK_n$$

A certain definition for base money implies in the American literature mostly also a certain policy of the central bank. As a result in that case (redefined) base money could be seen as an exogenous policy variable of the central bank. It should be emphasized that in this paper this is not the case. Therefore redefined base money (Br) will be regarded as an endogenous variable. Given the above discussion, equation 1) can be rewritten as follows:

$$G_n(-1) + F + NCI + SK_n = Ch + RU + NFA$$

It follows from equations 11), 13) and 14):

$$Br = F + NCI + SK_n + GN (-1)$$

Summarising the following conclusions can be drawn. As we have seen the money stock can be described with equation 8. This equation contains a multiplier (with the contributions of the Banking and the Private Sector) and redefined base money. On the basis of equation 16, redefined base money can be subdivided into the contributions of the Foreign Sector and of the Central Bank. As a result the total money stock is based on the contributions of:

1. the Central Bank (SK_n)
2. the Banking Sector (k, b, a)
3. the Private Sector (c, t)
4. the Foreign Sector (F, NCI)

The next step is to give the variables k, b, a, c, t, F and NCI economic content by developing behavioural equations for them.

5.5. The Basic specification

In the monetary block we use a basic specification that can be used for the behavioural equations of the money supply and of the demand for money. The general structure of this stock adjustment or „partial adjustment“ equation is as follows:

$$1) \quad S_t = S_{t-1} + \lambda [S_t^* - S_{t-1}]$$

Where S is the actual stock (of e.g. reserves or money) in the current period t , S_{t-1} the one period lagged stock (i.e. the starting position) and S_t^* is the desired stock in the current period. Note that the parameter λ represents the speed of adjustment from the actual stock in the current period to the desired stock in the current period. When, for example, $\lambda=1.0$ this adjustment occurs immediately in the current period. However, when λ is smaller than 1.0 the adjustment will take more than one period (e.g. when $\lambda=0.5$ it takes two periods, etc.) The next step is to endogenize the desired stock as follows:

$$2) \quad S_t^* = f(S_c, rp, ri)_t$$

which says that the desired stock is a function of scale variables (for example nominal GDP or monetary aggregates) S_c , relative prices (interest rate differentials) rp and risk factors (uncertainty in financial markets). It should be emphasized that this treatment of the desired stock is completely in line with modern monetary analysis as presented in the portfolio balance approach and the wealth adjustment theory. Substitution of equation (2) in equation (1) gives:

$$3) \quad S_t = S_{t-1} + \alpha_1 \lambda S_c + \alpha_2 \lambda rp_t + \alpha_3 \lambda ri_t - \lambda S_{t-1}$$

or

$$4) \quad \Delta S_t = \alpha_1 \lambda S_{c_t} + \alpha_2 \lambda r p_t + \alpha_3 \lambda r i_t - \lambda S_{t-1}$$

It is obvious that in estimating such equation the found parameter for S_{t-1} represents the discussed speed of adjustment. Finally, it should be noted that we can also use the above procedure for linking different types of interest rates e.g.:

$$5) \quad r l_t = r l_{t-1} + \lambda [r l_t^* - r l_{t-1}]$$

in which $r l_t$ is the long run term interest rate in the current period and the $r l_t^*$ the desired interest rate in the current period. The next step is:

$$6) \quad r l_t^* = f(r s_t)$$

in which the desired long term interest rate is a function of the short term interest rate ($r s_t$). After some rearrangements the equation (5) using (6) can be rewritten as follows:

$$7) \quad \Delta r l_t = \beta \lambda r s_t - \lambda r l_{t-1}$$

In the monetary block we will use the above explained basic specification for all behavioural equations. Note that in the absence of the one period lagged dependent variable the supposed adjustment is immediate, i.e. $\lambda=1.0$. This is the case in, for example, the equations for the percentage changes in currency, demand and time deposits.

5.6. Transmission Channels to the Real Sector

In the real sector we use two transmission channels from the monetary sector: namely the transmission by means of relative prices (interest rates) and the transmission by means of spill-over effects or dynamic inter-market pressures (some kind of a money ratio). As these two transmission channels supplement each other they occur next to each other in each of the relevant expenditure equations. The link between the monetary and the real sphere by means of relative prices is based on the traditional IS-LM model. Almost every textbook contains a similar link and therefore it need not be dealt with at length. As is well known, this principle is based on inclusion of the real of interest in the expenditure equations, the underlying idea being that in framing and implementing their expenditure plans the different economic agents should take into consideration the (opportunity) costs of the required means of financing. We use the call money rate corrected for the inflation rate as the relevant real rate of interest. The actual rate of inflation functions as a proxy for the *expected* inflation rate, because in a inflationary climate the interest rate will be weighed against the price increases to be expected in the different expenditure categories.

As a second transmission mechanism we distinguish the spill-over of monetary tension to the real sector. Our previous discussion of the monetary sector in quasi-equilibrium, offers important starting points for this way of linking. Those dis-equilibrium positions in the monetary sector, that find their expression in buffers (in this case „undesired“ quantity adjustments), may in fact lead to a certain spill-over to other markets over time. In particular we can refer to the spill-over effects specified by Patinkin in this regard. According to Patinkin these effects imply that quantity constraints in one market will lead to a spill-over to other markets, as „the very function of money is to be spent on both commodities and bonds....dynamic inter-market pressures (spill-over effects) become the very essence of any analysis which is concerned with the money market.“

In the real block we have quantified a spill-over effect of this kind in a general way by using the buffer variable of the monetary block. This item, a transformation of the difference between the growth rate of redefined base money and that of expenditures, measures the pressure or suction in the monetary markets, not expressed in interest rates.

1	RSBU	=	$rc + (1/\text{coef}(1)) * (kb - \text{coef}(2) * (BR\% - ADP\%) - \text{coef}(3) * kv - \text{coef}(4) + b)$
2	AM	=	$-\text{coef}(5) * (\text{rsbu} - \text{rsf}) + \text{coef}(6) * .5 * ((BR\% - ADP\%) + (BR\%(-1) - ADP\%(-1))) + \text{coef}(7)$
3	CI/BR(-1)	=	$\text{coef}(8) * .5 * ((\text{rsbu} - \text{rsf}) + (\text{rsbu}(-1) - \text{rsf}(-1))) + \text{coef}(9)$
4	CH%	=	$\text{coef}(10) * ADP\% + \text{coef}(11) * ((\text{rsbu} - \text{rsbu}(-1))) + \text{coef}(12)$
5	D%	=	$\text{coef}(13) * ADP\% + \text{coef}(14) * (\text{rsbu} - \text{rsbu}(-1)) + \text{coef}(15) * .5 * ((BR\% - \text{adp}\%) + (\text{br}\%(-1) - \text{adp}\%(-1))) + \text{coef}(16)$
6	T%	=	$\text{coef}(17) * \text{adp}\% + \text{coef}(18) * (\text{rsbu} - \text{rsbu}(-1)) + \text{coef}(19) * .5 * ((\text{br}\% - \text{adp}\%) + (\text{br}\%(-1) - \text{adp}\%(-1))) + \text{coef}(20)$
7	Kb	=	$100 * (1 / (1 - .01 * CM)) * (BR - CH) / M2 - AM$
8	BR%	=	$CIBR + CA_BR + DIBR + BRPCAUT$
9	RT3	=	$\text{rt3}(-1) + \text{coef}(21) * \text{rsbu} + \text{coef}(22) * \text{rt3}(-1)$
10	RL	=	$0.7 * \text{rt3} + 0.3 * \text{rlbu}$
11	RLBU	=	$\text{rlbu}(-1) + \text{coef}(23) * \text{rsbu} + \text{coef}(24) * \text{rlbu}(-1)$
12	M1	=	$CH + Dd$
13	M2	=	$M1 + T$
14	CM	=	$100 * (CH / M2)$
15	TM	=	$100 * (T / M2)$
16	CH	=	$(1 + .01 * CH\%) * CH(-1)$
17	DD	=	$(1 + .01 * D\%) * Dd(-1)$
18	M1%	=	$100 * (M1 / M1(-1) - 1)$
19	T	=	$(1 + .01 * T\%) * T(-1)$
20	M2%	=	$100 * (M2 / M2(-1) - 1)$
21	BR	=	$(1 + .01 * BR\%) * BR(-1)$

Identities (series)

1	MB	=	$CH + R$
2	BR	=	$MB + NFA$

3	MK	=	CH + DD
4	KM	=	100 * (R / (DD + T))
5	AM	=	100 * (NFA / (DD + T))
6	CM	=	100 * (CH / M2)
7	TM	=	100 * (T / M2)
8	KV	=	100 * (RR / (DD + T))

List of variables

% denotes annual percentage change

MB	Base money
BR	Redefined base money
NBA	Net foreign assets held by the banking sector
MK	Monetary aggregate M1
CH	Cash
DD	Deposits
T	time deposits
ADP	aggregate demand, current prices
F	current account balance, $F=EXPGSP-IMPGSP$
CI	capital account of the balance of payments
R	total reserves
RR	required reserves
RSBU	Short term Interest Rate Bulgaria
RC	Bulgarian National Bank main policy rate

5.7. Monetary Sector simulations

This section describes the monetary sector in isolation in terms of changes in some exogenous variables. The main features of the monetary sector are described elsewhere but they can be summarised as follows. Money supply is determined through a money multiplier and base money. The latter largely is defined in terms of the current account of the balance of payments, capital imports and foreign direct investments. The multiplier is the result of private bank behaviour in which on the basis of interest rates the optimum distribution over various assets and liabilities play the dominant role. Money demand is determined on the basis of requirements for transactions in the economy and interest rates.

The most important exogenous variables in this sub-model are foreign interest rates, the REPO rate set by the Central Bank of Bulgaria, Direct Foreign Investment and aggregate demand from the real sector. Tables 1.1 to 1.4 describe the behaviour of this sub-model if changes in these exogenous variables are introduced.

Within a period of about 10 years an increase in foreign interest rates is almost fully translated into domestic interest rates. A discrepancy between foreign and domestic rates induces a capital flow in this case to abroad contributing to lower money supply. Domestic interest rates adjust positively to this initial decline of money supply. On the demand side the interest increase has a negative effect on money demand. The equilibrium is reached with lower demand and lower supply.

Table 5.1: Foreign interest rates + 1%, permanent					
	2003	2004	2005	2010	2015
<i>Cumulated as % of baseline</i>					
Base money	-0.21	-0.60	-0.94	-2.05	-2.58
Currency outside banks	-0.63	-0.68	-0.72	-0.87	-0.94
Deposits	-4.90	-5.24	-5.55	-6.67	-7.20
M1	-2.32	-2.47	-2.62	-3.13	-3.37
M2	-2.21	-2.36	-2.51	-3.02	-3.26
<i>Absolute difference from baseline</i>					
Capital Imports as % of base money	-0.21	-0.39	-0.34	-0.16	-0.08
Short term Interest	0.63	0.67	0.71	0.86	0.93

An increase in the Central Bank Rate (REPO) has a positive impact on domestic market rates that as a result invites more capital imports. As a result money supply increases, which induces a negative pressure on domestic rates. In long term the positive initial effect is virtually fully compensated by increased money supply and the initial lower money demand, which resulted from the initial rise of interest rates.

Table 5.2: Central Bank Rate + 1%, permanent					
	2003	2004	2005	2010	2015
<i>Cumulated as % of baseline</i>					
Base money	0.17	0.48	0.75	1.69	2.16
Currency outside banks	-0.30	-0.27	-0.23	-0.12	-0.06
Deposits	-2.31	-2.05	-1.80	-0.88	-0.42
M1	-1.09	-0.97	-0.85	-0.41	-0.20
M2	-1.04	-0.92	-0.80	-0.38	-0.17
<i>Absolute difference from baseline</i>					
Capital Imports as % of base money	0.16	0.31	0.27	0.14	0.07
Short term Interest	0.30	0.26	0.23	0.11	0.06

The monetary effect of an increase in Foreign Direct Investment is an increase in the base money and therefore of money supply. As a result domestic interest rates come under pressure with a negative effect on interest sensitive capital imports. After a period of about 10 years the positive effect on

money supply through Foreign Direct Investment is almost fully compensated by an outflow of money through capital exports.

Table 5.3: Direct Foreign Investment + 1% of Base money					
	2003	2004	2005	2010	2015
<i>Cumulated as % of baseline</i>					
Base money	0.95	1.80	2.55	5.09	6.37
Currency outside banks	0.10	0.19	0.29	0.61	0.76
Deposits	0.81	1.54	2.30	4.87	6.17
M1	0.38	0.72	1.08	2.27	2.86
M2	0.37	0.70	1.04	2.20	2.77
<i>?bsolute difference from baseline</i>					
Capital Imports as % of base money	-0.06	-0.16	-0.27	-0.64	-0.82
Short term Interest	-0.10	-0.19	-0.29	-0.60	-0.75

The model translates an increase in domestic (real) demand initially into an equal increase in money demand. As a result interest rates increase partly dampening the initial increase in demand. The increasing discrepancy between domestic and foreign interest rates fuels capital imports increasing money supply. The results after about 10 years are larger money supply and demand and higher domestic interest rates.

Table 5.4: Domestic demand +5% growth permanent					
	2003	2004	2005	2010	2015
<i>Cumulated as % of baseline</i>					
Base money	0.28	1.09	2.40	15.80	38.96
Currency outside banks	4.49	9.26	14.23	43.67	82.03
Deposits	1.04	2.57	4.00	18.10	42.17
M1	3.13	6.63	10.21	33.72	66.59
M2	3.20	6.73	10.34	33.78	66.48
<i>?bsolute difference from baseline</i>					
Capital Imports as % of base money	0.28	0.80	1.29	3.11	4.02
Short term Interest	0.50	0.94	1.39	2.92	3.68

6. Total model including real and monetary sectors

6.1. World Trade

An acceleration in growth of world imports stimulates exports and overall demand. This increasing internal demand is translated into additional domestic demand (consumption and investment) and

overall GDP growth. This increasing demand requires additional imports partly compensating the benefits on the current account. It also fuels domestic costs and prices as well reducing the initial impulse in exports. The cost increases is caused by two effects. The first is the Phillips curve effect and the second is related to the declining marginal benefits from private investments because it is not followed by equivalent increases in government investments. The initial impulse in production growth creates additional employment and reduction in unemployment, which induces additional wage increases. The government budget balance improves, both through increased production growth benefiting government income and increased prices, which also have a positive effect on the ration of the government deficit as a percentage of GDP.

The positive current account of the balance of payments affects the money supply positively reflected in base money and M2. The increase in money supply induces a negative effect on domestic interest rates and as a result declining capital imports.

Table 6.1: World trade + 1% permanent					
	2003	2004	2005	2010	2015
<i>Cumulative as % of baseline</i>					
GDP	0.23	0.56	0.82	0.87	1.16
Production Capacity	0.03	0.11	0.27	0.44	1.15
Private Consumption	0.08	0.46	0.96	1.35	3.74
Disposable Income Households	0.29	0.87	1.70	2.57	8.83
Exports G&S	0.80	1.44	1.79	1.84	2.87
Investment	-0.11	0.67	1.89	2.60	3.58
Base money	0.99	2.33	3.37	3.93	13.51
M2	0.57	1.44	2.36	3.09	10.09
Currency outside banks	0.39	1.07	1.90	2.64	8.53
Deposits	0.89	2.15	3.24	3.94	12.97
Wage rate	0.10	0.52	1.29	2.25	8.40
Deflator private consumption	0.05	0.25	0.69	1.31	5.81
GDP deflator	0.08	0.33	0.86	1.63	7.44
Employment	0.04	0.13	0.30	0.47	0.85
<i>?bsolute difference from baseline</i>					
Unemployment	-0.03	-0.12	-0.26	-0.41	-0.75
Investment, % GDP	-0.04	-0.01	0.06	0.08	-0.11
Current account BoP, % GDP	0.22	0.25	0.18	0.10	0.22
Government Deficit, % GDP	-0.08	-0.21	-0.39	-0.56	-1.31
Capital imports, % base money	-0.04	-0.12	-0.17	-0.19	-0.63
Short term Interest rate	-0.07	-0.14	-0.17	-0.16	-0.60

6.2. World prices

An overall increase in external prices stimulates as a start exports and reduces imports because the initial effect is an improvement of the competitive position of the Bulgarian economy. However, over time the initial benefits almost completely disappear because the increased import prices are translated into increasing domestic prices. A second effect reducing the initial positive effects is an additional increase in domestic expenditures as a result of greater liquidity in the economy. As a result the initial benefits disappear completely. On balance the initial positive real effects disappear virtually completely in terms of the real economy. The ultimate effects are price and monetary effects only.

Table 6.2: World prices + 1% permanent					
	2003	2004	2005	2010	2015
<i>Cumulative as % of baseline</i>					
GDP	0.05	0.17	0.34	0.41	-0.28
Production Capacity	0.01	0.03	0.06	0.10	-0.25
Private Consumption	-0.13	-0.27	-0.15	0.03	0.00
Disposable Income Households	0.25	0.83	1.67	2.68	10.70
Exports G&S	0.37	0.98	1.27	1.29	0.19
Investment	-0.55	-1.08	-0.69	-0.16	-1.08
Base money	0.16	1.47	3.07	4.43	17.97
M2	0.36	1.27	2.41	3.58	13.87
Currency outside banks	0.42	1.15	2.12	3.19	12.02
Deposits	0.25	1.50	2.95	4.31	17.27
Wage rate	0.21	0.72	1.51	2.53	10.30
Deflator private consumption	0.41	0.98	1.75	2.71	11.89
GDP deflator	0.20	0.66	1.32	2.23	11.10
Employment	0.01	0.05	0.11	0.18	-0.14
<i>?bsolute difference from baseline</i>					
Unemployment	-0.01	-0.04	-0.10	-0.16	0.13
Investment, % GDP	-0.03	-0.07	-0.03	0.02	0.00
Current account BoP, % GDP	0.04	0.26	0.28	0.24	0.26
Government Deficit, % GDP	-0.06	-0.19	-0.37	-0.56	-1.49
Capital imports, % base money	0.02	0.00	-0.07	-0.13	-0.73
Short term Interest rate	0.03	-0.03	-0.10	-0.14	-0.69

6.3 Wage rate

International competitiveness is a major issue for the Bulgarian economy. Reducing costs per unit of output gives a clear stimulus to the domestic economy. This is clearly illustrated in the table below, which gives the results of a lower wage rate growth of 1% per annum. The table clearly shows a combination of higher growth and lower inflation. The lower costs per unit of output induce larger exports and lower imports, which after some years overcompensates the initial decline in private

consumption. As a result employment increases to such an extent that the unemployment rate is about 4% points lower after a period of about 10 years. Although initially tax revenues of the government decline together with the declining wages the government deficit ultimately improves as a result of the economy's better performance.

Table 6.3: Wage rate – 1% permanent					
	2003	2004	2005	2010	2015
<i>Cumulative as % of baseline</i>					
GDP	0.17	0.57	1.09	1.55	4.04
Production Capacity	0.05	0.22	0.54	0.97	4.12
Private Consumption	-0.03	-0.03	0.14	0.45	2.21
Disposable Income Households	-0.36	-0.84	-1.03	-0.94	-0.62
Exports G&S	0.22	0.92	1.78	2.37	5.10
Investment	0.33	0.91	1.83	2.96	5.29
Base money	-0.12	-0.10	0.19	0.21	1.31
M2	-0.15	-0.28	-0.17	0.00	0.95
Currency outside banks	-0.15	-0.34	-0.29	-0.09	0.79
Deposits	-0.14	-0.18	0.06	0.16	1.26
Wage rate	-1.14	-2.38	-3.36	-3.94	-8.04
Deflator private consumption	-0.29	-0.86	-1.31	-1.54	-2.77
GDP deflator	-0.43	-1.20	-1.84	-2.18	-4.05
Employment	0.06	0.25	0.61	1.08	4.21
<i>?bsolute difference from baseline</i>					
Unemployment	-0.05	-0.22	-0.54	-0.94	-3.73
Investment, % GDP	0.04	0.10	0.16	0.23	0.30
Current account BoP, % GDP	-0.04	-0.02	0.03	-0.01	0.00
Government Deficit, % GDP	0.06	0.10	0.06	-0.06	-0.63
Capital imports, % base money	0.00	-0.02	-0.05	-0.05	-0.08
Short term Interest rate	0.00	-0.03	-0.05	-0.04	-0.07

6.4. Increase of direct taxes households

In the model tax increases above inflation are translated into increases in costs per unit of output. This phenomenon is clearly illustrated when government increases direct taxes. Wages and prices increase deteriorating the competitiveness of the economy. As a result not only domestic consumption decline but exports as well. This reducing demand is only partly compensated by the increase in investment. The positive effect on investment is caused by the relative decline of capital costs first by relative higher wage costs and secondly by the domestic lower interest rates. The latter is mainly induced by the lower government deficit. In the end total GDP is about .25 % lower than it would have been without the direct tax increases.

Table 6.4: Direct taxes households + 1% of GDP					
	2003	2004	2005	2010	2015
<i>Cumulative as % of baseline</i>					
GDP	-0.37	-0.75	-0.53	-0.24	-0.25
Production Capacity	-0.11	-0.31	-0.51	-0.53	-0.10
Private Consumption	-0.59	-1.12	-0.94	-0.65	-0.02
Disposable Income Households	-0.82	-0.89	-1.09	-1.03	-0.21
Exports G&S	-0.28	-0.77	-0.89	-0.74	-1.58
Investment	-0.35	0.61	2.38	3.60	2.68
Base money	1.81	4.38	6.06	6.88	9.50
M2	0.56	1.32	1.97	2.53	4.02
Currency outside banks	0.07	0.18	0.37	0.66	1.48
Deposits	1.44	3.46	5.03	6.10	8.82
Wage rate	1.47	1.39	0.96	0.77	1.21
Deflator private consumption	0.36	0.63	0.43	0.33	1.02
GDP deflator	0.58	0.95	0.65	0.49	1.38
Employment	-0.12	-0.36	-0.61	-0.69	-0.65
<i>?bsolute difference from baseline</i>					
Unemployment	0.11	0.31	0.54	0.61	0.57
Investment, % GDP	-0.03	0.10	0.26	0.33	0.20
Current account BoP, % GDP	0.40	0.45	0.24	0.13	0.03
Government Deficit, % GDP	-0.86	-0.81	-0.78	-0.81	-0.96
Capital imports, % base money	-0.11	-0.37	-0.63	-0.80	-1.15
Short term Interest rate	-0.20	-0.47	-0.66	-0.78	-1.05

6.5. Increase Indirect Taxes

As in the case of direct taxes higher indirect taxes induce higher labour costs deteriorating competitiveness, but here the negative impact on consumption and exports is compensated by the higher private investments. The latter mainly result from the relative decline in capital costs resulting from lower interest rates. In a way this is the opposite effect of what in literature is called ‘Crowding out’. Following this positive private investment developments GDP growth restores and becomes positive after a period of about 10 years.

Table 6.5: Indirect taxes + 1% of GDP					
	2003	2004	2005	2010	2015
<i>Cumulative as % of baseline</i>					
GDP	-0.22	-0.34	-0.03	0.19	0.13
Production Capacity	-0.02	-0.08	-0.09	-0.02	0.30
Private Consumption	-0.52	-0.91	-0.60	-0.22	0.35
Disposable Income Households	-0.46	-0.61	-0.50	-0.21	0.30
Exports G&S	0.00	0.03	0.06	-0.03	-0.95
Investment	-0.27	0.78	2.41	3.57	2.05
Base money	1.34	3.44	4.96	5.40	6.96
M2	0.50	1.10	1.81	2.31	3.17
Currency outside banks	0.16	0.23	0.59	0.94	1.38
Deposits	1.10	2.75	4.16	4.90	6.54
Wage rate	0.15	0.10	-0.02	0.20	0.65
Deflator private consumption	0.58	0.53	0.45	0.53	0.85
GDP deflator	0.56	0.53	0.40	0.48	1.06
Employment	-0.03	-0.09	-0.12	-0.09	-0.11
<i>?bsolute difference from baseline</i>					
Unemployment	0.02	0.08	0.11	0.08	0.09
Investment, % GDP	-0.04	0.09	0.22	0.29	0.12
Current account BoP, % GDP	0.30	0.37	0.23	0.07	0.01
Government Deficit, % GDP	-0.90	-0.87	-0.93	-1.01	-1.06
Capital imports, % base money	-0.08	-0.28	-0.48	-0.59	-0.81
Short term Interest rate	-0.14	-0.36	-0.51	-0.56	-0.74

6.6. Government investment

An increase in government investment expenditures government has a number of contrasting effects. Like all government expenditures it first of all stimulates domestic demand, but at the expense of a larger budget deficit. This larger demand induces larger imports with as a result a deterioration of the current account of the balance of payments. This is translated into higher interest rates depressing domestic demand. In contrast to government consumption expenditures government investment has also an impact on the economy's production capacity. The way in which this effect is modelled is that increasing government investment increases positively efficiency of the private sector investments, reducing overall cost per unit of output. This is clearly reflected in the table below, which shows as a result decreasing GDP deflator and therefore an improving international competitiveness. In the end this effect is larger than the negative effects related to the growing budget deficit.

Table 6.6: Government investment + 1% of GDP					
	2003	2004	2005	2010	2015
<i>Cumulative as % of baseline</i>					
GDP	0.54	0.44	0.37	0.64	2.98
Production Capacity	0.06	0.30	0.50	0.64	2.63
Private Consumption	0.14	0.09	-0.31	-0.47	0.83
Disposable Income Households	0.58	0.38	-0.04	-0.49	-0.45
Exports G&S	-0.17	-0.12	0.41	1.23	5.28
Investment	7.36	6.75	6.15	6.15	9.22
Base money	-2.21	-5.00	-6.63	-6.95	-12.52
M2	-0.33	-1.42	-2.40	-2.90	-5.01
Currency outside banks	0.40	-0.06	-0.65	-1.03	-1.46
Deposits	-1.64	-3.96	-5.71	-6.40	-11.37
Wage rate	0.23	0.60	0.46	0.14	2.49
Deflator private consumption	0.12	-0.03	-0.40	-1.03	-3.17
GDP deflator	0.07	-0.13	-0.54	-1.29	-4.17
Employment	0.07	0.16	0.25	0.30	1.55
<i>?bsolute difference from baseline</i>					
Unemployment	-0.06	-0.14	-0.22	-0.26	-1.37
Investment, % GDP	0.78	0.69	0.60	0.57	0.75
Current account BoP, % GDP	-0.45	-0.47	-0.22	-0.03	-0.10
Government Deficit, % GDP	0.72	0.81	0.95	1.07	1.11
Capital imports, % base money	0.17	0.49	0.73	0.86	1.70
Short term Interest rate	0.31	0.57	0.75	0.80	1.58

6.7. Government consumption

Similarly to the increase in government investments increasing government consumption expenditures increases domestic demand in the short run. But in contrast to investment expenditures consumption has a negative impact on international competitiveness. Together with the monetary effects of increasing interest rates an increase in government consumption ‘crowds out’ private investment with a negative impact on overall growth in the long run.

Table 6.7: Government consumption + 1% of GDP					
	2003	2004	2005	2010	2015
<i>Cumulative as % of baseline</i>					
GDP	0.32	0.06	-0.33	-0.46	-0.10
Production Capacity	0.06	0.10	0.08	-0.07	-0.35
Private Consumption	0.19	0.21	-0.26	-0.64	-0.78
Disposable Income Households	0.68	0.79	0.55	0.12	-0.35
Exports G&S	-0.11	-0.33	-0.44	-0.23	0.82
Investment	-0.39	-1.70	-3.48	-4.69	-2.29
Base money	-1.78	-4.00	-5.35	-5.39	-7.08
M2	-0.15	-0.88	-1.69	-2.11	-2.93
Currency outside banks	0.47	0.29	-0.18	-0.58	-0.94
Deposits	-1.28	-3.05	-4.52	-4.97	-6.60
Wage rate	0.20	0.56	0.51	0.10	-0.37
Deflator private consumption	0.11	0.32	0.35	0.07	-0.60
GDP deflator	0.42	0.73	0.85	0.57	-0.28
Employment	0.07	0.13	0.14	0.05	0.16
<i>?bsolute difference from baseline</i>					
Unemployment	-0.06	-0.11	-0.12	-0.04	-0.14
Investment, % GDP	-0.11	-0.23	-0.35	-0.42	-0.18
Current account BoP, % GDP	-0.35	-0.35	-0.17	0.02	-0.02
Government Deficit, % GDP	0.69	0.70	0.80	0.92	0.97
Capital imports, % base money	0.15	0.42	0.63	0.72	0.95
Short term Interest rate	0.27	0.49	0.64	0.65	0.86

6.8. Combination of increase in income taxes and government investment

This balance budget operation shows positive effects in the long run, mainly as a result of the productivity improvements of private investments. While the negative effects of increasing taxes, prices and interest rates dominate the picture in the short run, the positive impact on productivity and therefore on costs per unit of output dominates the developments in the long run.

Table 6.8: Direct Taxes Households & Government investment + 1% of GDP					
	2003	2004	2005	2010	2015
<i>Cumulative as % of baseline</i>					
GDP	0.18	-0.31	-0.15	0.42	2.74
Production Capacity	-0.04	-0.02	-0.01	0.11	2.56
Private Consumption	-0.45	-1.03	-1.23	-1.07	0.89
Disposable Income Households	-0.25	-0.51	-1.11	-1.48	-0.61
Exports G&S	-0.45	-0.88	-0.50	0.45	3.57
Investment	6.99	7.34	8.63	9.94	11.99
Base money	-0.40	-0.60	-0.57	-0.18	-3.60
M2	0.24	-0.06	-0.37	-0.32	-1.05
Currency outside banks	0.47	0.14	-0.23	-0.31	0.07
Deposits	-0.18	-0.42	-0.63	-0.34	-3.07
Wage rate	1.70	2.01	1.44	0.95	3.73
Deflator private consumption	0.49	0.60	0.03	-0.69	-2.17
GDP deflator	0.65	0.82	0.11	-0.79	-2.81
Employment	-0.05	-0.20	-0.36	-0.39	0.89
<i>Absolute difference from baseline</i>					
Unemployment	0.04	0.17	0.32	0.34	-0.79
Investment, % GDP	0.75	0.79	0.87	0.92	0.95
Current account BoP, % GDP	-0.05	-0.01	0.01	0.07	-0.09
Government Deficit, % GDP	-0.14	0.00	0.17	0.25	0.14
Capital imports, % base money	0.06	0.10	0.08	0.03	0.51
Short term Interest rate	0.10	0.08	0.06	0.00	0.49

Table 6.9: Indirect Taxes & Government investment + 1% of GDP					
	2003	2004	2005	2010	2015
<i>Cumulative as % of baseline</i>					
GDP	0.32	0.10	0.35	0.85	3.13
Production Capacity	0.04	0.21	0.41	0.63	2.96
Private Consumption	-0.39	-0.82	-0.90	-0.65	1.24
Disposable Income Households	0.12	-0.23	-0.52	-0.67	-0.09
Exports G&S	-0.17	-0.09	0.46	1.18	4.25
Investment	7.07	7.54	8.65	9.89	11.37
Base money	-0.86	-1.55	-1.68	-1.63	-5.96
M2	0.18	-0.28	-0.54	-0.56	-1.87
Currency outside banks	0.56	0.18	-0.03	-0.04	-0.03
Deposits	-0.52	-1.16	-1.51	-1.53	-5.18
Wage rate	0.38	0.70	0.45	0.37	3.20
Deflator private consumption	0.71	0.50	0.05	-0.49	-2.32
GDP deflator	0.62	0.41	-0.14	-0.80	-3.10
Employment	0.05	0.08	0.13	0.22	1.44
<i>?bsolute difference from baseline</i>					
Unemployment	-0.04	-0.07	-0.12	-0.19	-1.28
Investment, % GDP	0.74	0.79	0.83	0.87	0.87
Current account BoP, % GDP	-0.14	-0.10	0.00	0.01	-0.10
Government Deficit, % GDP	-0.18	-0.06	0.02	0.05	0.04
Capital imports, % base money	0.09	0.20	0.23	0.24	0.85
Short term Interest rate	0.17	0.20	0.22	0.22	0.81

This picture is different when the increase in government revenues is spent on government consumption expenditures. In this case the model simulation shows that the negative effects of increased taxation dominates the positive effects of increased domestic demand over the whole period. In the end GDP is lower, prices are higher and unemployment is larger.

Table 6.10: Direct Taxes Households & Government consumption + 1% of GDP					
	2003	2004	2005	2010	2015
<i>Cumulative as % of baseline</i>					
GDP	-0.05	-0.69	-0.85	-0.68	-0.36
Production Capacity	-0.05	-0.21	-0.44	-0.60	-0.44
Private Consumption	-0.39	-0.91	-1.18	-1.25	-0.77
Disposable Income Households	-0.14	-0.11	-0.54	-0.88	-0.53
Exports G&S	-0.38	-1.09	-1.34	-0.99	-0.82
Investment	-0.74	-1.09	-1.01	-0.93	0.33
Base money	0.03	0.41	0.71	1.42	2.17
M2	0.42	0.48	0.34	0.48	1.09
Currency outside banks	0.55	0.48	0.23	0.14	0.58
Deposits	0.19	0.47	0.55	1.11	2.01
Wage rate	1.66	1.97	1.50	0.91	0.86
Deflator private consumption	0.48	0.95	0.78	0.42	0.44
GDP deflator	1.01	1.69	1.52	1.09	1.15
Employment	-0.06	-0.23	-0.47	-0.65	-0.50
<i>?bsolute difference from baseline</i>					
Unemployment	0.05	0.20	0.41	0.57	0.45
Investment, % GDP	-0.14	-0.13	-0.09	-0.07	0.01
Current account BoP, % GDP	0.05	0.10	0.06	0.13	0.01
Government Deficit, % GDP	-0.17	-0.11	0.02	0.09	0.00
Capital imports, % base money	0.03	0.04	-0.02	-0.10	-0.24
Short term Interest rate	0.06	0.01	-0.04	-0.14	-0.21

Table 6.11: Indirect Taxes & Government consumption + 1% of GDP					
	2003	2004	2005	2010	2015
<i>Cumulative as % of baseline</i>					
GDP	0.10	-0.28	-0.35	-0.25	0.03
Production Capacity	0.03	0.02	-0.01	-0.08	-0.05
Private Consumption	-0.33	-0.71	-0.85	-0.83	-0.41
Disposable Income Households	0.22	0.18	0.06	-0.07	-0.02
Exports G&S	-0.10	-0.30	-0.39	-0.27	-0.17
Investment	-0.66	-0.92	-1.00	-1.00	-0.29
Base money	-0.44	-0.55	-0.41	-0.06	-0.30
M2	0.36	0.25	0.17	0.23	0.24
Currency outside banks	0.64	0.53	0.43	0.40	0.47
Deposits	-0.16	-0.26	-0.34	-0.09	-0.21
Wage rate	0.35	0.66	0.50	0.32	0.30
Deflator private consumption	0.69	0.85	0.80	0.61	0.27
GDP deflator	0.98	1.27	1.26	1.07	0.82
Employment	0.04	0.04	0.02	-0.04	0.04
<i>?bsolute difference from baseline</i>					
Unemployment	-0.03	-0.04	-0.02	0.03	-0.04
Investment, % GDP	-0.14	-0.14	-0.13	-0.12	-0.06
Current account BoP, % GDP	-0.05	0.02	0.05	0.07	-0.01
Government Deficit, % GDP	-0.21	-0.17	-0.13	-0.10	-0.09
Capital imports, % base money	0.07	0.14	0.13	0.11	0.11
Short term Interest rate	0.13	0.12	0.12	0.08	0.10

6.9. Foreign Direct Investment

Here it is assumed that the topping up of Foreign Direct Investment is fully channelled to actual domestic physical investment. The model shows large increase in investments. But since the private investments are not accompanied by government investment the marginal productivity of private investments decrease. The latter is translated into higher costs per unit of output. The higher investment demand has further a negative impact on the current account of the balance of payments compensating partly the positive effects on the capital account. As a result interest rates increase further contributing to a slow down in investment.

Table 6.12: Foreign Direct Investment + 1% of GDP					
	2003	2004	2005	2010	2015
<i>Cumulative as % of baseline</i>					
GDP	0.56	1.08	0.72	-0.29	1.18
Production Capacity	0.07	0.37	0.82	1.12	3.56
Private Consumption	0.14	0.80	0.83	-0.03	1.07
Disposable Income Households	0.56	1.85	3.10	3.60	11.01
Exports G&S	-0.16	-0.90	-2.39	-4.00	-10.70
Investment	7.42	15.60	21.62	23.98	50.26
Base money	1.89	0.72	-2.68	-5.58	-0.03
M2	1.11	1.56	1.06	-0.08	4.42
Currency outside banks	0.79	1.79	2.27	1.96	6.66
Deposits	1.71	1.08	-1.25	-3.84	0.35
Wage rate	0.22	1.23	2.66	3.47	5.47
Deflator private consumption	0.11	0.81	2.09	3.27	8.44
GDP deflator	0.04	0.80	2.34	3.85	11.05
Employment	0.08	0.25	0.39	0.28	-1.73
<i>?bsolute difference from baseline</i>					
Unemployment	-0.07	-0.22	-0.35	-0.25	1.54
Investment, % GDP	0.79	1.52	1.92	2.05	3.67
Current account BoP, % GDP	-0.45	-1.08	-1.43	-1.37	-0.48
Government Deficit, % GDP	-0.15	-0.45	-0.68	-0.72	-1.74
Capital imports, % base money	-0.07	0.00	0.36	0.79	1.08
Short term Interest rate	-0.13	0.12	0.53	0.89	0.93

6.10. Interest rates

An increase in foreign interest rates of 1% point is followed by an increase of the domestic rates increasing costs per unit of output and as a result depressing domestic physical investment. As a result domestic expenditures and therefore GDP growth slows down. On the other hand, capital imports from abroad decline because investments abroad are more attractive.

With the exception of capital imports similar effects can be witnessed if the Central Bank raises its REPO rate.

Table 6.13: Foreign Interest Rates + 1%					
	2003	2004	2005	2010	2015
<i>Cumulative as % of baseline</i>					
GDP	-0.01	-0.08	-0.15	-0.12	-0.04
Production Capacity	0.00	-0.01	-0.04	-0.08	-0.10
Private Consumption	0.00	-0.07	-0.20	-0.24	-0.23
Disposable Income Households	0.01	-0.03	-0.14	-0.23	-0.26
Exports G&S	-0.01	-0.03	0.00	0.10	0.26
Investment	-0.04	-0.39	-0.91	-0.96	-0.38
Base money	-0.34	-0.85	-0.95	-0.80	-1.23
M2	-1.16	-1.38	-1.51	-1.52	-1.65
Currency outside banks	-0.32	-0.43	-0.55	-0.60	-0.61
Deposits	-2.71	-3.22	-3.40	-3.33	-3.64
Wage rate	0.00	-0.01	-0.10	-0.24	-0.25
Deflator private consumption	0.02	0.03	-0.01	-0.10	-0.17
GDP deflator	0.02	0.05	0.01	-0.10	-0.21
Employment	0.00	-0.01	-0.04	-0.06	-0.01
<i>?bsolute difference from baseline</i>					
Unemployment	0.00	0.01	0.03	0.05	0.01
Investment, % GDP	-0.01	-0.04	-0.08	-0.07	-0.02
Current account BoP, % GDP	0.01	0.05	0.11	0.14	0.11
Government Deficit, % GDP	0.00	0.01	0.03	0.05	0.04
Capital imports, % base money	-0.36	-0.68	-0.65	-0.65	-0.61
Short term Interest rate	0.36	0.41	0.42	0.41	0.45

Table 6.14: Central Bank Rate + 1%					
	2003	2004	2005	2010	2015
<i>Cumulative as % of baseline</i>					
GDP	-0.01	0.00	0.02	0.01	-0.01
Production Capacity	0.00	0.00	0.00	0.01	0.01
Private Consumption	0.00	0.02	0.08	0.11	0.12
Disposable Income Households	0.01	0.04	0.09	0.13	0.15
Exports G&S	-0.01	-0.04	-0.09	-0.14	-0.23
Investment	-0.04	0.06	0.27	0.32	0.11
Base money	0.20	0.53	0.67	0.65	0.87
M2	-1.03	-0.93	-0.84	-0.80	-0.71
Currency outside banks	-0.29	-0.24	-0.18	-0.15	-0.13
Deposits	-2.42	-2.25	-2.14	-2.08	-1.87
Wage rate	0.00	0.02	0.05	0.09	0.09
Deflator private consumption	0.01	0.04	0.07	0.11	0.14
GDP deflator	0.02	0.04	0.07	0.12	0.17
Employment	0.00	0.00	0.00	0.00	-0.02
<i>?bsolute difference from baseline</i>					
Unemployment	0.00	0.00	0.00	0.00	0.02
Investment, % GDP	0.00	0.00	0.02	0.02	0.00
Current account BoP, % GDP	0.00	-0.01	-0.05	-0.07	-0.06
Government Deficit, % GDP	0.00	-0.01	-0.02	-0.03	-0.02
Capital imports, % base money	0.18	0.35	0.33	0.32	0.29
Short term Interest rate	0.32	0.30	0.29	0.29	0.26

6.11. Increase in Base money

The model has also been used to simulate the effects of an increase in money supply. Because initially increased money has a negative effect on interest rates it has a negative effect on capital imports. The downward pressure on interest rates has a negative on costs per unit of output initially inducing higher exports. But this effect is only temporary. After a limited period of time wage rate started to increase contributing to increasing costs per unit of output. The negative effect of this on exports dominates after a while the positive effects on investments that result of lower capital costs.

Table 6.15: Base money + 5% permanent					
	2003	2004	2005	2010	2015
<i>Cumulative as % of baseline</i>					
GDP	0.01	0.65	0.86	0.43	0.12
Production Capacity	0.00	0.08	0.29	0.50	0.48
Private Consumption	0.00	0.85	1.59	1.67	1.60
Disposable Income Households	-0.01	0.59	1.41	1.90	1.87
Exports G&S	0.02	-0.12	-0.66	-1.50	-2.33
Investment	0.06	3.97	6.16	5.78	2.18
Base money	4.82	7.62	7.92	6.78	10.23
M2	1.67	3.07	3.91	3.83	4.84
Currency outside banks	0.45	1.36	2.12	2.28	2.37
Deposits	3.87	6.28	7.32	6.81	9.51
Wage rate	-0.01	0.24	1.11	1.93	1.58
Deflator private consumption	-0.02	0.06	0.57	1.26	1.47
GDP deflator	-0.03	-0.03	0.54	1.37	1.82
Employment	0.00	0.09	0.24	0.35	-0.10
<i>?bsolute difference from baseline</i>					
Unemployment	0.00	-0.08	-0.21	-0.31	0.09
Investment, % GDP	0.01	0.36	0.49	0.43	0.10
Current account BoP, % GDP	-0.01	-0.49	-0.89	-1.04	-0.76
Government Deficit, % GDP	0.00	-0.15	-0.33	-0.40	-0.28
Capital imports, % base money	-0.28	-0.66	-0.78	-0.74	-1.06
Short term Interest rate	-0.50	-0.69	-0.72	-0.62	-0.99

7. Impact Monetary Sector Variables

Since monetary developments play such an important role in Bulgaria quite a lot of attention has been given to the monetary sector in the overall model. In this respect it is appropriate to compare the model results with and without monetary sector. Table 7.1 compares some model simulation results without and with the impact of monetary variables. It clearly shows that the inclusion of the monetary sector dampens the effects of the changes. In general that is logical. An additional feedback mechanism has been introduced. An increase in demand has in general negative effects on the current account of the balance of payments, which reduces money supply. As a result interest rates increases and liquidity in the economy declines. Both have a negative effect on domestic expenditures.

Table 7.1 Model simulations, real sector only compared with overall model, year 2015

	Wage rate -1%		Gov't inv. & dir. Taxes + 1% of GDP		Gov't cons. & dir. Taxes + 1% of GDP	
	Real sector only	Total mode l	Real sector only	Total model	Real sector only	Total model
<i>Cumulated as % of baseline</i>						
GDP	5.65	4.04	3.62	2.74	-0.85	-0.36
Prod.capacity	5.58	4.12	3.02	2.56	-0.86	-0.44
Priv. Consumption	1.75	2.21	1.40	0.89	-1.44	-0.77
Disp. Inc. Households	-4.32	-0.62	-2.13	-0.61	-0.91	-0.53
Exports G&S	9.89	5.10	5.09	3.57	-0.78	-0.82
Investment	5.49	5.29	17.17	11.99	-0.87	0.33
Base Money		1.31		-3.60		2.17
M2		0.95		-1.05		1.09
Currency outside banks		0.79		0.07		0.58
Deposits		1.26		-3.07		2.01
Wage rate	-13.69	-8.04	1.69	3.73	1.25	0.86
Defl. Priv. Cons.	-6.26	-2.77	-3.62	-2.17	0.54	0.44
GDP deflator	-9.06	-4.05	-4.81	-2.81	1.22	1.15
Employment	6.15	4.21	0.39	0.89	-0.85	-0.50
<i>Absolute difference from baseline</i>						
Unemployment	-5.71	-3.73	-0.35	-0.79	0.75	0.45
Current Acc. BOP, % GDP	1.10	0.00	-0.64	-0.09	0.11	0.01
Gov't. deficit, % GDP	-1.55	-0.63	-0.32	0.14	0.14	0.00
Capital imp., % base money		-0.08		0.51		-0.24
Short term interest		-0.07		0.49		-0.21

Annex 1: Annual Model Bulgaria, Real Sector, VERSION : 21-04-2003

Exogenous Variables

Pmwpc	=	exogenous
Pexcomppc	=	exogenous
Mwpc	=	exogenous
popu_15pc	=	exogenous
popu	=	exogenous
pimpGPC	=	exogenous
pimpspc	=	exogenous
emplg	=	exogenous
emplz	=	exogenous
rlf	=	exogenous
rsf	=	exogenous
rc	=	exogenous
DIBRaut	=	exogenous
kv	=	exogenous
b	=	exogenous
BRPCaut	=	exogenous

Impulse variables

TAXH_imp	=	(taxh_impupc) * .01 * YP(-1)
TAXC_imp	=	(taxc_impupc) * .01 * YP(-1)
NETTAX_imp	=	(indtax_impupc) * .01 * YP(-1)
TAXH_GDP	=	100 * TAXH/YP(-1)
TAXC_GDP	=	100 * TAXC/YP(-1)
NETTAX_GDP	=	100 * NETTAX/YP(-1)
I_GDP	=	100 * IP/YP
IG_GDP	=	100 * IGP/YP
IPR_GDP	=	100 * IPRP/YP
Dibrcc	=	100 * (dibr_imp * .01 * YP(-1))/BR(-1)
dibr	=	dibraut + dibrcc
igp	=	igpbase + ig_imp * .01 * YP(-1)
gp	=	gpbase + g_imp * .01 * YP(-1)
k_imp	=	k_imp(-1) + (inv_imp * .01 * YP(-1)) / (.01 * pipr) + (.01 * DIBRcc * BR(-1)) / (.01 * pipr)

National Accounts

(1) Private sector accounts

YPRP	=	YP - NETTAX + ITAX - YGP
DEPRPRIVP	=	0.125 * YPRP
WBUPR	=	WRPR * EMPLDPR/100
EMPLDPR	=	EMPLPR - EMPLZ
WRPR	=	(1 + .01 * WRPRPC) * WRPR(-1)
WAGESPR	=	WBUPR - SSCPR
SSCPR	=	0.30 * WBUPR
MIXINC	=	0.20 * YPRP
NETTAX	=	0.15 * YPRP + NETTAX_imp
ITAX	=	ITAX(-1)
GOSPR	=	YPRP - WBUPR - ITAX - MIXINC
YPRquote	=	100 * YPRP / YP
Mixincquote	=	100 * mixinc / yp

(2) Households

GOSHH	=	0.35 * GOSPR
WAGESHH	=	WAGES - WAGESROW
WBUHH	=	WAGESHH + SSCC
NETPROPINCH	=	NETPROPINCH(-1)
NATINCHH	=	NETPROPINCH + GOSHH + WBUHH + MIXINC
SOCBENH	=	.164 * (YP - NETTAX + ITAX)
OTHERTRH	=	.0096 * (YP - NETTAX + ITAX)
TAXH	=	0.0667 * DIH + TAXH_imp
SSCH	=	0.35 * WBUHH
DIH	=	NATINCHH + SOCBENH + OTHERTRH - TAXH - SSCH + SOCTRINKIND

(3) Companies

GOSC	=	GOSPR - GOSHH
NETPROPINCC	=	.0024 * GOSC
NATINCC	=	GOSC + NETPROPINCC
OTHERTRC	=	-.044 * YPRP
TAXC	=	.25 * GOSC + TAXC_imp
DIC	=	NATINCC + OTHERTRC - TAXC

(4) Total Economy

GOS	=	GOSPR + GOSG
DEPRP	=	DEPRPRIVP + DEPRGP
WBU	=	WBUPR + WBUG
WR	=	100 * WBU/(empldpr + emplg)
WAGES	=	WAGESPR + WAGESG
SSCC	=	SSCPR + SSCG
WAGES	=	WBU - SSCC
NETEXPORTS	=	EXPGSP - IMPGSP
NETPROPROW	=	(NETPROPROW(-1)/YP(-1))*YP
OTHTRROW	=	OTHTRROW(-1)
WAGESROW	=	WAGESROW(-1)
SOCBENROW	=	SOCBENROW(-1)
CA	=	NETEXPORTS - NETPROPROW - OTHTRROW - WAGESROW - SOCBENROW
CA_GDP	=	100 * (CA/YP)
CA_BR	=	100 * CA / BR(-1)
BR_ADAP	=	100 * BR(-1)/adap

Block 1: SupplySide

kg	=	(1 - delta_g * kg(-1) + ig
kastpc	=	1.0 * capstarpc - parprodfn(4) * (0.333 * (pkpc - cpupc - parprodfn(3)) + 0.333 * (pkpc(-1) - cpupc(-1) - parprodfn(3)) + 0.333 * (pkpc(-2) - cpupc(-2) - parprodfn(3))) - parprodfn(3) + .40 * (BRPC(-1) - adappc)
capstarpc	=	(0.333 * adapc + 0.333 * adapc(-1) + 0.333 * adapc(-2)) + parsupply(3) * (0.333 * (cpupc - padapc) + 0.333 * (cpupc(-1) - padapc(-1)) + 0.333 * (cpupc(-2) - padapc(-2)))
kast	=	(1 + .01 * kastpc) * kast(-1)
kpr	=	(kast ^ parsupply(1)) * ((1 - parsupply(2)) * kpr(-1)) ^ (1 - parsupply(1)) + K_impu
capstar	=	(1 + .01 * capstarpc) * capstar(-1)
cap	=	(1 + .01 * cappc) * cap(-1)
kprpc	=	100 * (kpr / kpr(-1) - 1)
kgpc	=	100 * (kg / kg(-1) - 1)
kpc	=	(1 - parprodfn(5)) * kprpc + parprodfn(5) * kgpc
k	=	(1 + .01 * kpc) * k(-1)
cappc	=	w_lab * (emplprpc + parprodfn(3)) + w_kpr * (kpc(-1) + parprodfn(3))
cap	=	(1 + .01 * cappc) * cap(-1)
qy	=	100 * y / cap
qypc	=	100 * (qy/qy(-1) - 1)

Block 2: Aggregate demand

$$\begin{aligned} \text{cnipc} &= 1.0 * (.5 * \text{dihpc} + .5 * \text{dihpc}(-1) - .5 * \text{pcnipc} - .5 * \text{pcnipc}(-1)) + .15 * (\text{BRpc}(-1) - \text{ADAPPC}) \\ \text{ipr} &= \text{kpr} - \text{kpr}(-1) + \text{parsupply}(2) * \text{kpr}(-1) \\ \text{Stock} &= \text{Stock}(-1) + \text{Parvol}(10) * \text{adapc} - \text{parvol}(11) * \text{Stock}(-1)/\text{ada}(-1) + \text{parvol}(12) \end{aligned}$$

Block 3: Foreign trade

$$\begin{aligned} \text{expgpc} &= \text{parvolpc}(1) * \text{mwpc} + \text{parvolpc}(2) * (.5 * (\text{pexpgpc} - \text{pmwpc}) + .5 * (\text{pexpgpc}(-1) - \text{pmwpc}(-1))) + \text{parvolpc}(3) * (\text{qy} - 100) \\ \text{expspc} &= \text{parvolpc}(4) * \text{tradepc} + \text{parvolpc}(5) * (.5 * (\text{pexpgpc} - \text{pmwpc}) + .5 * (\text{pexpgpc}(-1) - \text{pmwpc}(-1))) \\ \text{impgpc} &= \text{parvolpc}(6) * \text{adapc} + \text{parvolpc}(7) * (.5 * (\text{pimpgpc} - \text{padapc}) + .5 * (\text{pimpgpc}(-1) - \text{padapc}(-1))) + \text{parvolpc}(8) * (\text{qy} - 100) \\ \text{impspc} &= \text{parvolpc}(9) * (\text{dihpc} - \text{pcnipc}) + \text{parvolpc}(10) * (.5 * (\text{pimpspc} - \text{padapc}) + .5 * (\text{pimpspc}(-1) - \text{padapc}(-1))) \end{aligned}$$

Block 4: Wages & Prices

$$\begin{aligned} \text{Pcnipc} &= (1 - \text{nettax}(-1) / \text{adap}(-1)) * (\text{cpupc} + (\text{impgsp}(-1) / \text{adap}(-1)) * (\text{pimpgpspc} - \text{cpupc})) + (\text{nettax}(-1) / \text{adap}(-1)) * (\text{nettaxpc} - \text{adappc}) + \text{parpricespc}(9) * (.5 * \text{qy} + .5 * \text{qy}(-1) - 100) \\ \text{Piprpc} &= \text{parpricespc}(1) * \text{pypc} + \text{parpricespc}(2) * \text{pimpgpc} \\ \text{Pigpc} &= \text{parpricespc}(1) * \text{pypc} + \text{parpricespc}(2) * \text{pimpgpc} \\ \text{Pggpc} &= \text{parpricespc}(3) * \text{padpc} + \text{parpricespc}(4) * \text{wrgpc} \\ \text{pexpgpc} &= \text{parpricespc}(5) * \text{pexcomppc} + \text{parpricespc}(6) * \text{cpupc} \\ \text{Pexpspc} &= \text{parpricespc}(7) * \text{pexcomppc} + \text{parpricespc}(8) * \text{cpupc} \\ \text{Cpupc} &= \text{w_lab} * (.5 * \text{wrprpc} + .5 * \text{wrprpc}(-1)) + \text{w_kpr} * (.5 * \text{pkpc} + .5 * \text{pkpc}(-1)) - \text{parprodfn}(3) - (1 / \text{parprodfn}(4)) * \text{w_kpr} * .4 * (\text{kgpc}(-1) - \text{kprpc}(-1)) \\ \text{Wrprpc} &= \text{parpricespc}(12) * (.75 * \text{pcnipc} + .250 * \text{pcnipc}(-1)) + \text{parpricespc}(13) * (.5 * (\text{ypc} - \text{emplpc}) + .5 * (\text{ypc}(-1) - \text{emplpc}(-1))) + \text{parpricespc}(14) * (\text{ur} - .250 * (\text{ur}(-1) + \text{ur}(-2) + \text{ur}(-3) + \text{ur}(-4))) + \text{parpricespc}(16) * \text{wpresspc} + \text{parpricespc}(17) * \text{wpresshpc} + \text{wage_impu} \\ \text{pipcstar} &= 0.25 * \text{pipc} + 0.75 * \text{pipcstar}(-1) \\ \text{realint} &= \text{rlbu} - \text{pipcstar} \\ \text{pkpc} &= \text{pipc} + (\text{pi}(-1)/\text{pk}(-1)) * (\text{realint} - \text{realint}(-1)) \\ \text{pk} &= (1 + .01 * \text{pkpc}) * \text{pk}(-1) \end{aligned}$$

Block 5: Labour market

Empl	=	emplpr + emplg
empldpr	=	emplpr - emplz
Emplpc	=	100 * (empl/empl(-1) - 1)
emplprpc	=	100 * (emplpr/emplpr(-1) - 1)
empldprpc	=	100 * (empldpr/empldpr(-1) - 1)
emplzpc	=	100 * (emplz/emplz(-1) - 1)
emplgpc	=	100 * (emplg/emplg(-1) - 1)
lfpc	=	parlabour(2) * popu_15pc
lf	=	(1 + .01 * lfpc) * lf(-1)
lastpc	=	1.0 * capstarpc - parprodfn(4) * (0.333 * (wrprpc - cpupc - parprodfn(3)) + 0.333 * (wrprpc(-1) - cpupc(-1) - parprodfn(3)) + 0.333 * (wrprpc(-2) - cpupc(-2) - parprodfn(3))) - parprodfn(3)
last	=	(1 + .01 * lastpc) * last(-1)
emplpr	=	last ^ parlabour(1) * emplpr(-1) ^ (1 - parlabour(1))
U	=	Lf - empl
ur	=	100 * U / lf
wrpc	=	100 * (wr / wr(-1) - 1)
wbupc	=	100 * (wbu / wbu(-1) - 1)
AIQ	=	100 * (wbu / yp)

Block 6: Government

YGP	=	WBUG + DEPRGP + YGPex
DEPRGP	=	0.140 * YGP
WBUG	=	WRG * EMPLG/100
SSCG	=	0.240 * WBUG
WAGESG	=	WBUG - SSCG
WRGPC	=	.6 * WRPRPC + .4 * WRGPC(-1)
WRG	=	(1 + .01 * WRGPC) * WRG(-1)
GOSG	=	YGP - WBUG
NETPROPINCG	=	NETPROPINCG(-1)
NATINCG	=	GOSG + NETTAX + NETPROPINCG
OTHERTRG	=	.056 * (YP - NETTAX + ITAX)
SOCBENROW	=	SOCBENROW(-1)
SOCTRINKIND	=	.094 * (YP - NETTAX + ITAX)
DTAX	=	TAXH + TAXC
DIG	=	NATINCG + DTAX + OTHERTRG - SOCBENROW - SOCBENH + SSCH - SOCTRINKIND
DEF	=	GP + IGP + SOCBENH + WBUG + DEPRGP + SOCTRINKIND + SOCBENROW - GOSG - NETTAX - NETPROPINCG - DTAX - SSCH
DEFGDP	=	100 * DEF/YP

PRESS_H	=	SSCH - SSCC + TAXH
PRESS	=	SSCC
PRESSPC	=	100 * (PRESS / PRESS(-1) - 1)
PRESS_HPC	=	100 * (PRESS_H / PRESS_H(-1) - 1)
PRESSHPC	=	PRESS_HPC - PCNIPC - YPC
PRESSPC	=	PRESSPC - PCNIPC - YPC
WPRESSPC	=	(SSCC(-1)/WBU(-1)) * PRESSPC
WPRESSHPC	=	(PRESS_H(-1)/DIH(-1)) * PRESSHPC

Block 7: Monetary Sector

RSBU	=	rc + (1/coef(1)) * (kb - coef(2) * (BR% - ADP%) - coef(3) * kv - coef(4) + b)
AM	=	-coef(5) * (rsbu-rsf) + coef (6) * .5 * ((BR% - ADP%) + (BR%(-1) - ADP%(-1))) + coef (7)
CI/BR(-1)	=	Coef (8) * .5 * ((rsbu - rsf) + (rsbu(-1) - rsf(-1))) + coef (9)
CH%	=	coef (10) * ADP% + coef (11) * ((rsbu - rsbu(-1))) + coef (12)
D%	=	coef (13) * ADP% + coef (14) * (rsbu - rsbu(-1)) + coef (15) * .5 * ((BR% - adp%) + (br%(-1) - adp%(-1))) + coef(16)
T%	=	coef (17) * adp% + coef (18) * (rsbu - rsbu(-1)) + coef (19) * .5 * ((br% - adp%) + (br%(-1) - adp%(-1))) + coef (20)
Kb	=	100 * (1 / (1 - .01 * CM)) * (BR - CH) / M2 - AM
BR%	=	CIBR + CA_BR + DIBR + BRPCAUT
RT3	=	rt3(-1) + coef (21) * rsbu + coef (22) * rt3(-1)
RL	=	0.7 * rt3 + 0.3 * rlbu
RLBU	=	rlbu(-1) + coef (23) * rsbu + coef(24) * rlbu(-1)
M1	=	CH + Dd
M2	=	M1 + T
CM	=	100 * (CH / M2)
TM	=	100 * (T / M2)
CH	=	(1 + .01 * CH%) * CH(-1)
DD	=	(1 + .01 * D%) * Dd(-1)
M1%	=	100 * (M1 / M1(-1) - 1)
T	=	(1 + .01 * T%) * T(-1)
M2%	=	100 * (M2 / M2(-1) - 1)
BR	=	(1+ .01 * BR%) * BR(-1)

Definitions

pcni	=	(1 + .01 * pcnipc) * pcni(-1)
pipr	=	(1 + .01 * piprpc) * pipr(-1)
pig	=	(1 + .01 * pigpc) * pig(-1)
pipc	=	100 * (pi / pi(-1) - 1)
pzas	=	100 * zasp / zas

pg = (1 + .01 * pgpc) * pg(-1)
 pexpg = (1 + .01 * pexpgpc) * pexpg(-1)
 pexps = (1 + .01 * pexpspc) * pexps(-1)
 expggs = 100 * expgsp / expgs
 pexpgspc = 100 * (pexpggs / pexpggs(-1) - 1)
 pimpg = (1 + .01 * pimpgpc) * pimpg(-1)
 pimps = (1 + .01 * pimpspc) * pimps(-1)
 impggs = 100 * impgsp / impgs
 pimpgspc = 100 * (pimpggs / pimpggs(-1) - 1)
 pad = 100 * adp/ad
 padpc = 100 * (pad / pad(-1) - 1)
 pada = 100 * adap/ada
 padapc = 100 * (pada / pada(-1) - 1)
 py = 100 * yp / y
 pypc = 100 * (py / py(-1) - 1)
 cni = (1 + .01 * cnipc) * cni(-1)
 zas = .02 * ada
 expg = (1 + .01 * expgpc) * expg(-1)
 exps = (1 + .01 * expspc) * exps(-1)
 expggs = expg + exps
 impg = (1 + .01 * impgpc) * impg(-1)
 imps = (1 + .01 * impspc) * imps(-1)
 impggs = impg + imps
 y = cni + i + zas + g + expggs - impggs
 ad = cni + i + zas + g + expggs
 ada = cni + i + g + expggs
 i = ipr + ig
 trade = expg + impg
 ipc = 100 * (i / i(-1) - 1)
 ipprc = 100 * (ipr / ipr(-1) - 1)
 igpc = 100 * (ig / ig(-1) - 1)
 impgspc = 100 * (impggs / impggs(-1) - 1)
 expgspc = 100 * (expggs / expggs(-1) - 1)
 ypc = 100 * (y / y(-1) - 1)
 adpc = 100 * (ad / ad(-1) - 1)
 adapc = 100 * (ada / ada(-1) - 1)
 itaxpc = 100 * (itax / itax(-1) - 1)
 tradepc = 100 * (trade / trade(-1) - 1)
 nettaxpc = 100 * (nettax / nettax(-1) - 1)
 cnip = .01 * pcni * cni
 zasp = .01 * zas * pada
 g = 100 * gp / pg

gpc	=	100 * (g / g(-1) - 1)
iprp	=	.01 * ipr * pipr
ig	=	100 * igp / pig
ip	=	iprp + igp
expgp	=	.01 * expg * pexpg
expsp	=	.01 * exps * pexp
expgsp	=	expgp + expsp
impgp	=	.01 * impg * pimpg
impsp	=	.01 * imps * pimps
impgsp	=	impgp + impsp
yp	=	cnip + ip + zasp + gp + expgsp - impgsp
adp	=	cnip + ip + zasp + gp + expgsp
adap	=	cnip + ip + gp + expgsp
pi	=	100 * ip / i
yppc	=	100 * (yp / yp(-1) - 1)
cnippc	=	100 * (cnip / cnip(-1) - 1)
iprppc	=	100 * (iprp / iprp(-1) - 1)
igppc	=	100 * (igp / igp(-1) - 1)
ippc	=	100 * (ip / ip(-1) - 1)
gppc	=	100 * (gp / gp(-1) - 1)
expgppc	=	100 * (expgp / expgp(-1) - 1)
expspc	=	100 * (expsp / expsp(-1) - 1)
expgspc	=	100 * (expgsp / expgsp(-1) - 1)
impgppc	=	100 * (impgp / impgp(-1) - 1)
impspc	=	100 * (impsp / impsp(-1) - 1)
impgspc	=	100 * (impgsp / impgsp(-1) - 1)
adppc	=	100 * (adp / adp(-1) - 1)
adappc	=	100 * (adap / adap(-1) - 1)
dihpc	=	100 * (dih/dih(-1) - 1)

Annex 2: Symbols

Variable name	Definition
a	$100 * (nfacb / (dd+t))$
ad	aggregate demand
ada	aggregate demand minus stock changes
adap	aggregate demand minus stock changes current prices
adapc	aggregate demand minus stock changes percentage change
adappc	aggregate demand minus stock changes current prices percentage change
adiff	=a - aq
adp	aggregate demand current prices
adpc	aggregate demand percentage change
adppc	aggregate demand current prices percentage change
adppc	aggregate demand current prices percentage change
aiq	share of labour income
aq	
b	$100*cocb/(dd + t)$
br	= mb - nfacb (= ch+r - nfacb)
brpc	= cibr + fbr + dibr + brpcaut
brpcaut	=brpc - fbr - dibr - cibr
c1	share of currency in m1 (= $100*(ch / m1)$)
c2	share of currency in m2 (= $100*(ch / m2)$)
ca	consumption
ca_gdp	share of consumption of gdp
cap	production capacity
cappc	production capacity percentage change
capstar	desired production capacity
capstarpc	desired production capacity percentage change
ch	currency outside banks
chpc	currency outside banks percentage change
cibr	
cni	consumption
cnip	consumption current prices
cnipc	consumption percentage change
cnippc	consumption current prices percentage change
cocb	Claims on commercial banks
cpupc	cost per unit percentage change
dd	demand deposits
ddpc	demand deposits percentage change
deprgp	depreciation government sector current prices
deprp	depreciation current prices
deprprivp	depreciation private sector current prices
dibr	
dic	disposable income companies
dig	disposable income government

dih	disposable income households
dihpc	disposable income households percentage change
dtax	direct tax
empl	total number of employees
empldpr	employment private sector minus self employed
empldprpc	employment private sector minus self employed percentage change
emplg	employment government
emplgpc	employment government percentage change
emplpc	employment percentage change
emplpr	employment private sector
emplprpc	employment private sector percentage change
emplz	employment self employed
emplzpc	employment self employed percentage change
expg	export goods
expgp	export goods current prices
expgpc	export goods percentage change
expgppc	export goods current prices percentage change
expgs	export goods and services
expgps	export goods and services current prices
expgpspc	export goods and services percentage change
expgpspc	export goods and services current prices percentage change
exps	export services
expssp	export services current prices
expsspc	export services percentage change
expsspc	export services current prices percentage change
g	government consumption
gos	gross operating surplus
gosc	gross operating surplus companies
gosg	gross operating surplus government
goshh	gross operating surplus households
gospr	gross operating surplus private sector
gp	government consumption current prices
gpc	government consumption percentage change
gppc	government consumption current prices percentage change
i	Investment
impg	Import goods
impgp	Import goods current prices
impgpc	Import goods percentage change
impgppc	Import goods current prices percentage change
impgs	Import goods and services
impgps	Import goods and services current prices
impgpspc	Import goods and services percentage change
impgpspc	Import goods and services current prices percentage change
imps	Import services
impssp	import services current prices
impsspc	import services percentage change

impsppc	import services current prices percentage change
ip	investment current prices
ipc	investment percentage change
ippc	investment current prices percentage change
itax	indirect tax
itaxpc	indirect tax percentage change
k	capital stock
k	$= 100 * (r / (dd+t))$
kast	desired capital stock
kastpc	desired capital stock percentage change
kb	$= 100 * (r / (dd+t)) - 100 * cocb / (dd + t)$
kpc	capital stock percentage change
kv	
labprod	labour productivity
last	desired labour
lastpc	desired labour percentage change
lf	labour force
lfpc	labour force percentage change
m1	money m1 (= ch + dd)
m1pc	money m1 percentage change
m2	money m2 (= m1 + t) = (ch + dd + t)
m2pc	money m2 percentage change
mb	monetary base (= ch + r)
mixinc	mixed income
multipl	$= m2/br$
multipl2	$= 1 / ((kb/100+a/100) * (1-s_chm2/100) + s_chm2/100)$
mw95pc	world trade percentage change
natincc	
natincg	
natinchh	
netexports	net exports (exports minus imports)
netpropincc	
netpropincg	
netpropinch	
netproprow	
nettax	
nettaxpc	
nfa	net foreign assets commercial banks (= foreign assets cb - foreign liabilities cb)
othertrc	other transfers companies
othertrg	other transfers government
othertrh	other transfers households
othtrrow	other transfers rest of world
pad	price index aggregate demand (1997=100)
pada	price index aggregate demand minus stock changes (1997=100)
padapc	price index aggregate demand minus stock changes (1997=100) percentage change
padpc	price index aggregate demand (1997=100) percentage change

pcni	price of consumption
pcnipc	price of consumption percentage change
pexcomppc	price of competitive export percentage change
pexpg	price index export goods (1997=100)
pexpgpc	price index export goods (1997=100) percentage change
pexpgs	price index export goods and services (1997=100)
pexpgspc	price index export goods and services (1997=100) percentage change
pexps	price index export services (1997=100)
pexpspc	price index export services (1997=100) percentage change
pg	price of goods
pgpc	price of goods percentage change
pi	price index investment (1997=100)
pimpg	price index import goods (1997=100)
pimpgpc	price index import goods (1997=100) percentage change
pimpgs	price index import goods and services (1997=100)
pimpgspc	price index import goods and services (1997=100) percentage change
pimps	price index import services (1997=100)
pimpspc	price index import services (1997=100) percentage change
pipc	price index investment (1997=100) percentage change
pk	price index capital cost (1997=100)
pkpc	price index capital cost (1997=100) percentage change
pmw95pc	price world trade percentage change
popu_15pc	population of 15 years and older percentage change
press	tax wedge
press_h	tax wedge households
press_hpc	tax wedge households percentage change
presshpc	
presspc	
presspc	tax wedge percentage change
py	price index gdp (1997=100)
pypc	price index gdp (1997=100) percentage change
pzas	price index stock changes
qy	Production
qypc	production percentage change
r	bank's reserves
rc	basic interest rate BNB
rcbu	
rl	
rl3	
rlbu	interest rate long term bulgaria
rr	
rsbu	interest rate short term bulgaria
rsf	interest rate short term foreign
rt3	
socbenh	social benefits households
socbenrow	social benefits row

soctrinkind	social transfer in kind
sscc	social security contribution companies
sscg	social security contribution government
ssch	social security contribution households
sscpr	social security contribution private sector
Stock	stock change
Stockp	stock change current prices
t	quasi money
taxc	tax companies
taxh	tax households
tcpupc	total cost per unit percentage change
tpc	quasi money percentage change
tq	= 100 * (t / m2))
trade	export + import of goods
tradepc	export + import of goods percentage change
u	Unemployment
ur	unemployment rate
wages	gross wages
wagesg	gross wages received by government employees
wageshh	gross wages received by households
wagespr	gross wages received by private sector employees
wagesrow	gross wages received by rest of world
wbu	wage sum
wbug	wage sum government (gross wages + social security contributions)
wbuhh	wage sum households
wbupc	wage sum percentage change
wbupr	wage sum private sector (gross wages + social security contributions)
wr	wage rate
wrg	wage rate government
wrgpc	wage rate government percentage change
wrpc	wage rate private sector percentage change
wrpr	wage rate private sector
wrprpc	wage rate private sector percentage change
y	Gdp
ygp	
ygpex	
yp	gdp current prices
ypc	gdp percentage change
yppc	gdp current prices percentage change
yprp	

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