Tax harmonization and public expenditures restructuring in Romania, in the process of preparation for the EU accession – A CGE modeling exercise

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Draft version

Abstract

During the past few years, Romania has been facing a new challenge: the accession to the European Union. The preparation process for accession includes meeting the 1993 Copenhagen European Council criteria and the adoption of the "Acquis Communautaire". In this paper, we use a dynamic multi-sector computable general equilibrium (CGE) model, called RoMod, in order to examine the effects of tax harmonization and public expenditures restructuring, in the process of preparation for the EU accession. The model distinguishes the economic behavior of four institutional sectors: firms, households, government and the rest of the world. Production is disaggregated into 35 sectors. The tax system is also modeled in detail. The model provides short-, medium- and long-term effects of economic policies. A reference baseline is established up to 2007, the indicative date chosen by the government for accession. The model is solved dynamically with annual steps. RoMod is used to evaluate the short- and medium-run economic impact of five policy scenarios. The first two are: the elimination of the VAT exemptions and the application of EU oriented VAT rates to certain commodities and services; and the increase in the excise duties on mineral oils. They both aim at tax harmonization as stipulated in the Chapter 10 on Taxation of the *"Acquis Communautaire"*. The next two, the elimination of direct subsidies on public passenger transport, and the shift of public expenditures from current to capital expenditures, intend to capture the restructuring of the budgetary expenditures. The fifth scenario aims to answer two questions: what is the overall effect of the tax harmonization and the public expenditures restructuring measures undertaken by the government (as presented in the first four scenarios), and by how much can the social security contributions rate be reduced by 2006, when the conventional budget deficit to GDP ratio is kept constant at a level of 3.6 per cent, starting with 2003.

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1. Introduction

Romania is an EU candidate country. The accession negotiations between the European Union and Romania started on February 15, 2000. After the Copenhagen Summit in December 2002, the target data for accession, 2007, has become the highest priority for the Romanian Government. Thus, for the period to come the government committed to take the necessary steps in order to comply with the requirement of functioning market economy and to finalize the negotiations during 2004 (Romanian Government, 2003).

Tax harmonization with the EU requirements (as stipulated in the Chapter 10 on Taxation of the *"Acquis Communautaire"*) and the restructuring of the public expenditures are among the objectives stated by the government in the Pre-accession program (Romanian Government, 2003). Thus, an evaluation of the macro and sectoral effects of implementing such types of policy measures can prove to be useful for policymakers. So far, only the Dobrescu macro-model and the Romanian version of the RMSM-X have been used to estimate such effects. Dobrescu macro-model is a macro-econometric model for the Romania economy developed at the Institute of Economic Forecasting. RMSM-X stands for Revised Minimum Standard Model - Extended and it has been developed at the World Bank. The purpose of these models is to monitor stabilization and structural adjustment, to analyze development strategies and the sustainability of policies. Their results have been used to develop the Pre-accession program (Romanian Government, 2003). However, neither of these models is able to provide detailed sectoral results as they only account for four main sectors: agriculture, forestry and fishing; manufacturing; construction and services. The effects of the policy measures examined in this paper have entirely different effects on various sectors like oil, publishing and printing, transport or pharmaceuticals. Therefore more detailed sectoral estimates have greater value for the policymakers.

This paper aims to provide a comprehensive analysis using a CGE model for the Romania economy (RoMod), of the possible effects of some of the policy measures already implemented or envisaged by the government in the Pre-accession program. It further explains the mechanisms through which they affect different economic agents, like the household, the firms and the government. The household's welfare gains or losses are assessed for each of the policy measures in terms of equivalent variation in income. We will focus our discussion on the harmonization of VAT taxes and excise duties on mineral oils, while the restructuring of the public expenditures is captured through the elimination of direct subsidies on public passenger transport and the shift of public expenditures from current to capital expenditures.

The paper is organized as follows. We begin in section 2 with a brief overview of four policy measures envisaged by the government in the Pre-accession program: the elimination of the VAT exemptions and the application of EU oriented VAT rates to certain commodities and services, the increase in excise duties on mineral oils, the elimination of direct subsidies on public passenger transport, and the shift of public expenditures from current to capital expenditures. Section 3 presents the quantitative framework which is used to evaluate the effects of these policy measures: the Computable General Equilibrium model for the Romanian economy (RoMod). In section 4 we evaluate the effects of the policy measures presented in section 2 using RoMod, followed by some concluding remarks in section 5.

2. Some basic facts

The Romanian legislation on VAT is mostly harmonized with the Sixth Council Directive (77/388/EEC). The new Fiscal Code[1] enforced in 2004 further eliminates the exemptions on:

- Supply of books, other than material wholly or substantially devoted to advertising matter;
- Admissions to shows, theatres, circuses, fairs, museums, zoos, exhibitions and similar cultural events and facilities;
- Medical equipment, aids and other appliances normally intended to alleviate or treat disability, for the exclusive personal use of the disabled, including the repair of such goods;

and introduces a reduced rate of VAT of 9 per cent on these commodities and services, in accordance with the Annex H of the Sixth Council Directive. The exemptions elimination aims at avoiding distortions of competition and harmonizing the taxable base by applying the Community rate to taxable transactions (77/388/EEC).

The reduced rate of VAT of 9 per cent also replaces the statutory rate of 19 per cent for:

- Newspapers and periodicals, other than material wholly or substantially devoted to advertising matter;
- Pharmaceutical products of a kind normally used for health care, prevention of diseases and treatment for medical and veterinary purposes;
- Accommodation provided by hotels and similar establishments and the letting of camping sites and caravan parks;

starting with 2004. The application of the reduced VAT rate is generally based on the argument that it affects prices and increases competitiveness. In the labor-intensive sectors is can further stimulate employment.

Romania continues the gradual alignment of excise duties for all harmonized commodities according to the schedule stipulated in the Chapter 10 on Taxation of the *"Acquis Communautaire".* For the mineral oils, Romania requested a five-year transition period, until 31 December 2011, for the implementation of the minimum levels provided in Directive 92/82/EEC. By 31 December 2006, the levels of the excise duties should be nevertheless increased by 50 per cent out of the difference between the Romanian levels in 2000 and the excise duties levels as in the directive. The minimum levels required for Romania by the end of 2006 are given in table 1, together with the minimum excise duties (in EUR/ton) adopted by the Council on 19/10/1992 (Directive 92/82/EEC).

Excise duties on mineral oils have been raised several times, starting with 2000 (see table 1). For all mineral oils, except for heavy fuel oil, Romania already meets the requirement established for 2006. For the period 2005-2006, it is envisaged that only the excise duties on heavy fuel oil will be gradually raised, in order to meet the minimum requirement (see table 1).

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[1] Law no.571/23 December 2003 regarding the Fiscal Code.

Table 1. Statutory excise duties on mineral oils during 2000-2004 and some estimates for 2005-2006

Excise duty on mineral oils (EUR/ton)	2000	2001	2002		2003		2004	2005	2006	EU*	Romania 2006**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Petrol											
Leaded	270	270	290	319.6	404	404	404	404	404	438	354
Unleaded	220	220	235	262.6	347	347	347	347	347	373	296
Gas oil											
Used as propellant	105	105	115	115	187	221	221	221	221	285	195
Used for ind./comm. purposes	105	105	115	115	187	221	221	221	221	21	21
Used for heating purposes	105	105	115	115	187	221	221	221	221	21	21
LPG and methane											
Used as propellant	0	0	100	100	100	100	100	100	100	100	50
Used for ind./comm. purposes	0	0	100	100	100	100	100	100	100	36	18
Used for heating purposes	0	0	0	0	0	0	0	0	0	0	0
Heavy fuel oil	0	0	0	0	0	0	0	3.3	6.5	13	6.5
Kerosene											
Used as propellant	0	0	290	319.6	404	404	404	404	404	318	159
Used for ind./comm. purposes	0	0	290	319.6	404	404	404	404	404	23	12
Used for heating purposes	0	0	290	319.6	404	404	404	404	404	0	0

Note: The data provided in the table is based on the legislation[2] and own estimates (columns 8-9). Excise duties in column (3) are enforced on 1st of January 2002, while the one in column (4) are enforced on 1st of August 2002. Excises duties in column (5) are enforced on 22nd of January 2003 and the one in column (6) are enforced on 1st of July 2003. Finally, excise levels in column (7) are enforced on 1st of January 2004.
* Minimum excise duties adopted by The Council on 19-10-1992 (Directive 92/82/EEC).
**Minimum excise duties required for Romania by 31 December 2006 (Chapter 10 -Taxation).

During the 1990s, subsidies to state-owned enterprises have either been channeled directly from the budget, or via the energy sector. In 2000 direct subsidies to enterprises represented around 1.3 per cent of GDP (National Institute of Statistics, 2003). Roughly half of these subsidies were supporting public passenger transport, of which 85 per cent for railways public transport. The problem resulting from the large amount of subsidization is that it allows the survival of unrestructured and inefficient state owned enterprises (OECD, 2002). Thus, the reduction of direct subsidies is envisaged by the government in the Pre-accession program (Romanian Government, 2003).

Another priority stated by the government in the Pre-accession program is the restructuring of the public expenditures. Public investments growth plays a key role in the restructuring process (Romanian Government, 2003). Thus, public capital expenditures are envisaged to be increased with 0.2 per cent of GDP at current market prices in 2004, and an additional 0.3 per cent of GDP at current market prices in 2006.

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[2] OG 27/2000 regarding the excise duties, enforced on 30th of January 2000; OUG 158/2001 regarding the excise duties enforced on 1st of January 2002; Law 523/2002 regarding the excise duties enforced on 1st of August 2002; OUG 3/2003 for the modification of the OUG 158/2001 regarding the excise duties and the enforcement of some measures meant to increase the collection of government revenues, enforced on 22nd of January 2003; OUG 57/2003 for the modification and completion of the OUG 158/2001 regarding the excise duties, enforced on 1st of July 2003; Law no.571/23 December 2003 regarding the Fiscal Code.

3. Model description

The core of the model is built in the tradition of Dervis, De Melo and Robinson (1982), but accounts for country-specific elements. The model incorporates the economic behavior of four institutional sectors: firms, households, the government sector and the external sector. All economic agents are assumed to adopt an optimizing behavior under relevant budget constraints. The goods-producing sectors, consisting of both public and private enterprises, are disaggregated into 35 production activities[3]. The government sector consists of both central and local government bodies. It should be stressed that the government sector does not include market producer public enterprises, which are part of the firms sector. With regard to the external sector the economy is treated as a small open economy with no influence on (given) world market prices.

The model has a recursive dynamic structure composed of a sequence of several temporary equilibria, in which current savings determine future capital accumulation and the growth rate of the economy. The simulation horizon of the model is set at 6 years, up to the indicative date chosen by the government for accession (2007). RoMod is calibrated on the Romanian Social Accounting Matrix for 2000, built by the authors. The model equations are presented in appendix B.

3.1. The firms sector

As already mentioned, the firms sector (comprising the entire production activities) is divided into 35 production sectors. Services had the highest contribution to GDP in 2000 with 48.2 per cent, followed by manufacturing with 35.8 per cent, agriculture with 11.01 per cent and construction with 4.99 per cent. Thus, Romania's GDP structure is more or less comparable to that of developed countries. Among the services sectors the wholesale and retail trade sector had the largest contribution to GDP with 10.2 per cent, while the manufacturing of processed food products among the manufacturing sectors held that position with 10.02 per cent.

The firms sector includes both public and private enterprises. The public firms sector is still relatively large in Romania, given that the contribution of the private firms sector to GDP was 64.5 per cent in 2000 (National Bank of Romania, 2001). Unfortunately, the necessary data to model the public and the private enterprises separately are not available. Apart from data limitations, the pace of privatization and the resulting decrease in importance of the public firms sector provide another reason for not modeling them separately. In 1995, the government took steps towards a more active privatization policy by launching the second Mass Privatization Program and the government elected at the end of 1996 further accelerated the pace of privatization, which was embedded in a wider program of structural reforms. In 2002 the private firms sector share in GDP had risen to a level of 69 per cent (Romanian Government, 2003). Meanwhile, the restructuring of public enterprises has increased their competitive awareness and has made them more comparable with private enterprises. In this context, the assumption of competitive markets with flexible prices, adopted in the model, seems more appropriate than the use of mark-up pricing or administered prices.

The CGE model does not model the behavior of individual firms, but of groups of similar ones aggregated into sectors. The usual assumption for such a model is that producers maximize profits under perfect competition. However, in this model firms

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[3] The disaggregation of the production sectors and their correspondence to NACE Rev.1 (Classification of Economic Activities in the European Community) is given in appendix A.

are assumed to minimize costs. For example, for the firms operating internationally, the world market dictates the output price to a large extent, so, for an optimal outcome they have to produce as efficiently as possible. Some other firms are constrained in the costs level by domestic competitors. Thus, the optimizing producers minimize their production costs at every output level, given their production technology. Furthermore, production prices equal average cost, a condition that implies profit maximization for a constant returns to scale technology.

Gross output for each sector except coal sector, oil sector and extraction of natural gas sector is determined from a nested production structure. At the outer nest producers are assumed to choose intermediate inputs of non-energy goods and a capital-labor-energy bundle, according to a Leontief production function. At the second stage, producers choose the optimal level of labor input and capital-energy composite. Production substitution possibilities are reflected in this case by a constant elasticity of substitution (CES) function. The optimal level of capital and energy is determined at the third stage, according to a CES function. Further, at the fourth stage, producers allocate the energy bundle between electricity and non-electric energy commodities. Production substitution possibilities are again reflected by a CES function. The allocation between different non-electric energy commodities: coal, oil and natural gas, is given at the fifth stage by another CES function. The complex nested structure and the functional forms used in all the production sectors except the coal, oil and extraction of natural gas sectors are summarized in figure 1.
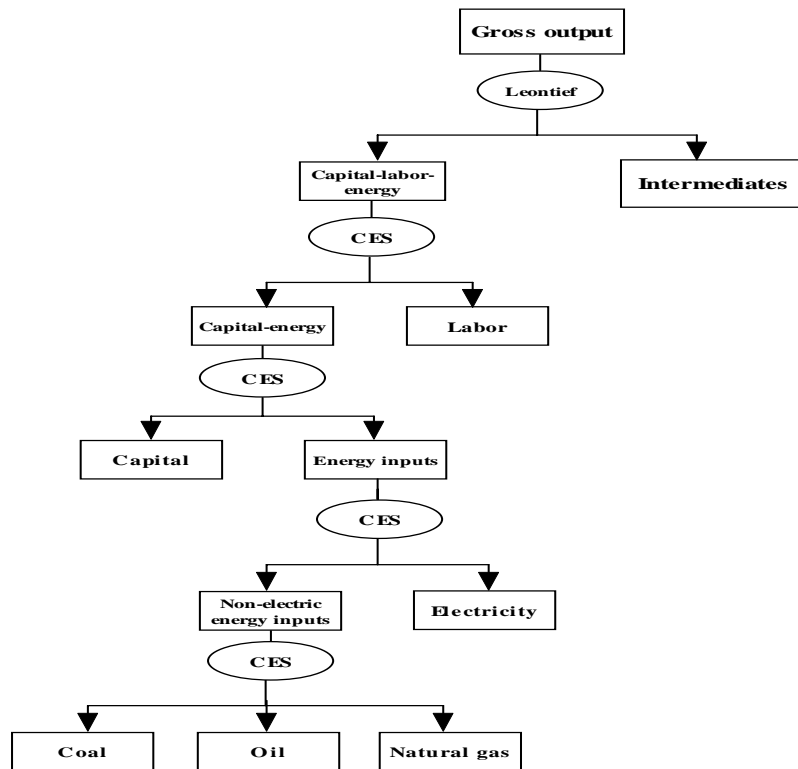

Figure 1. The nested CES and Leontief production technology for all production sectors except coal, oil and natural gas sectors

Gross output for the coal sector, oil sector and the extraction of natural gas sector is also determined from a nested production structure. At the outer nest producers are assumed to choose intermediate inputs of non-energy goods, energy inputs and a capital-labor bundle, according to a Leontief production function. The energy inputs are represented by coal, oil, natural gas and electricity. At the second stage, producers choose the optimal level of labor and capital, according to a CES function. The nested structure and the functional forms used for coal sector, oil sector and natural gas sector are given in figure 2.
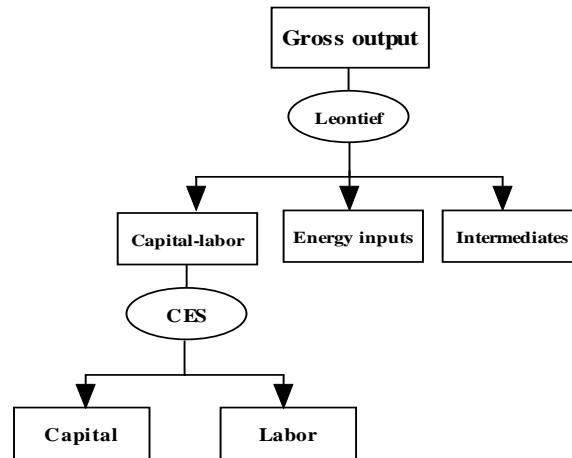
Figure 2. A nested Leontief and CES production technology for the coal, oil, and natural gas sectors

Treated at an aggregate level, firms receive income from sales of goods and subsidies and transfers from the government, they purchase non-energy intermediate inputs and energy inputs, make wage payments, pay taxes on production, social security contributions and corporate taxes, they make transfers to the household and the external sector and save.

3.2. The households sector

Surprisingly, a high share of the household's income consists of capital income, 33.9 per cent in 2000 (National Institute of Statistics, 2003), compared with the labor income which accounts for 39.3 per cent. Production is generally not the main feature of the household. However, the households sector includes family associations and independent private entrepreneurs. Thus, capital income also comprises mixed income accruing to unincorporated enterprises owned by this sector. By 2001 the small and medium-sized enterprises (SMEs) represented 56 per cent of total turnover in the economy, of which individual entrepreneurs accounted for about 60 per cent. Some of the new entrepreneurs benefited from earlier experience in public enterprises and from personal connections with banks and clients. This type of entrepreneurship developed mainly in the area of foreign trade, as well as in highly specialized segments of the manufacturing and service sectors (textiles, constructions, furniture and business services). Some other entrepreneurs, young, often inexperienced people, typically with a university education and eager to engage in new business, because of the difficult access to capital, engaged in business areas with lower entry costs, such as trade and services (OECD, 2002). In the agricultural sector, family association has been the predominant way of organizing production.

The income distribution in Romania is unequal, with many people living below the poverty line. The highest incidence of poverty is reported for members of households whose heads are unemployed or of working age but not in the labor force mostly due to disability or home responsibilities. Relatively high poverty rates are also found in the households of farmers and other self-employed persons. Households headed by employees and by pensioners, have below-average poverty rates while the employers are found to have the lowest rates (OECD, 1998). Although a disaggregation of the household sector in different social groups would have been useful for an analysis of the income distribution effects of different types of fiscal measures, the lack of data doesn't allow such an analysis.

In the model, the representative household receives a fixed share of capital income, labor income from resident and non-resident firms in return for labor services and transfers from the government, the firms and the external sector. The transfers from the government consist of unemployment benefits, interest payments for the public debt and other transfers, while the exogenous transfers from the firms refer mostly to insurance premiums and other transfers. The household pays taxes on income and social contributions (social contributions in this case refer to those paid by the self employed members of the household sector) to the government and save a fixed fraction of net income. The household's disposable budget for consumption is allocated between consumption commodities according to a Stone-Geary function. A schematic representation of households' decisions is given in figure 3.
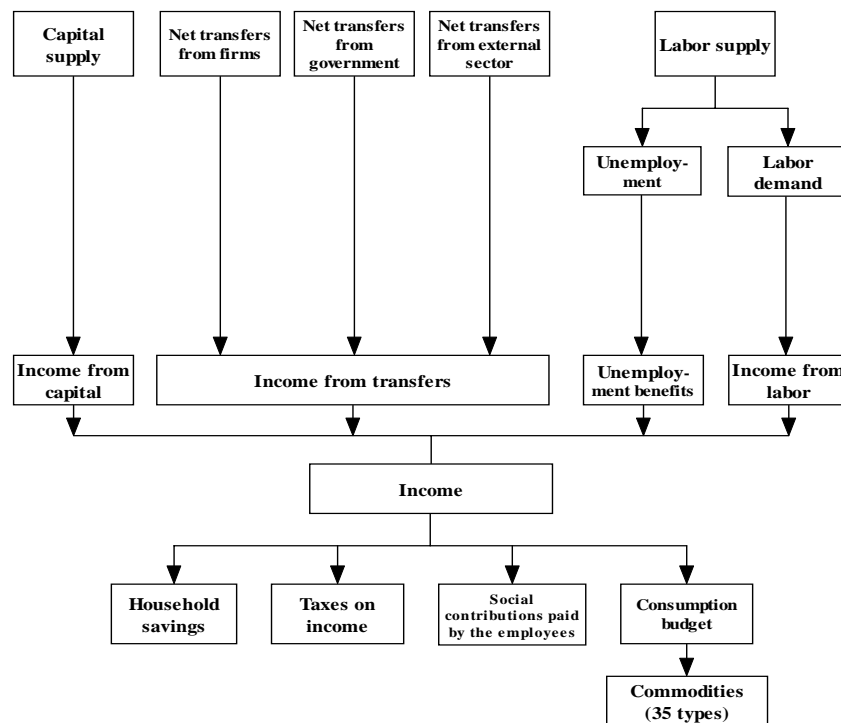

Figure 3. The decisions made by the household

Commodities are distinguished in 35 categories, following the same classification as used for the production sectors. This classification is dictated by the level of

disaggregation of the SAM, but it should not necessarily be the same as the classification of the production sectors.

To evaluate the overall change in consumer welfare we use the equivalent variation in income, which is based on the concept of a money metric indirect utility function. Equivalent variation measures the income needed to make the household as well off as she is in the new counter-factual equilibrium (policy scenario) evaluated at benchmark prices. The equivalent variation is positive for welfare gains from the policy scenario and negative for losses (Harrison and Kriström, 1997).

3.3. The government sector

The principal budget entities are the state budget (representing 52.68 per cent of general government spending in 2000); the social security fund, which covers old-age pensions and invalidity benefits (19.65 per cent); and local government administrations, responsible for most local services (excluding health and education, which are centrally funded) and some basic social assistance benefits (11.70 per cent)[4]. In 2000 there were several smaller funds, covering additional areas of social support (including unemployment compensation and health insurance benefits) and some more specialized functions (such as energy projects and road constructions). Starting with 2003, all the funds with specialized functions have been included in the state budget. The consolidated budget also includes State Ownership Fund (SOF) which gathers the revenues from privatization. In the model however, the general government consolidated budget is presented from the revenues and expenditures perspective to reflect the contributions of the economic agents to the budget and government expenditures. The primary and the conventional balance are chosen to define the size of the fiscal surplus/deficit.

It would have been interesting to distinguish and model the revenues from privatization, but due to the lack of data on public firms and private firms sectors this was not possible. Instead, these revenues are treated exogenously and are included in the net transfers to the firms sector. Similarly, lack of data did not allow a modeling of the financial sector in greater detail, which would have given a deeper insight in the financing of the budget deficit. In 2000 all forms of quasi-fiscal spending were eliminated, with support for agriculture, industry and other activities brought fully in the budget. This decision was a significant step on the path towards a market-oriented economy and thereby, raised the degree of realism of the model proposed here even if the financing of the budget deficit is presented in a simplified manner in RoMod.

In the model, the government is represented in two ways: as a production sector[5] (public administration and defence; copulsory social security) and as an institutional sector. The public administration sector produces public goods using non-energy intermediates, energy inputs, labor and capital. The government sector (seen as an institutional sector) collects taxes, subsidizes consumption and production, makes transfers and capital expenditures and buys public goods from the public administration sector.

Government revenues consist of taxes on both intermediate and final consumption (value added taxes and excise duties), taxes on production, social security contributions, import tariffs, taxes on household's income and corporate taxes, and

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[4] Data available at http://www.mfinante.ro
[5] The treatment of the public administration sector has been discussed together with the firms sector in section 3.1.

transfers from the external sector. The government makes transfers to the household, which consist of unemployment benefits, determined by the combination of the replacement rate and the national average real wage, other transfers, such as pensions, translated into nominal terms by using the Laspeyres consumer price index and a share of interest payments on public debt.

Total government expenditures comprise transfers to firms and to households (including the interest payments on the public debt), subsidies on consumption and production, purchases of goods and services and capital expenditures, where the government disposable budget for current and capital expenditures is modeled as a fixed share of GDP at current market prices. The optimal allocation between purchases of goods and services (including public goods bought from the public administration sector) and capital expenditures is given by the maximization of a Cobb-Douglas utility function subject to the budget constraint.

The primary budget surplus is given by total revenues minus current and capital expenditures (except interest payments). The conventional budget deficit is then derived as the difference between the primary budget balance and the interest payments on public debt. The debt accumulation is explained in section 3.9 together with the model's dynamics.

3.4. The external sector

The trade regime is relatively liberal for most products. Imports reflect a high degree of concentration on industrial commodities, 80.3 per cent in 2000, due to the high share of imports of electrical machinery, appliances and equipment (29.1 per cent) textiles and clothing (18.6 per cent) and chemicals (9.1 per cent). Most textile imports are used as intermediate inputs by the domestic textile industry showing the high dependency on imports of this sector. Exports are also characterized by a high degree of concentration, with industrial commodities representing 83.1 per cent of the total in 2000. Articles of apparel and clothing alone represent 27.4 per cent of exports, and basic metals and fabricated metal products (iron and steel) 15.1 per cent. Romania displays a large export surplus in apparel and clothing segments and the largest deficit in intermediate textile products (OECD, 2002). This reflects the very considerable subcontracting activities for firms in various European Union countries (mainly Italy and Germany). However, due to the lack of data on imports of intermediate inputs used by each sector, and on import tariffs by country of origin, it is not possible to analyze these aspects in detail.

As already mentioned, the trade regime is relatively liberal for most products. For non-agricultural products the average (non-weighted) tariff rate reached 16 per cent in 2000, while for agricultural and food products was nearly 34 per cent. This issue is important in the process of preparation for EU accession. Besides, Romania does not apply any quantitative restriction to imports (OECD, 2002). Some restrictions on exports are applied for environmental reasons (in the case of wood), for preservation of mineral resources (ferrous and non-ferrous metals, precious metals, marble) and biological products (e.g. blood), but they are not specifically considered in the present model.

In the model, the specification of foreign trade is based on the small-country assumption, which means that the country is a price taker in both its imports and exports markets. As a result, both world import prices and world export prices are exogenously fixed.

Limited substitution possibilities are assumed between domestically produced and imported goods (Armington, 1969). It indicates that domestic consumers use

composite goods of imported and domestically produced goods, according to a CES function. A limited substitution is also assumed to exist between goods produced for the domestic market and for export as captured by a constant elasticity of transformation (CET) function.

The balance of payments deficit, expressed in foreign currency, is determined by the difference between exports and imports, valued at world prices, the transfers received by the households and the government from the external sector, the remuneration for labor supplied to the external sector, the transfers of the firms to the external sector as well as the interest payments on foreign debt. The deficit of the balance of payments reflects the net borrowing of the economy from the external sector.

3.5. Investment demand

There are no formal restrictions on foreign or domestic direct investment in any specific sector in Romania. The only exception refers to foreign companies wishing to establish a subsidiary, which are required as insurance to associate with a Romanian partner. Furthermore an amendment, passed in April 1997, to the 1991 Foreign Investment Law provides the right of a foreign investor established as a legal Romanian person to acquire real estate, including land, necessary to carrying out its activities.

In the model, investment is modeled through an optimization process, providing the optimal allocation of investment commodities. The input-output table provides only the investments disaggregated by type of commodity. Therefore, within a single period, the model generates savings, the demand for investment commodities, and the demand for capital goods. However, by assumption, these capital goods are not installed during the same period, so that investment simply represents a demand category with no effect on supply in the static part of the model (Robinson *et al.*, 1999). The allocation of investment commodities between production sectors is further provided in the dynamic part of the model. However, due to the lack of data, the model does not show the composition of investment commodities distributed to each sector. Instead, a homogenous composite investment good is allocated for each production sector, in the dynamic part of the model.

Changes in inventories are derived by multiplying the domestic demand by the inventory investment ratio, while sectoral depreciation is determined by the product of capital stock and the depreciation rate.

Total available savings are determined by the sum of households' savings, firms savings, government savings, foreign savings (equivalent to net borrowing of the economy from the external sector) and depreciation. Government savings are further given by the sum of the conventional budget deficit and public capital expenditures.

3.6. Price equations

A common assumption for a CGE model, which has also been adopted here, is that economy is initially in equilibrium with the quantities normalized in such a way that prices equal unity. An exception has been made for the capital and labor market. Due to the homogeneity of degree zero in prices the model can only determine relative prices. A particular price has been selected to provide the numeraire price level against which all relative prices in the model will be measured. In this case, the GDP deflator, defined as the ratio of GDP in current prices to GDP at constant prices, is chosen as the numeraire.

Separate prices are distinguished for all producing sectors, exports and imports. The domestic price of exports reflects the price received by the domestic producers for selling their output on the external market. The cost of trade, railways transport, land transport, and water transport inputs further reduces the domestic price received by the producers. The cost of trade and transport inputs for exports reflects the cost of moving the commodity from the producer to the border, which is paid by the producer (Löfgren, Harris and Robinson, 2002). The domestic price of imports is determined by the world price of imports, the exchange rate, the tariffs rate and the cost of trade, railways transport, land transport and water transport inputs for imports. The cost of trade and transport inputs for imports reflects the cost of moving the commodity from the border to the final consumer.

The model distinguishes the price of domestic output supplied to domestic market paid by the consumers and the price received by the producers. The difference between the two prices is represented by the cost of trade and transport inputs for domestic output delivered to domestic market.

3.7. The labor market

The enterprise restructuring, which is meant to improve the profitability of firms across the Romanian economy, has increased the risk of dismissal for many employees in the short-run. Wage differentials are substantial and growing, especially in private firms. Formal education is a major criterion for wage differentiation, as in many transition countries. Wage bargaining is generally decentralized and not subject to direct intervention by the government, apart from the public administration and Régies Autonomes where the government has the final authority. The legal minimum wage was fixed at 1,000,000 ROL (51 EUR) per month in 2000. Almost all employees earn more than the legal minimum since it is low relative to average wages. The legal minimum wage serves primarily as a benchmark for social transfers, and as a lower limit for taxable income.

The usual unemployment-inflation relationship observed for stable, developed economies, is far from being valid for a country in transition like Romania, where for some periods hyperinflation has been associated with medium-term trends of increasing unemployment rates. One of the frequent explanations is the liberalization of the previous command economic system, allowing prices to adjust freely. Another explanation refers to the existence of hidden unemployment. Some authors (Ciupagea, 2000) point at the impact of hysteresis on the labor market in Romania. However, the labor market is modeled in quite a simple manner. A deeper analysis of the labor market including the incorporation of all sorts of rigidities is left for future research.

In the model labor market rigidities are introduced by using a wage type curve, which seems quite realistic, at least in the long-run. The wage curve assumes a long-run negative relationship between the real average wage rate and the unemployment rate (Blanchflower and Oswald, 1994). A labor supply curve, which assumes a positive correlation between the labor supply and the real average wage rate is used to endogenize labor supply in the model. The labor market is closed by changes in unemployment. Furthermore, the inter-sectoral wage differentials are included in the model, introducing more rigidities in the labor market.

3.8. Other macroeconomic indicators

Gross domestic product is defined in the model both at constant prices and in current market prices. Some other macroeconomic indicators like total private consumption, the aggregate demand for investment commodities, total imports and exports are given in appendix B.

3.9. Incorporation of recursive dynamics

So far we presented the static general equilibrium model for 2000. However, an evaluation of tax policy measures based on a static equilibrium can be misleading. For example, the change in households' welfare will not include the expected consumption in later years (Ballard, Fullerton, Shoven and Walley, 1985). Therefore, we incorporate a recursive dynamic structure in the model. The recursive dynamic structure is composed of a sequence of several static equilibria. The first equilibrium in the sequence is given by the benchmark year[6]. In each time period, the model is solved for an equilibrium given the exogenous conditions assumed for that particular period. The equilibria are connected to each other through capital accumulation. In the benchmark case, we assume that the economy is on a steady-state growth path, where all the quantity variables grow at the same rate and all relative prices remain unchanged. When a policy measure is implemented the economy enters on a transition path, until, after some time it has reached a new steady-state growth path (Ballard, Fullerton, Shoven and Walley, 1985). We are of course interested in the transition path induced by the policy measure and the characteristics of the new growth path.

The endogenous determination of investment behavior is essential for the dynamic part of the model. Investment and capital accumulation in year *t* depend on expected rates of return for year *t+1*, which are determined by actual returns on capital in year *t*. This approach involves adaptive expectations. Thus, investment is not only a demand category in the model. In the dynamic economic processes a homogenous composite investment commodity is allocated between sectors according to the actual (year *t*) returns on capital in that sector.

For all the production sectors except the public administration sector the expected rate of return is specified as an inverse logistic function of the proportionate growth in the sector's capital stock, following Dixon and Rimmer (2000). The investment behavior equation derived under these assumptions is provided in appendix B, equation B.87. The accumulation of the public capital stock is modeled in a simple way. As already explained in section 3.3, in each year *t* the public capital expenditures are derived through an optimization process. Then, the accumulation of capital in the public administration sector (year *t+1*) is given by the capital stock in year *t* less the depreciation plus the public capital expenditures in year *t*.

It is not possible to solve the model for an infinite time horizon. Therefore, after a transition period (after year T)[7] we assume that the economy returns to the steady-state growth path. In the terminal period T we impose a constraint on investments, which assures sufficient investment to cover growth plus depreciation in each sector in the last period (Lau, Pahlke and Rutherford, 2000).

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[6] Year 2000 has been chosen as benchmark equilibrium for RoMod.
[7] In this case we chose T=30 years.

Domestic government debt in year *t+1* is given by the domestic debt in year *t* plus the share of the conventional budget deficit covered from domestic sources[8]. In a similar way, foreign government debt in year *t+1* is derived as the foreign debt in year *t* plus the share of the conventional budget deficit covered from external sources. Then, total government debt in year *t+1* is given by the sum of the domestic and foreign debt in year *t+1*.

To evaluate the long-run change in consumer welfare we use the present value of the equivalent variation in income (Ballard, Fullerton, Shoven and Walley, 1985), which is given in appendix B, equation B.98.

The model is solved dynamically with annual steps. The simulation horizon of the model has been set at 30 years but it can easily be extended. In between periods, some other variables like the transfers between firms, government and the rest of the world, and the balance of payments balance (foreign savings) are updated exogenously.

3.10. Closure rules

The particular set of closure rules should also be consistent, to the largest extent possible, with the institutional structure of the economy and with the purpose of the model. Specifically, for a country like Romania, where the transition process implies a lot of institutional change, the closure should not be too restrictive.

To balance the number of endogenous variables and the number of linearly independent equations in the model, additional assumptions are needed. First of all, in each year *t* the transfers received by the households from the firms, from the external sector and from the government, as well as the transfers received by the firms form the government, the transfers received by the government from the external sector and the transfers of the firms to the external sector are exogenously fixed. Due to the lack of detailed data, it was not possible to model these transfers.

The inter-sectoral mobility of both labor and capital is limited in the model. In the labor market allowance for unemployment and inter-sectoral wage differentials introduce rigidities. Unemployment is endogenously determined through a wage curve type and a labor supply curve assumes a positive relation between labor supply and the real wage rate. Labor supply to the external sector is treated as an exogenous variable. In the capital market the supply of capital is exogenously fixed by sector, restricting the factor inter-sectoral mobility.

The most widely accepted macro closure rule for CGE models implies the assumption that investment and savings balance. In the model, the investment is assumed to adjust to the available domestic and foreign savings. This reflects an economy in which savings form a binding constraint. The interest rate is assumed to effectively balance the supply and demand for investments, even if the specific mechanism is not incorporated in the model. This may also be interpreted as a stylized representation of a restrictive monetary policy (Roberts and Zolkiewski, 1996). This macro closure rule is neoclassical in spirit. However, the fact that the model allows for unemployment introduces a Keynesian element. In models of this size it is not uncommon that a few closure rules are combined to get as close as possible to a realistic representation of the economy.

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[8] In appendix B, in the equations for the debt accumulation the conventional budget deficit is subtracted rather than added to the government debt because it is negative (as defined in the calibration part of the model).

Government behavior is modeled through an optimization process, which yields the optimal allocation of government consumption and public capital expenditures. Further, the production of public goods is modeled in a similar way as the other production activities. The government budget for purchases of goods and services and public capital expenditures is specified as a fixed share of GDP at current market prices. Two alternative closure rules are specified relating to government behavior. Under the first one, the primary and conventional budget balances are endogenously determined. Under the alternative closure rule, the conventional budget balance is fixed as a share of GDP at current market prices, and the social security contributions rate adjusts to bring the budget deficit toward this value.

For the external sector, the balance of payments balance in foreign currency is considered as given and the varying exchange rate is assumed to steer the balance of payments towards this number. This assumption may be interpreted as the government's obligation to reach a balance of payments target.

According to Walras' law if (n-1) markets are cleared the nth one is cleared as well. Therefore, in order to avoid overdetermination of the model, the balance of payments equation has been dropped. However, the system of equations guarantees, through Walras' law, that the balance of payments balance equals the difference between imports and exports and the transfers between different institutional sectors and the external sector.

4. Policy scenarios

In this section we analyze the economic impact of five main policy scenarios, using RoMod. The first two are: the elimination of the VAT exemptions and the replacement of the statutory rate of 19 per cent by the reduced rate of 9 per cent for certain goods and services, in accordance with the Annex H of the Sixth Council Directive (77/388/EEC); and the increase in the excise duties on mineral oils. They both aim at tax harmonization as stipulated in the Chapter 10 on Taxation of the *"Acquis Communautaire"*. The next two, the elimination of direct subsidies on public passenger transport, and the shift of public expenditures form current to capital expenditures intend to capture the restructuring of the budgetary expenditures. The first two scenarios are set up in two alternative ways. First, the conventional budget deficit is allowed to adjust given the increase in revenues. Second, the additional revenues are recycled through a cut in the social security contributions rate.

The fifth scenario aims to answer two questions: what is the overall effect of the tax harmonization and the public expenditures restructuring measures undertaken by the government (as presented in the first four scenarios), and by how much can the social security contributions rate be reduced by 2006, when the conventional budget deficit to GDP ratio is kept constant at a level of 3.6 per cent, starting with 2003. A brief description of the policy measures, which constitute the base of these scenarios, has already been given in section 2.

4.1. The elimination of the VAT exemptions and the application of EU oriented VAT rates to certain commodities and services

As already mentioned, the VAT reform implemented starting with 2004 is evaluated using RoMod within two simulations. In the first simulation (non-neutral VAT scenario) the tax revenues and the government conventional deficit are allowed to adjust. The second simulation (neutral VAT scenario) is made revenue neutral compared to the baseline by modifying the social security contributions rate starting

with 2004. The conventional budget deficit is therefore kept constant as a share of GDP.

RoMod does not take into account the statutory tax rates but the average effective ones. Therefore, a first step would be to estimate the changes in the effective VAT rates induced by the VAT reform. The difficulty consists in the lack of information on the taxable base. In this stage, the only estimation on the VAT base is produced by the National Institute of Statistics with a three years lag. Furthermore, it is not possible to track the products subject to a reduced VAT rate in great detail. As a consequence, the elimination of the exemption for the medical equipment and other appliances normally intended to alleviate or treat disability has not been considered in the two simulations. Therefore, the impact of the policy measure might be slightly underestimated. The average effective VAT rates in the baseline and the estimated rates used in the policy simulations are given in table 2.

Table 2. Average effective VAT rates in the baseline and the policy simulations (%)

Commodities	Average effective VAT rates			
	Baseline	**2004**	**2005**	**2006**
Average effective VAT rates on households consumption				
Manufacture of publishing and printing (sec9)	0.67%	7.07%	7.07%	7.07%
Manufacture of pharmaceutical products and cosmetics (sec11)	7.82%	5.75%	5.75%	5.75%
Hotels and restaurants; activities of traveling agencies (sec23)	6.56%	5.55%	5.55%	5.55%
Other community, social and personal service activities (sec35)	2.25%	7.07%	7.07%	7.07%
Average effective VAT rates on intermediate consumption				
Manufacture of publishing and printing (sec9)	0.28%	2.99%	2.99%	2.99%
Manufacture of pharmaceutical products and cosmetics (sec11)	3.16%	2.33%	2.33%	2.33%
Hotels and restaurants; activities of traveling agencies (sec23)	2.67%	2.67%	2.67%	2.67%
Other community, social and personal service activities (sec35)	0.94%	2.99%	2.99%	2.99%
Average effective VAT rates on government consumption				
Manufacture of publishing and printing (sec9)	0.86%	9.00%	9.00%	9.00%
Manufacture of pharmaceutical products and cosmetics (sec11)	0.00%	0.00%	0.00%	0.00%
Hotels and restaurants; activities of traveling agencies (sec23)	0.00%	0.00%	0.00%	0.00%
Other community, social and personal service activities (sec35)	2.88%	9.00%	9.00%	9.00%

Source: National Institute of Statistics and own estimates.

Non-neutral VAT scenario

The VAT reform has a direct effect on costs and prices. For the publishing and printing products (sec9) and other community services (sec35) the increase in the effective tax rates on private and public consumption augments the share of indirect taxation in consumer prices. Thus, consumer prices gross of taxes raise by about 6.5 per cent for publishing and printing (sec9) and by 4.5 per cent for the other community services (sec35) comparing to the baseline, pressuring consumer prices net of taxes. The decline in the private and public consumption triggers a downwards shift in the output price for the community services, and a fall in the profitability of both sectors. Profitability is expressed here in terms of rental rate of capital (see table 3).

Output supply of both sectors reduces followed by a decline in employment, capital and energy demand. For the publishing and printing sector (sec9), the high share of inputs originating from the same sector (about 25 per cent of the gross output) combined with the rise in the VAT on intermediate consumption outweighs the adjustment pressure on the consumer price and the output price goes up, inducing a lift in the consumer price net of taxes (see table 3).

The relative increase of domestic prices compared with the world prices for publishing and printing products and other community services makes the domestic market more attractive and export supply of the two sectors diminish. Imports lessen due to the lower domestic demand (see table 3). Furthermore, the rise in non-deductible VAT on intermediate consumption for both publishing and printing (sec9) and other community services (sec35) produces an upward shift in the cost curves for the financial intermediation (sec29), public administration (sec32) and education (sec33) sectors.

Table 3. Effects of the VAT reform on the publishing and printing sector and on other community, social and personal service activities

Sectoral results	Non-neutral scenario			Neutral scenario		
	2004	2005	2006	2004	2005	2006
Manufacture of publishing and printing (sec9)						
Consumer price gross of taxes	6.45	6.48	6.50	6.39	6.42	6.45
Consumer price net of taxes	0.09	0.11	0.14	0.03	0.06	0.09
Rental rate of capital net of taxes	-2.85	-2.74	-2.65	-2.70	-2.58	-2.47
Price of gross output	0.13	0.16	0.19	0.09	0.12	0.15
Price of domestic deliveries (including trade and transportation margins)	0.11	0.13	0.16	0.06	0.09	0.11
Price of domestic deliveries (excluding trade and transportation margins)	0.13	0.16	0.19	0.09	0.12	0.15
Private consumption	-2.07	-2.06	-2.06	-1.85	-1.85	-1.84
Public consumption	-7.59	-7.59	-7.60	-7.52	-7.53	-7.55
Domestic sales	-0.93	-0.93	-0.92	-0.82	-0.81	-0.81
Gross output	-0.96	-0.96	-0.95	-0.86	-0.86	-0.85
Employment	-1.74	-1.72	-1.69	-1.56	-1.53	-1.50
Demand for capital-energy bundle	-0.18	-0.21	-0.23	-0.17	-0.20	-0.23
Investments carried out in the sector	0.00	-0.67	-0.62	0.00	-0.80	-0.76
Exports	-1.17	-1.20	-1.23	-1.16	-1.19	-1.22
Imports	-0.71	-0.67	-0.64	-0.51	-0.47	-0.44
Other community, social and personal service activities (sec35)						
Consumer price gross of taxes	4.55	4.58	4.61	4.48	4.51	4.54
Consumer price net of taxes	-0.16	-0.13	-0.10	-0.23	-0.20	-0.17
Rental rate of capital net of taxes	-4.16	-3.98	-3.82	-4.05	-3.87	-3.69
Price of gross output	-0.16	-0.13	-0.10	-0.23	-0.20	-0.17
Price of domestic deliveries (including trade and transportation margins)	-0.17	-0.13	-0.10	-0.23	-0.20	-0.17
Price of domestic deliveries (excluding trade and transportation margins)	-0.17	-0.13	-0.10	-0.23	-0.20	-0.17
Private consumption	-1.46	-1.46	-1.46	-1.25	-1.25	-1.24
Public consumption	-5.50	-5.51	-5.53	-5.42	-5.44	-5.45
Domestic sales	-1.48	-1.48	-1.47	-1.39	-1.39	-1.38
Gross output	-1.46	-1.46	-1.46	-1.38	-1.38	-1.38
Employment	-1.85	-1.84	-1.82	-1.74	-1.73	-1.71
Demand for capital-energy bundle	-0.78	-0.81	-0.83	-0.74	-0.78	-0.80
Investments carried out in the sector	0.00	-1.27	-1.22	0.00	-1.42	-1.38
Exports	-1.22	-1.29	-1.35	-1.25	-1.31	-1.37
Imports	-1.79	-1.71	-1.62	-1.57	-1.48	-1.40

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

The reduction in the effective tax rates on private consumption for the pharmaceutical products (sec11) and hotels services (sec23) lowers the share of

indirect taxation in the consumer prices gross of taxes and induces an augmentation of private consumption. Profitability of both sectors improves. Gross output rises, stimulating job-creation and mounting the demand for capital and energy in the sectors (see table 4). The mechanism implies that increased production is covered by hiring new staff and not by rising productivity. The enhancement of domestic sales for pharmaceutical products (sec11) induces a rise in output price. The decline in trade and transportation costs offsets the upward shift in the cost curve of this sector and the price of domestic deliveries (including trade and transportation margins) drops producing an adjustment in the consumer price net of taxes.

Table 4. Effects of the VAT reform on pharmaceutical products and hotels and restaurants; activities of travel agencies

Sectoral results	Non-neutral scenario			Neutral scenario		
	2004	2005	2006	2004	2005	2006
Manufacture of pharmaceutical products and cosmetics (sec11)						
Consumer price gross of taxes	-1.96	-1.96	-1.96	-2.03	-2.03	-2.03
Consumer price net of taxes	-0.04	-0.04	-0.05	-0.12	-0.12	-0.12
Rental rate of capital net of taxes	0.56	0.50	0.45	0.73	0.69	0.65
Price of gross output	0.02	0.01	-0.01	-0.01	-0.02	-0.03
Price of domestic deliveries (including trade and transportation margins)	-0.01	-0.02	-0.03	-0.05	-0.05	-0.06
Price of domestic deliveries (excluding trade and transportation margins)	0.02	0.01	0.00	-0.01	-0.01	-0.02
Private consumption	0.44	0.45	0.47	0.68	0.69	0.71
Domestic sales	0.25	0.27	0.28	0.42	0.43	0.45
Gross output	0.18	0.21	0.24	0.26	0.29	0.31
Employment	0.40	0.41	0.41	0.57	0.58	0.59
Demand for capital-energy bundle	0.08	0.12	0.16	0.12	0.15	0.18
Investments carried out in the sector	0.00	0.90	0.95	0.00	0.79	0.83
Exports	0.16	0.20	0.23	0.20	0.23	0.26
Imports	0.31	0.31	0.31	0.55	0.55	0.56
Hotels and restaurants; activities of travel agencies (sec23)						
Consumer price gross of taxes	-0.98	-0.98	-0.98	-0.98	-0.98	-0.98
Consumer price net of taxes	-0.03	-0.03	-0.04	-0.03	-0.03	-0.04
Rental rate of capital net of taxes	0.04	0.01	-0.02	0.21	0.19	0.17
Price of gross output	-0.03	-0.03	-0.04	-0.03	-0.03	-0.03
Price of domestic deliveries (including trade and transportation margins)	-0.03	-0.03	-0.04	-0.02	-0.02	-0.02
Price of domestic deliveries (excluding trade and transportation margins)	-0.03	-0.03	-0.04	-0.02	-0.02	-0.02
Private consumption	0.11	0.12	0.14	0.30	0.32	0.33
Domestic sales	0.08	0.09	0.11	0.23	0.24	0.26
Gross output	0.08	0.09	0.11	0.20	0.21	0.23
Employment	0.16	0.16	0.15	0.41	0.42	0.42
Demand for capital-energy bundle	0.02	0.04	0.07	0.06	0.08	0.10
Investments carried out in the sector	0.00	0.66	0.71	0.00	0.55	0.59
Exports	0.06	0.08	0.10	0.08	0.10	0.12
Imports	0.12	0.12	0.12	0.43	0.44	0.45

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

The fall in the real wage rate and the higher contribution of labor to value added (about 38 per cent) for the hotels services (sec23) reverse the effect on the output price for this sector (see table 4). Foreign demand picks up for both sectors and thus

export revenue increases. The most notable effect of the decline in the average effective VAT rate on intermediate consumption for the pharmaceutical products (sec11) resides in the downward shift in the cost curve for the health and social work sector (sec34). Pharmaceutical products represent about 22.3 per cent out of the material inputs used by the health and social work sector (sec34).

The overall rise in unemployment and the decline in the real wage rate have a negative impact on household's income and savings (see table 5). Consequently, total private consumption diminishes. The overall decline in the firms' profitability results in changes in income distribution. Firms' income and savings decline in favor of government revenues (see table 5).

Table 5. Macroeconomic effects of the VAT reform (% change compared with the baseline)

Macroeconomic results	Non-neutral scenario			Neutral scenario		
	2004	2005	2006	2004	2005	2006
GDP at constant prices	-0.04	-0.02	-0.01	-0.02	-0.01	0.00
Private consumption	-0.15	-0.13	-0.12	0.03	0.04	0.06
Labor supply	-0.01	-0.01	-0.01	0.04	0.05	0.05
Unemployment	0.03	0.02	0.02	-0.11	-0.12	-0.13
Households						
Households' income	-0.22	-0.21	-0.20	0.03	0.04	0.05
Households' savings	-0.22	-0.22	-0.20	0.02	0.03	0.04
Firms						
Firms income	-0.30	-0.30	-0.29	-0.17	-0.16	-0.16
Firms savings	-0.36	-0.36	-0.35	-0.21	-0.20	-0.20
Government						
Total government revenues	0.40	0.42	0.43	-0.03	-0.03	-0.03
Total government expenditures	-0.09	-0.08	-0.08	-0.03	-0.03	-0.02
Government transfers to the households	-0.12	-0.12	-0.12	-0.01	-0.01	-0.01
Interest payments	-0.32	-0.34	-0.35	-0.19	-0.20	-0.21
Primary budget surplus	18.19	18.56	18.94	-0.93	-1.03	-1.14
Conventional budget deficit	-4.57	-4.67	-4.77	-0.02	-0.01	0.00
Foreign debt	-0.69	-0.70	-0.72	-0.15	-0.14	-0.14
Domestic debt	-0.96	-0.98	-1.00	0.00	0.00	0.00
Total debt	-0.80	-0.82	-0.83	-0.09	-0.09	-0.08
Savings/Investment						
National savings	0.64	0.67	0.70	-0.20	-0.19	-0.19
Total investment	0.62	0.65	0.68	-0.02	-0.02	-0.02
Current account						
Total exports	0.08	0.10	0.12	0.01	0.02	0.04
Total imports	0.07	0.08	0.10	0.02	0.03	0.04
Prices						
Exchange rate	-0.05	-0.05	-0.05	-0.17	-0.17	-0.16
Real interest rate	-0.34	-0.36	-0.38	-0.19	-0.20	-0.21
Average wage rate	-0.16	-0.14	-0.13	0.28	0.30	0.33
Equivalent variation (billions ROL)	-994	-958	-912	191	313	449
Change in the social security contributions rate	0.00	0.00	0.00	-2.21	-2.27	-2.32

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

The growth in VAT revenues represents about 0.23 per cent of GDP at current market prices in 2004. As a result, the primary budget surplus improves having positive effects on the conventional budget deficit, interest payments and the public debt (see table 5). The 4.57 per cent drop in the conventional budget deficit

compared with the baseline in 2004 is equivalent to 0.18 per cent of GDP at current market prices.

Total savings, defined as the change in the national wealth, expand due to the reduction of the government deficit (see table 5). The higher supply of loanable funds, i.e. savings, boosts the investment incentives in all sectors except for manufacture of publishing and printing (sec9) and other community, social and personal service activities (sec35).

The equivalent variation in income expressed in terms of billions ROL over a one-year period, reflects household's welfare losses during 2004-2006. However, in the long-run the non-neutral VAT reform leads to a slight efficiency gain of 13,668 in billions of 2000 ROL (which represents about 0.11 per cent of the present value of households' income), expressed as the present value of the equivalent variation. The reason is the rise in the investments which reverses the negative impact on firms' profitability in the long-run. As a consequence, household's capital income enlarges, resulting in welfare gains.

Neutral VAT scenario

Using the additional government revenues to reduce social security contributions has positive effects in terms of welfare, by reducing the labor tax distortion (see table 5). In Romania statutory social security contributions paid by employers are differentiated according to the work conditions. In the neutral VAT scenario all contribution rates are cut by about 2.3 per cent during 2004-2006 compared with the baseline, from 35 to 34.20 per cent for normal work conditions, from 40 to 39.08 per cent for particular conditions and from 45 to 43.97 per cent for special work conditions. The decline in the social contribution rates has direct beneficial effects on all sectors though the impact is greater on labor intensive sectors like services and on sectors with particular and special work conditions, like coal sector (sec2), oil sector (sec3), natural gas sector (sec4), manufacture of glass and glass products (sec13), transport via railways (sec24) and air transport (sec27). Overall, employment and the real wage rate increase. Furthermore, the profitability of most of the sectors improves compared with the non-neutral VAT scenario.

The increase in households' labor and capital income induces a lower decline in private consumption of publishing and printing materials (sec9) and community, social and personal services (sec35). It further enhances the domestic sales and the output of pharmaceutical products (sec11) and hotels services (sec23), comparing to the non-neutral scenario (see tables 3-4).

Even though the deficit ratio is kept constant starting with 2004, GDP retrenchment generates a slight fall in the deficit. In budgetary terms the cut in social security contributions represents about 0.2 per cent of GDP at current market prices in 2004. Thus, the position of the primary budget balance worsens to some extent (see table 5). The fall in firms' savings outweighs the positive effects on household's savings and results in an overall investment decline.

The reduction of the social security contributions reverses the short-run negative impact of the measure on household's welfare (see table 5). Furthermore, it results in higher long-run efficiency gains compared with the non-neutral scenario (32,664 in billions of 2000 ROL, equivalent to 0.26 per cent of the present value of households' income). The downwards shift in the cost curves of the production sectors improves their profitability, and represents the main source of long-run welfare gains though income.

4.2. Increase in excise duties on mineral oils

RoMod is used to simulate the harmonization of the excise duties on mineral oils during 2001-2006 within two scenarios. In the first scenario (the non-neutral excise scenario) the conventional budget deficit is allowed to adjust, while in the second one (the neutral excise scenario) the conventional deficit adjusts during 2001-2002 while, starting with 2003, the additional revenues are recycled through a decrease in social security contributions so as to ensure budget neutrality. In the neutral excise scenario the start of the recycling of the additional revenues has been made to correspond to the moment the Romanian government actually started decreasing the social security contributions, in order to show by how much the social contributions could have been be reduced by increasing the excises duties on mineral oils. In this scenario the deficit ratio is kept constant at its 2002 level.

The average effective excise rates are used in RoMod instead of the statutory levels, because it is not possible to distinguish between the prices and the quantities of petroleum products used by the sectors in the production process. Starting with 2002, the changes in the estimated excise revenues, expressed in EUR, have been taken as a proxy for the change in the average effective excise rates. The excise revenues for 2001-2006 have been calculated assuming that consumption of mineral oils (expressed in tons) will remain unchanged compared with 2000 (the latest year for which data are available). Total consumption of mineral oils in 2000 and the estimated excise revenues are given in table 6.

Table 6. Consumption of mineral oils in 2000 and excise revenues during 2000-2006

Excise revenues (EUR)	Total consumption 2000 (tons)	Excises 2000 (EUR)	Excises 2001 (EUR)	Excises 2002 (EUR)	Excises 2003 (EUR)	Excises 2004 (EUR)	Excises 2005 (EUR)	Excises 2006 (EUR)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Petrol								
Leaded	911	246063	246063	275529	368183	368183	368183	368183
Unleaded	415	91224	91224	102213	143886	143886	143886	143886
Gas oil	2565	269325	269325	294975	523260	566865	566865	566865
LPG and methane	281			28100	28100	28100	28100	28100
Heavy fuel oil	803						2610	5220
Kerosene	615			185935	248460	248460	248460	248460
Total	**5590**	**606612**	**606612**	**886752**	**1311889**	**1355494**	**1358103**	**1360713**
Percentage change in excise revenues	-	-	0.00	46.18	47.94	3.32	0.19	0.19

Source: International Energy Agency and own estimates.

The average effective excise rates paid by the sectors and the households for the use of mineral oils in the baseline are presented in table 7. As already explained, the rates used in the policy simulations (see table 7, columns 2-7) are estimated by applying the percentage change in excise revenues to the baseline tax rates levels, given that for most of the uses the excise levels are the same.

Table 7. Average effective excise rates (%) on final and intermediate consumption

Sectors		Baseline (1)	2001 (2)	2002 (3)	2003 (4)	2004 (5)	2005 (6)	2006 (7)
Agriculture, forestry and fishing	sec1	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Coal sector	sec2	21.1	21.1	30.8	45.6	47.1	47.2	47.2
Oil sector	sec3	0.5	0.5	0.7	1.0	1.1	1.1	1.1
Natural gas sector	sec4	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Manufacture of food products and beverages; tobacco	sec5	21.0	21.0	30.8	45.5	47.0	47.1	47.2
Manufacture of textile and leather products	sec6	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Manufacture of wood and products of wood	sec7	21.0	21.0	30.8	45.5	47.0	47.1	47.2
Manufacture of paper and paper products	sec8	21.1	21.1	30.8	45.5	47.0	47.1	47.2
Manufacture of publishing and printing	sec9	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Manufacture of chemicals and chemical products	sec10	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Manufacture of pharmaceutical products and cosmetics	sec11	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Manufacture of rubber and plastic products	sec12	21.1	21.1	30.8	45.5	47.1	47.2	47.2
Manufacture of glass and glass products	sec13	21.1	21.1	30.8	45.5	47.1	47.2	47.2
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	21.1	21.1	30.8	45.6	47.1	47.2	47.2
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	21.1	21.1	30.8	45.5	47.1	47.1	47.2
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	21.1	21.1	30.8	45.6	47.1	47.2	47.2
Manufacture of domestic appliances	sec17	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Manufacture of electrical and machinery and apparatus	sec18	21.1	21.1	30.8	45.5	47.1	47.2	47.2
Manufacture of transport equipment	sec19	21.1	21.1	30.8	45.6	47.1	47.2	47.2
Electricity, gas and water supply	sec20	1.4	1.4	2.1	3.1	3.2	3.2	3.2
Construction	sec21	21.1	21.1	30.8	45.5	47.1	47.2	47.2
Wholesale and retail trade	sec22	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Hotels and restaurants; activities of travel agencies	sec23	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Transport via railways	sec24	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Other land transport; transport via pipelines	sec25	20.3	20.3	29.7	44.0	45.5	45.5	45.6
Water transport	sec26	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Air transport	sec27	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Post and telecommunications	sec28	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Financial intermediation	sec29	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Real estate activities	sec30	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Other business activities	sec31	20.6	20.6	30.1	44.5	46.0	46.1	46.2
Public administration and defence; compulsory social security	sec32	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Education	sec33	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Health and social work	sec34	21.1	21.1	30.8	45.6	47.1	47.2	47.3
Other community, social and personal service activities	sec35	21.1	21.1	30.8	45.6	47.1	47.2	47.2
Households		21.1	21.1	30.8	45.5	47.1	47.1	47.2

Source: National Institute of Statistics and own estimates.

Non-neutral excise scenario

The rise in the excise levels for mineral oils has a direct impact on prices. The consumer price including taxes for petroleum products (sec3) increases by about 20 per cent compared with the baseline, exerting downward pressure on the consumer price net of taxes. Private consumption of mineral oils declines triggering a fall in the output price and the profitability of the sector. Consequently, the sectoral gross output diminishes (see table 8). Employment, capital and energy demand of the sector also decrease. The strong decline in domestic sales results in a reduction of imports (about 7 per cent during 2004-2006 compared with the baseline) and in a reorientation of the oil sector (sec3) towards exports.

Raising mineral oil taxes on intermediate consumption affects firms' input choice. It generates an upward shift in the cost curves of the production sectors and the demand for petroleum products falls. The relative increase in the mineral oils price with respect to other factors of production induces a substitution effect in favor of capital and labor.

Nevertheless, the decline in output triggers a downwards adjustment in capital and labor demand which outweighs the substitution effects. Thus, the share of capital income in value added declines in most of the sectors. Furthermore, unemployment rises and the real wage rate falls (see table 9).

The impact of the adjustment of excise duties on oil concentrates on 2003, when it causes an increase of revenues of 0.64 per cent of GDP at current market prices. After 2004, the harmonization of excise duty levels for heavy fuel oil has negligible effects on government revenues (0.01 per cent of GDP at current market prices in 2005 and 2006). The budget deficit drops by about 27 per cent compared with the baseline, which is equivalent to about 1 per cent of GDP at current market prices during 2004-2006 (see table 9). The retrenchment of the government deficit crowds in private investment and the real interest rate declines.

Table 8. Effects of changes in excises on mineral oils on the oil sector

Sectoral results	Non-neutral scenario			Neutral scenario		
	2004	**2005**	**2006**	**2004**	**2005**	**2006**
Oil sector (sec3)						
Consumer price gross of taxes	19.83	19.95	20.08	19.43	19.56	19.68
Consumer price net of taxes	-1.36	-1.32	-1.27	-1.69	-1.65	-1.60
Rental rate of capital net of taxes	-8.92	-8.90	-8.88	-8.67	-8.59	-8.52
Price of gross output	-1.67	-1.62	-1.57	-2.01	-1.96	-1.91
Price of domestic deliveries (including trade and transportation margins)	-1.75	-1.70	-1.66	-2.06	-2.01	-1.96
Price of domestic deliveries (excluding trade and transportation margins)	-2.00	-1.94	-1.89	-2.31	-2.25	-2.20
Private consumption	-6.14	-6.11	-6.06	-5.43	-5.37	-5.30
Domestic sales	-4.00	-3.98	-3.95	-3.70	-3.68	-3.65
Gross output	-1.42	-1.42	-1.42	-1.27	-1.29	-1.30
Employment	-2.43	-2.45	-2.45	-2.17	-2.18	-2.19
Demand for capital-labor bundle	-1.42	-1.42	-1.42	-1.27	-1.29	-1.30
Investments carried out in the sector	-0.03	0.19	0.43	-0.57	-0.45	-0.27
Exports	2.75	2.70	2.67	2.58	2.50	2.43
Imports	-7.15	-7.08	-7.01	-6.69	-6.61	-6.53

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

The equivalent variation, in terms of ROL over a one-year period, reflects the loss of households as a result of higher excise duties (see table 9). Still, in the long-run, the measure generates welfare gains of 71,969 billions ROL, equivalent to 0.57 per cent of the present value of households' income in 2000 prices (the present value of the equivalent variation over a 30 years horizon). The welfare gains are induced in this case by the increase in investments which increases the profitability of the firms in the long-run, and further affects households' capital income.

Neutral excise scenario

Compared with the non-neutral scenario the recycling of additional government revenues by reducing social security contributions has positive effects in terms of GDP and other terms of welfare such as the employment and the real wage rate, by reducing the labor tax distortion (see table 9). The recycling of government revenues benefits all sectors even through the impact is higher in sectors with special and particular work conditions and in labor intensive sectors like services.

In the model the social security contribution rates decrease by about 8 per cent during 2004-2006, from 35 to 32.2 per cent for normal work conditions, from 40 to 36.8 per cent for particular work conditions and from 45 to 41.4 per cent for special work conditions. The actual social contribution rates enforced by the government starting with 2004 are very close to these figures: 31.5 per cent for normal work conditions, 36.5 per cent for particular work conditions and 41.5 per cent for special work conditions. Hence, the rise in excise duties would almost be sufficient to cover the loss in social security contributions revenues.

Table 9. Macroeconomic effects of changes in excises on mineral oils (% change comparing to the baseline)

Macroeconomic results	Non-neutral scenario			Neutral scenario		
	2004	2005	2006	2004	2005	2006
GDP at constant prices	-0.05	0.04	0.14	-0.01	0.08	0.16
Private consumption	-1.09	-1.02	-0.94	-0.47	-0.37	-0.27
Labor supply	-0.11	-0.09	-0.07	0.09	0.12	0.14
Unemployment	0.28	0.23	0.18	-0.22	-0.30	-0.37
Households						
Households' income	-1.04	-0.98	-0.91	-0.15	-0.05	0.05
Households' savings	-1.05	-0.99	-0.93	-0.19	-0.10	0.00
Firms						
Firms income	-1.86	-1.84	-1.83	-1.39	-1.37	-1.34
Firms savings	-2.39	-2.38	-2.36	-1.85	-1.82	-1.79
Government						
Total government revenues	2.46	2.58	2.70	0.91	0.94	0.97
Total government expenditures	-0.34	-0.31	-0.28	-0.15	-0.11	-0.07
Government transfers to the households	-0.32	-0.34	-0.36	0.06	0.06	0.05
Interest payments	-2.14	-2.25	-2.36	-1.67	-1.75	-1.83
Primary budget surplus	102.23	104.88	107.67	33.95	33.21	32.44
Conventional budget deficit	-26.08	-26.82	-27.59	-9.84	-9.77	-9.69
Foreign debt	-4.10	-4.17	-4.25	-2.15	-2.11	-2.07
Domestic debt	-5.49	-5.64	-5.80	-2.07	-2.05	-2.04
Total debt	-4.65	-4.76	-4.87	-2.12	-2.09	-2.06
Savings/Investment						
National savings	3.41	3.60	3.81	0.41	0.44	0.48
Total investment	3.33	3.51	3.70	1.00	1.03	1.06
Current account						
Total exports	-0.14	-0.03	0.08	-0.42	-0.34	-0.27
Total imports	-0.15	-0.06	0.03	-0.34	-0.28	-0.22
Prices						
Exchange rate	-0.48	-0.45	-0.41	-0.88	-0.85	-0.82
Real interest rate	-2.28	-2.40	-2.52	-1.74	-1.83	-1.91
Average wage rate	-0.70	-0.59	-0.47	0.87	1.05	1.23
Equivalent variation (billions ROL)	-7270	-7100	-6862	-3043	-2464	-1785
Change in the social security contributions rate	0.00	0.00	0.00	-7.86	-8.24	-8.63

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

The households' losses from raising the excise duties, in terms of equivalent variation over a one-year period, are more than halved compared with the non-neutral scenario during 2004-2006 (see table 9). Furthermore, the present value of the welfare gains over a 30 years horizon is more than 50 per cent higher (167,674 ROL, equivalent to 1.32 per cent of the present value of households' income). As in the neutral VAT scenario, the long-run welfare gains are induced by the decrease in

labor tax distortions and consequently, the downwards shift in the cost curves of the production activities.

4.3. Elimination of direct subsidies on public passenger transport

We evaluate the effects of subsidies elimination for public transport activities using RoMod. In this case only a non-neutral subsidy scenario is examined, where subsidies on transport activities are removed gradually during 2004-2006 and the conventional budget balance adjusts to account for the fall in expenditures. It is unlikely that direct subsidies supporting public passenger transport would be totally eliminated by the end of 2006. However, for the setup of the policy scenario it seems to be a natural benchmark. The average effective subsidy rates on the transport sectors, in the baseline and those used in the policy scenario are given in table 10. Only the results for railways and water transport are presented in this section as the direct subsidies are particularly important for these sectors.

Table 10. The average effective subsidy rates (%) for the transport activities in the baseline and policy scenario

Sectors		Average effective subsity rates			
		Baseline	2004	2005	2006
Transport via railways	sec24	16.7	11.1	3.7	0.0
Other land transport; transport via pipelines	sec25	0.9	0.6	0.2	0.0
Water transport	sec26	2.8	1.9	0.6	0.0
Air transport	sec27	1.4	0.9	0.3	0.0

Source: National Institute of Statistics and own estimates.

Non-neutral subsidy scenario

The initial micro effect of the reduction in direct subsidies to transport sectors is an upwards shift in the cost curves of these sectors and their output price. As a consequence of the increase in consumer prices for transport services private and public consumption fall. Output supply adjusts to the lower domestic demand triggering a decrease in employment, capital and energy use. Also the profitability rates of the railways transport (sec24) and water transport (sec26) sectors decline (see table 11).

On the one hand, the export supply diminishes due to the decline in profitability. On the other hand, foreign services become more interesting price-wise relative to domestic products so imports will rise. For the railways transport imports increase by almost 16 per cent in 2006 compared with the baseline (see table 11). Investments carried out in railways transport (sec24) and water transport (sec26) sectors fall due to the relative decline in the profit rate of these sectors compared with the other activities.

Cutting subsidies has a negative impact on many activities by raising transport costs. Most affected are the manufacturing sectors due to their high share of transport services used in the production process (between 3 and 8 per cent of their gross output). The increase in production costs are reflected in higher consumer prices, which generate a contraction of private consumption and a decline in overall employment.

Households' income and savings drop due to the fall in the real wage rate and the employment rate. As expected, the equivalent variation, in terms of ROL over a one-year period, shows households' welfare losses as a result of the elimination of direct subsidies supporting public passenger transport (see table 12). However, the

present value of equivalent variation over a 30 years horizon indicates a gain in welfare of 31,888 billions ROL, equivalent to 0.25 per cent of the present value of households' income. A rise in investments is the source of these long-run welfare gains (see below).

Table 11. Effects of subsidies elimination on railways transport and water transport sectors

Sectoral results	Non-neutral scenario		
	2004	2005	2006
Transport via railways (sec24)			
Consumer price net of taxes	3.37	8.51	11.53
Rental rate of capital net of taxes	-4.82	-10.96	-13.55
Price of gross output	3.55	8.99	12.21
Price of domestic deliveries (including trade and transportation margins)	3.70	9.37	12.72
Price of domestic deliveries (excluding trade and transportation margins)	3.70	9.37	12.72
Private consumption	-1.06	-2.53	-3.30
Public consumption	-3.27	-7.84	-10.32
Domestic sales	-0.43	-1.03	-1.34
Gross output	-0.93	-2.27	-2.99
Employment	-2.19	-5.12	-6.52
Demand for capital-energy bundle	-0.28	-0.74	-1.08
Investments carried out in the sector	0.00	-1.59	-3.56
Exports	-1.61	-3.90	-5.15
Imports	4.53	11.55	15.77
Water transport (sec26)			
Consumer price net of taxes	0.11	0.28	0.39
Rental rate of capital net of taxes	-2.72	-6.31	-8.07
Price of gross output	0.11	0.28	0.39
Price of domestic deliveries (including trade and transportation margins)	0.16	0.41	0.57
Price of domestic deliveries (excluding trade and transportation margins)	0.16	0.41	0.57
Private consumption	-0.20	-0.46	-0.59
Public consumption	-0.12	-0.29	-0.37
Domestic sales	-0.04	-0.08	-0.09
Gross output	-0.30	-0.75	-1.03
Employment	-1.27	-3.00	-3.92
Demand for capital-energy bundle	-0.12	-0.31	-0.46
Investments carried out in the sector	0.00	-0.62	-1.38
Exports	-0.39	-0.96	-1.33
Imports	0.08	0.21	0.32

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

Government finances benefit from the cut in subsidies to the tune of 0.19 per cent of GDP in 2004, 0.47 per cent in 2005, and 0.61 per cent of GDP in 2006 compared with the baseline. Subsidy expenditures reduction has a positive impact on the primary and conventional balance, causing a reduction in the total government debt (see table 12). Deficit retrenchment crowds in private investment and the real interest rate falls. Thus, investments in all sectors tend to go up except for the railways transport (sec24) and water transport (sec26).

Table 12. Macroeconomic effects of subsidies elimination (% change compared with the baseline)

Macroeconomic results	Non-neutral scenario		
	2004	2005	2006
GDP at constant prices	-0.01	0.00	0.02
Private consumption	-0.15	-0.34	-0.43
Labor supply	-0.01	-0.02	-0.02
Unemployment	0.03	0.06	0.06
Households			
Households' income	-0.18	-0.42	-0.53
Households' savings	-0.18	-0.43	-0.54
Firms			
Firms income	-0.32	-0.76	-0.99
Firms savings	-0.40	-0.96	-1.25
Government			
Total government revenues	-0.09	-0.20	-0.23
Tota government expenditures	-0.53	-1.27	-1.65
Government transfers to the households	-0.08	-0.20	-0.27
Interest payments	-0.33	-0.80	-1.08
Primary budget surplus	18.14	43.81	57.87
Conventional budget deficit	-4.56	-11.04	-14.60
Foreign debt	-0.58	-1.40	-1.84
Domestic debt	-0.96	-2.32	-3.07
Total debt	-0.73	-1.77	-2.34
Savings/Investment			
National savings	0.65	1.57	2.11
Total investment	0.52	1.27	1.71
Current account			
Total exports	0.04	0.11	0.18
Total imports	0.03	0.08	0.12
Prices			
Exchange rate	0.07	0.18	0.25
Real interest rate	-0.36	-0.89	-1.19
Average wage rate	-0.10	-0.23	-0.28
Equivalent variation (billions ROL)	-997	-2455	-3201

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

4.4. Shifting public expenditures from current to capital expenditures

As already mentioned in section 2, one of the priorities stated by the government in the Pre-accession program is the restructuring of the public expenditures. Therefore, we asses the effects of a shift away from current expenditures (government purchases of goods and services) towards capital expenditures using RoMod. In this non-neutral scenario the public budget balance is allowed to adjust, to account for the change in the public expenditures structure. As explained below (and shown in table 15) the shift in the public expenditure structure has positive effects in terms of government revenues and thus on the public budget balance. This illustrates how useful the CGE approach is in analyzing the possible outcomes of a policy measure.

The shares of current and capital expenditures in total public expenditures in the baseline and in the policy simulation are given in table 13. The change in the share of capital expenditures during 2004-2006 corresponds with an increase of 0.2 per cent of GDP at current market prices in 2004, and an additional rise of 0.3 per cent of GDP at current market prices in 2006, in line with the provisional consolidated

budget published in the Pre-accession program (Romanian Government, 2003). The current expenditures on public administration services (sec32), education (sec33), health and social work (sec34) and other community, social and personal services (sec35) have been kept unchanged not to affect the social safety net.

Table 13. Shares of current and capital expenditures in total public expenditures

Current and capital expenditures		Baseline	2004	2005	2006
Goods and services					
Agriculture, forestry and fishing	**sec1**	1.33	1.18	1.18	0.94
Manufacture of publishing and printing	**sec9**	0.02	0.02	0.02	0.01
Electricity, gas and water supply	**sec20**	3.10	2.75	2.75	2.20
Construction	**sec21**	2.58	2.29	2.29	1.83
Transport via railways	**sec24**	0.75	0.67	0.67	0.54
Other land transport; transport via pipelines	**sec25**	0.64	0.56	0.56	0.45
Water transport	**sec26**	0.07	0.06	0.06	0.05
Air transport	**sec27**	0.28	0.24	0.24	0.20
Post and telecommunications	**sec28**	0.09	0.08	0.08	0.06
Real estate activities	**sec30**	0.22	0.19	0.19	0.16
Other business activities	**sec31**	0.20	0.18	0.18	0.14
Public administration and defence; compulsory social security	**sec32**	34.56	34.56	34.56	34.56
Education	**sec33**	17.21	17.21	17.21	17.21
Health and social work	**sec34**	21.01	21.01	21.01	21.01
Other community, social and personal service activities	**sec35**	5.43	5.43	5.43	5.43
Capital		12.50	13.56	13.56	15.19
Total		100.00	100.00	100.00	100.00

Source: National Institute of Statistics and own calculations.

Non-neutral capital expenditures scenario

The primary result of this policy measure is a change in the structure of government expenditures. Current purchases of goods and services (except for public administration services, education, health and community services) decline by about 11 per cent in 2004-2005 and 28 per cent in 2006, compared with the baseline (see table 14). Overall, the fall in public purchases of goods and services is equivalent to 0.2 per cent of GDP at current market prices in 2004 and 0.3 per cent in 2006. As a consequence, total government expenditures remain unchanged (see table 15).

The decline in public consumption results in a fall of domestic sales of agriculture products (sec1), electricity, gas and water supply (sec20) and transport services (sec24-sec27). Consequently, it triggers a downwards adjustment in gross output of these sectors and depresses output and consumer prices. Demand for labor, capital and energy inputs in the sectors also diminishes.

The reduction of output of the electricity, gas and water supply sector (sec20) reduces demand for coal and natural gas substantially. Consumption of coal and natural gas by the electricity sector represents 46 and 80 per cent, respectively, of total demand for these products. Therefore output of the coal (sec2) and natural gas (sec4) sectors goes down.

The shift towards public capital expenditures has a positive impact on the output of capital goods producing activities, like manufacturing sectors and construction. It further stimulates job-creation and increases the profitability of these sectors.

Table 14. Government purchases of goods and services (% change compared with the baseline)

Commodities		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-11.23	-11.24	-28.56
Manufacture of publishing and printing	sec9	-11.43	-11.44	-28.95
Electricity, gas and water supply	sec20	-11.28	-11.28	-28.64
Construction	sec21	-11.55	-11.55	-29.19
Transport via railways	sec24	-11.03	-11.06	-28.17
Other land transport; transport via pipelines	sec25	-11.34	-11.35	-28.77
Water transport	sec26	-11.42	-11.42	-28.92
Air transport	sec27	-11.36	-11.36	-28.79
Post and telecommunications	sec28	-11.43	-11.44	-28.95
Real estate activities	sec30	-11.41	-11.41	-28.91
Other business activities	sec31	-11.47	-11.48	-29.04
Public administration and defence; compulsory social security	sec32	0.02	0.09	0.19
Education	sec33	0.03	0.02	0.06
Health and social work	sec34	0.02	0.02	0.06
Other community, social and personal service activities	sec35	0.02	0.01	0.04

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

The policy measure examined here results in changes in income distribution. The negative effects on the profitability of the agricultural, electricity, the gas and water supply and transport services sectors outweigh the effects on the capital goods producing activities and generate a fall in firms' income and savings. On the other hand, households' income and savings increase due to the drop in unemployment and the rise in the real average wage rate. It further causes an upwards adjustment in private consumption. The equivalent variation in income expressed in terms of billions ROL over a one-year period, shows that households' register a very small gain during 2004-2006 (see table 15). In the long-run, the policy measure leads to an efficiency gain of 24,049 billions in 2000 ROL (equivalent to 0.19 per cent of the present value of households' income).

Government revenues slightly improve due to the positive effects on employment and the rise in the social security contributions (equivalent to 0.01 per cent of GDP at current market prices in 2004 and an additional 0.01 per cent of GDP at current market prices in 2006). Given that total government expenditures remain unchanged, the primary budget surplus improves, positively influencing the conventional budget deficit and total debt (see table 15). The deficit reduction crowds in private investment and the real interest rate declines.

Table 15. Macroeconomic effects of raising government capital expenditures (% change compared with the baseline)

Macroeconomic results	Non-neutral scenario		
	2004	2005	2006
GDP at constant prices	0.04	0.04	0.10
Private consumption	0.04	0.04	0.11
Labor supply	0.00	0.00	0.01
Unemployment	-0.01	-0.01	-0.03
Households			
Households' income	0.02	0.03	0.06
Households' savings	0.02	0.02	0.06
Firms			
Firms income	-0.02	-0.02	-0.04
Firms savings	-0.01	-0.02	-0.04
Government			
Total government revenues	0.04	0.05	0.12
Total government expenditures	0.00	0.00	0.00
Government transfers to the households	-0.02	-0.02	-0.05
Interest payments	-0.01	-0.02	-0.05
Primary budget surplus	1.79	1.79	4.54
Conventional budget deficit	-0.43	-0.44	-1.11
Foreign debt	-0.03	-0.03	-0.07
Domestic debt	-0.09	-0.09	-0.23
Total debt	-0.05	-0.05	-0.13
Savings/Investment			
National savings	1.10	1.10	2.79
Total investment	1.03	1.03	2.62
Current account			
Total exports	0.18	0.18	0.46
Total imports	0.14	0.14	0.37
Prices			
Exchange rate	0.04	0.04	0.10
Real interest rate	-0.02	-0.03	-0.07
Average wage rate	0.01	0.01	0.02
Equivalent variation (billions ROL)	308	302	825

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

4.5. Combined measure of tax harmonization and public expenditures restructuring

The last policy simulation combines all the measures already presented in this paper: the elimination of the VAT exemptions and the replacement of the statutory rate of 19 per cent by the reduced rate of 9 per cent for certain goods and services; the increase in the excise duties on mineral oils; the elimination of direct subsidies supporting public passenger transport; and the shift from current government expenditures to capital expenditures. This policy simulation (neutral combined scenario) is set up such that the conventional budget balance adjusts during 2001-2002 and remains constant afterwards (at 3.6 per cent) as a share of GDP at current market prices. The additional revenues are recycled though a decrease in social security contributions. There are two reasons for analyzing this combined measure. First, it presents an overall picture of the possible effects induced by the tax harmonization and public expenditures restructuring scenarios discussed in this

paper. More important, it estimates by how much the social security contributions rate can be reduced during 2004-2006 while keeping the deficit ratio constant. The Romanian government started diminishing the social contributions rates in 2003. That is why in this scenario the additional government revenues are recycled beginning with 2003. In 2004 social security contributions have been reduced with another 3 percentage points. Further cuts in the social contributions of at least 1 percentage point per year are envisaged in the Pre-accession program for 2005-2006 (Romanian Government, 2003).

Neutral combined scenario

The combined measure of tax harmonization and public expenditures restructuring has a negative impact on the profitability of all production sectors (except for public administration, education and health services) due to the upwards shift in their cost curves. However, the reduction of the labor tax distortions generates substitution effects between energy inputs and labor, given the relative price changes. Consequently, unemployment declines and the real wage rate goes up (see table16).

Table 16. Macroeconomic effects of the combined measure (% change compared with the baseline)

Macroeconomic results	Neutral scenario		
	2004	2005	2006
GDP at constant prices	0.02	0.13	0.32
Private consumption	-0.36	-0.20	0.06
Labor supply	0.18	0.28	0.37
Unemployment	-0.47	-0.72	-0.95
Households			
Households' income	-0.01	0.22	0.49
Households' savings	-0.07	0.13	0.37
Firms			
Firms income	-1.74	-1.97	-2.07
Firms savings	-2.30	-2.61	-2.73
Government			
Total government revenues	0.36	-0.32	-0.64
Total government expenditures	-0.64	-1.25	-1.52
Government transfers to the households	0.07	0.10	0.09
Interest payments	-2.05	-2.43	-2.69
Primary budget surplus	31.81	29.34	27.22
Conventional budget deficit	-9.82	-9.72	-9.55
Foreign debt	-2.30	-2.29	-2.21
Domestic debt	-2.07	-2.04	-2.01
Total debt	-2.20	-2.19	-2.13
Savings/Investment			
National savings	1.03	0.81	2.28
Total investment	1.83	1.68	3.12
Current account			
Total exports	-0.26	-0.22	0.13
Total imports	-0.20	-0.16	0.12
Prices			
Exchange rate	-1.06	-1.07	-1.00
Real interest rate	-2.14	-2.55	-2.83
Average wage rate	1.52	2.21	2.78
Equivalent variation (billions ROL)	-2254	-1212	709
Change in the social security contributions rate	-12.30	-15.69	-17.99

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

Households' income and savings rise starting with 2005, causing a recovery in private consumption beginning with 2006. Thus, the combined policies generate welfare gains in 2006, expressed in terms of equivalent variation over a one-year period (see table 16). In the long-run, the efficiency gains of 317,539 billions ROL in 2000 prices (equivalent to about 2.46 per cent of the present value of households' income) are caused by the reduction of the labor tax distortions and the rise in investments.

In this scenario, to keep the conventional budget deficit at a level of 3.6 per cent of GDP during 2005-2006, contributions rates can be reduced by as much as 15.69 per cent in 2005 and 17.99 per cent in 2006, compared with the baseline. For the normal work conditions this would imply a rate of 29.5 per cent in 2005 and 28.7 per cent in 2006, for the particular work conditions the rate would be 33.7 per cent in 2005 and 32.8 per cent in 2006, and for the special work conditions it would be 37.9 per cent in 2005 and 36.9 per cent in 2006. In budgetary terms, the cut in social contributions revenues is equivalent to 0.29 per cent of GDP in 2005 and an additional 0.19 per cent of GDP in 2006. The combination of policies has positive effects on the primary budget surplus (even though the conventional deficit to GDP ratio is kept constant) due to the faster decline in public expenditures compared with the tax revenues (see table 16).

The impact on growth is positive although small, due to the higher supply of loanable funds. The deficit reduction until 2003 crowds in private investment and the real interest rate declines.

5. Concluding remarks

As already mentioned in section 3, we use the concept of the equivalent variation in income that is needed to keep households at the same welfare level in the new counter-factual equilibrium[9] (evaluated at benchmark prices) to assess welfare gains or losses. Thus it can be shown (see table 17) that during 2004-2006 households lose from the elimination of the VAT exemptions and the replacement of the statutory rate of 19 per cent by the reduced rate of 9 per cent for certain goods and services (non-neutral VAT scenario), from the increase in excise duties on mineral oils (non-neutral and neutral excise scenario), and from the elimination of direct subsidies supporting public passenger transport (non-neutral subsidy scenario).

Table 17. Equivalent variation in income (billions ROL) over a one-year period and in the long-run

Scenarios	Equivalent variation (billions ROL)			
	2004	**2005**	**2006**	**Long-run**
Non-neutral VAT scenario	-994	-958	-912	13,668
Neutral VAT scenario	191	313	449	32,664
Non-neutral excise scenario	-7,270	-7,100	-6,862	71,969
Neutral excise scenario	-3,043	-2,464	-1,785	167,674
Non-neutral subsidy scenario	-997	-2,455	-3,201	31,888
Non-neutral capital expenditures scenario	308	302	825	24,049
Neutral combined scenario	-2,254	-1,212	709	317,539

Source: Results of the policy simulations.

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[9] The counter-factual equilibrium is given by each of the policy scenarios discussed in this paper.

In the neutral VAT scenario, the recycling of additional government revenues through social security contributions has positive effects in terms of welfare, compared with the non-neutral scenarios, by reducing the labor tax distortion. The highest gain in welfare expressed over a one-year period during 2004-2006 results from the shift from current government expenditures to capital expenditures. Overall, the combined measures of tax harmonization and public expenditures restructuring generate welfare losses during 2004-2005 and efficiency gains starting with 2006.

The welfare gains in the long-run are expressed as the present value of the equivalent variation in 2000 prices. They are achieved through two main mechanisms. The first is based on the retrenchment of the conventional budget deficit which crowds in private investment. As a result, the profitability of production sectors improves in the long-run giving rise to capital income gains for the households. The second mechanism derives from the reduction of the labor tax distortion, which stimulates job-creation and increases households' labor income. In both cases private consumption recovers due to the higher disposable income. Even though all policy scenarios generate welfare gains in the long-run, the size is small. The highest efficiency gain, achieved by the combined measures due to the superior reduction in labor tax distortion, is equivalent to only 2.46 per cent of the present value of households' income in 2000 prices (see table 18).

Table 18. Equivalent variation in % of households' income over a one-year period and in the long-run

Scenarios	Equivalent variation in % of households' income			
	2004	2005	2006	Long-run
Non-neutral VAT scenario	-0.13	-0.12	-0.11	0.11
Neutral VAT scenario	0.03	0.04	0.05	0.26
Non-neutral excise scenario	-0.96	-0.90	-0.82	0.57
Neutral excise scenario	-0.40	-0.31	-0.21	1.32
Non-neutral subsidy scenario	-0.13	-0.31	-0.38	0.25
Non-neutral capital expenditures scenario	0.04	0.04	0.10	0.19
Neutral combined scenario	-0.30	-0.15	0.08	2.46

Source: Results of the policy simulations.

It has further been shown that all policy measures yield positive effects on the primary budget surplus, the conventional deficit and total debt (in the non-neutral scenarios). Furthermore, the neutral combined scenario shows that social contributions rates can be reduced by 15.69 per cent in 2005 and by 17.99 per cent in 2006 compared with the baseline, when the conventional deficit to GDP ratio is kept unchanged after 2003. The social contributions rates envisaged in the Pre-accession program and the one estimated in the neutral combined scenario are given in table 19.

Table 19. Social security contributions rates (%)

Statutory social security contributions rates (%)	2005		2006	
	Neutral combined scenario	Envisaged in the Pre-accession program	Neutral combined scenario	Envisaged in the Pre-accession program
Normal work conditions	29.5	30.5	28.7	29.5
Particular work conditions	33.7	35.5	32.8	34.5
Special work conditions	37.9	40.5	36.9	39.5

Source: Pre-accession program (Romanian Government, 2003) and results of the neutral combined scenario.

It should be stressed that the deficit ratio is slightly higher in the neutral combined scenario (3.6 per cent) than in the forecast published in the Pre-accession program (3.3 per cent). There are two main reasons for this difference. First, the corporate tax rate applied to export-related profits has been increased in 2003, from 6 per cent to 12.5 per cent, and starting with 2004 to 25 per cent. Due to the lack of information on the share of export-related profits in the total profits it was not possible to evaluate the effects of such a policy measure. Furthermore, the harmonization of the excise duties on tobacco and alcoholic beverages has not been taken into account due to the lack of data on their tax base (expressed in quantities). When the positive budgetary effects of these two measures are eliminated from the Pre-accession program estimates, the conventional deficit would also have been about 3.6 per cent of GDP.

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Appendix A - Disaggregation of the production sectors and commodities

Table A.1 - Disaggregation of the commodities and production sectors in RoMod and in the Romanian SAM

Code RoMod[10]	Classification of the production sectors in the SAM and in RoMod	ESA 95	Code NACE[11] Rev.1
Sec1	Agriculture, forestry and fishing	Agriculture, hunting and related service activities Forestry, logging and related service activities Fishing, fish farming and related service activities	01 02 05
Sec2	Coal sector	Mining of coal and lignite; extraction of peat Manufacture of coke, refined petroleum products and nuclear fuel	10 23 (partly)
Sec3	Oil sector	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying Manufacture of coke, refined petroleum products and nuclear fuel	11 (partly) 23 (partly)
Sec4	Natural gas sector	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying Manufacture of coke, refined petroleum products and nuclear fuel	11 (partly) 23 (partly)
Sec5	Manufacture of food products and beverages; tobacco	Manufacture of food products and beverages Manufacture of tobacco products	15 16
Sec6	Manufacture of textile and leather products	Manufacture of textiles Manufacture of wearing apparel; dressing and dyeing of fur Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	17 18 19
Sec7	Manufacture of wood and products of wood	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials Manufacture of furniture; manufacturing n.e.c.	20 36
Sec8	Manufacture of paper and paper products	Manufacture of pulp, paper and paper products	21
Sec9	Manufacture of publishing and printing	Publishing, printing and reproduction of recorded media	22
Sec10	Manufacture of chemicals and chemical products	Manufacture of chemicals and chemical products	24 (partly)
Sec11	Manufacture of pharmaceutical products and cosmetics	Manufacture of chemicals and chemical products	24 (partly)
Sec12	Manufacture of rubber and plastic products	Manufacture of rubber and plastic products	25
Sec13	Manufacture of glass and glass products	Manufacture of other non-metallic mineral products	26 (partly)
Sec14	Other mining and quarrying; manufacture of other non-metallic mineral products	Other mining and quarrying Manufacture of other non-metallic mineral products	14 26 (partly)
Sec15	Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	Mining of metal ores Manufacture of basic metals Manufacture of fabricated metal products, except machinery and equipment	13 27 28
Sec16	Manufacture of general purpose machinery; manufacture of special purpose machinery	Manufacture of machinery and equipment n.e.c.	29 (partly)
Sec17	Manufacture of domestic appliances	Manufacture of machinery and equipment n.e.c.	29 (partly)

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[10] Code of the sectors used in RoMod and in the Romanian SAM.
[11] Classification of Economic Activities in the European Community.

Table A.1 - Disaggregation of the commodities and production sectors in RoMod and in the Romanian SAM (continued)

Code RoMod[12]	Classification of the production sectors in the SAM and in RoMod	ESA 95	Code NACE[13] Rev.1
Sec18	Manufacture of electrical and machinery and apparatus	Manufacture of office machinery and computers	30
		Manufacture of electrical machinery and apparatus n.e.c.	31
		Manufacture of radio, television and communication equipment and apparatus	32
		Manufacture of medical, precision and optical instruments, watches and clocks	33
Sec19	Manufacture of transport equipment	Manufacture of motor vehicles, trailers and semi-trailers	34
		Manufacture of other transport equipment	35
Sec20	Electricity, gas and water supply	Electricity, gas, steam and hot water supply	40
		Collection, purification and distribution of water	41
Sec21	Construction	Construction	45
Sec22	Wholesale and retail trade	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	50
		Wholesale trade and commission trade, except of motor vehicles and motorcycles	51
		Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	52
Sec23	Hotels and restaurants; activities of travel agencies	Hotels and restaurants	55
		Supporting and auxiliary transport activities; activities of travel agencies	63
Sec24	Transport via railways	Land transport; transport via pipelines	60 (partly)
Sec25	Other land transport; transport via pipelines	Land transport; transport via pipelines	60 (partly)
Sec26	Water transport	Water transport	61
Sec27	Air transport	Air transport	62
Sec28	Post and telecommunications	Post and telecommunications	64
Sec29	Financial intermediation	Financial intermediation, except insurance and pension funding	65
		Insurance and pension funding, except compulsory social security	66
		Activities auxiliary to financial intermediation	67
Sec30	Real estate activities	Real estate activities	70
Sec31	Other business activities	Renting of machinery and equipment without operator and of personal and household goods	71
		Computer and related activities	72
		Research and development	73
		Other business activities	74
Sec32	Public administration and defence; compulsory social security	Public administration and defence; compulsory social security	75
Sec33	Education	Education	80
Sec34	Health and social work	Health and social work	85
Sec35	Other community, social and personal service activities	Sewage and refuse disposal, sanitation and similar activities	90
		Activities of membership organizations n.e.c.	91
		Recreational, cultural and sporting activities	92
		Other service activities	93
		Activities of households as employers of domestic staff	95

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[12] Code of the sectors used in RoMod and in the Romanian SAM.
[13] Classification of Economic Activities in the European Community.

Appendix B – Model equations

B.1. Households sector

$$C_i = \mu H_i + \alpha H_i \cdot [(1+vat_i) \cdot (1+tc_i) \cdot (1-tsc_i) \cdot P_i]^{-1} \cdot \Big[CBUD - $$
$$\sum_j (1+vat_j) \cdot (1+tc_j) \cdot (1-tsc_j) \cdot P_j \cdot \mu H_j \Big] \tag{B.1}$$

$$SH = mps \cdot (YH - ty \cdot YHI - tsch \cdot \sum_i LSK_i \cdot PL \cdot wdif_i) \tag{B.2}$$

$$YH = aich \cdot \sum_i KSK_i \cdot RK_i + \sum_i LSK_i \cdot PL \cdot wdif_i + PLWZ \cdot ER \cdot LW + TRHG$$
$$+ TRHF \cdot INDEX + ER \cdot TRHW \tag{B.3}$$

$$YHI = aich \cdot \sum_i KSK_i \cdot RK_i + \sum_i LSK_i \cdot PL \cdot wdif_i + PLWZ \cdot ER \cdot LW +$$
$$TRO \cdot INDEX + GDEBTD_{-1} \cdot RGD \cdot inth \tag{B.4}$$

$$CBUD = YH - ty \cdot YHI - tsch \cdot \sum_i LSK_i \cdot PL \cdot wdif_i - SH \tag{B.5}$$

$$VL = \Big[CBUD - \sum_i P_i \cdot (1+vat_i) \cdot (1+tc_i) \cdot (1-tsc_i) \cdot \mu H_i \Big] \cdot$$
$$\prod_i [\alpha H_i /(P_i \cdot (1+vat_i) \cdot (1+tc_i) \cdot (1-tsc_i))]^{\alpha H_i} \tag{B.6}$$

$$VL0 = \Big[CBUDZ - \sum_i PZ_i \cdot (1+vat0_i) \cdot (1+tc0_i) \cdot (1-tsc0_i) \cdot \mu H_i \Big] \cdot$$
$$\prod_i [\alpha H_i /(PZ_i \cdot (1+vat0_i) \cdot (1+tc0_i) \cdot (1-tsc0_i))]^{\alpha H_i} \tag{B.7}$$

$$EV = (VL - VL0) \cdot \prod_i \Big[\frac{PZ_i \cdot (1+vat0_i) \cdot (1+tc0_i) \cdot (1-tsc0_i)}{\alpha H_i} \Big]^{\alpha H_i} \tag{B.8}$$

B.2. Firms sector

$$aP_c \cdot XD_c = KLE_c \tag{B.9}$$

$$(1-tp_c+tsp_c) \cdot PD_c \cdot XD_c = KLE_c \cdot PKLE_c + \sum_{nen} io_{nen,c} \cdot P_{nen} \cdot (1+vati_{nen,c}) \cdot (1+tci_{nen,c}) \cdot XD_c \tag{B.10}$$

$$KE_c = KLE_c \cdot (\gamma P11_c / PKE_c)^{\sigma P1_c} \cdot PKLE_c^{\sigma P1_c} \tag{B.11}$$

$$LSK_c = KLE_c \cdot [\gamma P12_c /((1+tsh_c) \cdot PL \cdot wdif_c)]^{\sigma P1_c} \cdot PKLE_c^{\sigma P1_c} \tag{B.12}$$

$$PKLE_c \cdot KLE_c = PKE_c \cdot KE_c + (1+tsh_c) \cdot PL \cdot wdif_c \cdot LSK_c \tag{B.13}$$

$$KSK_c = KE_c \cdot (\gamma P21_c /(RK_c + d_c \cdot PI))^{\sigma P2_c} \cdot PKE_c^{\sigma P2_c} \tag{B.14}$$

$$ENER_c = KE_c \cdot (\gamma P22_c / PEN_c)^{\sigma P2_c} \cdot PKE_c^{\sigma P2_c} \tag{B.15}$$

$$PKE_c \cdot KE_c = RK_c \cdot KSK_c + DEP_c \cdot PI + PEN_c \cdot ENER_c \tag{B.16}$$

$$ENEROG_c = ENER_c \cdot (\gamma P31_c / PEOG_c)^{\sigma P3_c} \cdot PEN_c^{\sigma P3_c} \tag{B.17}$$

$$ENINP_{el,c} = ENER_c \cdot [\gamma P32_{el,c} / (P_{el} \cdot (1+vati_{el,c}) \cdot (1+tci_{el,c}))]^{\sigma P3_c} \cdot PEN_c^{\sigma P3_c} \tag{B.18}$$

$$PEN_c \cdot ENER_c = \sum_{el} \left[ENINP_{el,c} \cdot P_{el} \cdot (1+vati_{el,c}) \cdot (1+tci_{el,c}) \right] + PEOG_c \cdot ENEROG_c \tag{B.19}$$

$$ENINP_{l,c} = ENEROG_c \cdot [\gamma P4_{l,c} / (P_l \cdot (1+vati_{l,c}) \cdot (1+tci_{l,c}))]^{\sigma P4_c} \cdot PEOG_c^{\sigma P4_c} \tag{B.20}$$

$$PEOG_c \cdot ENEROG_c = \sum_{l} \left[ENINP_{l,c} \cdot P_l \cdot (1+vati_{l,c}) \cdot (1+tci_{l,c}) \right] \tag{B.21}$$

$$aL1_l \cdot XD_l = KL_l \tag{B.22}$$

$$aL2_{en,l} \cdot XD_l = ENINP_{en,l} \tag{B.23}$$

$$(1-tp_l+tsp_l) \cdot PD_l \cdot XD_l = KL_l \cdot PKL_l + \sum_{en} \left[ENINP_{en,l} \cdot P_{en} \cdot (1+vati_{en,l}) \cdot (1+tci_{en,l}) \right] +$$
$$\sum_{nen} \left[io_{nen,l} \cdot XD_l \cdot P_{nen} \cdot (1+vati_{nen,l}) \cdot (1+tci_{nen,l}) \right] \tag{B.24}$$

$$KSK_l = KL_l \cdot \left[\gamma L11_l / (RK_l + d_l \cdot PI) \right]^{\sigma Ll_l} \cdot PKL_l^{\sigma Ll_l} \tag{B.25}$$

$$LSK_l = KL_l \cdot [\gamma L12_l / ((1+tsh_l) \cdot PL \cdot wdif_l)]^{\sigma Ll_l} \cdot PKL_l^{\sigma Ll_l} \tag{B.26}$$

$$PKL_l \cdot KL_l = RK_l \cdot KSK_l + DEP_l \cdot PI + (1+tsh_l) \cdot PL \cdot wdif_l \cdot LSK_l \tag{B.27}$$

$$YF = (1-aich) \cdot \sum_{i} KSK_i \cdot RK_i + TRFG \cdot GDPDEF + GDEBTD_{-1} \cdot RGD \cdot intf \tag{B.28}$$

$$YFI = (1-aich) \cdot \sum_{i} KSK_i \cdot RK_i + GDEBTD_{-1} \cdot RGD \cdot intf \tag{B.29}$$

$$SF = YF - tyf \cdot YFI - TRHF \cdot INDEX - ER \cdot TRWF \tag{B.30}$$

B.3. Government sector

$$TAXR = ty \cdot YHI + tyf \cdot YFI + tsch \cdot \sum_{i} LSK_i \cdot PL \cdot wdif_i + \sum \left[P_i \cdot C_i \cdot (1-tsc_i) \cdot tc_i + \right.$$
$$P_i \cdot C_i \cdot (1-tsc_i) \cdot (1+tc_i) \cdot vat_i + tsh_i \cdot LSK_i \cdot PL \cdot wdif_i + tm_i \cdot M_i \cdot PWMZ_i \cdot ER +$$
$$\left. XD_i \cdot PD_i \cdot tp_i + P_i \cdot CG_i \cdot vatg_i + P_i \cdot I_i \cdot vatinv_i \right] + \sum_{nen} \sum_{i} \left[io_{nen,i} \cdot P_{nen} \cdot XD_i \cdot \right.$$
$$tci_{nen,i} + io_{nen,i} \cdot P_{nen} \cdot XD_i \cdot (1+tci_{nen,i}) \cdot vati_{nen,i} \right] + \sum_{en} \sum_{i} \left[ENINP_{en,i} \cdot P_{en} \cdot tci_{en,i} + \right.$$
$$\left. ENINP_{en,i} \cdot P_{en} \cdot (1+tci_{en,i}) \cdot vati_{en,i} \right] + ER \cdot TRGW \tag{B.31}$$

$$GEXP = CGBUD + TRFG \cdot GDPDEF + trep \cdot PL \cdot UNEMP + TRO \cdot INDEX +$$
$$INTR + \sum_{i} \left[P_i \cdot C_i \cdot tsc_i + XD_i \cdot PD_i \cdot tsp_i \right] \tag{B.32}$$

$$TRHG = trep \cdot PL \cdot UNEMP + TRO \cdot INDEX + GDEBTD_{-1} \cdot RGD \cdot inth \tag{B.33}$$

$$CGBUD = govsh \cdot GDPC \qquad (B.34)$$

$$CG_i = \left[(1+vatg_i) \cdot P_i\right]^{-1} \cdot \alpha G_i \cdot CGBUD \qquad (B.35)$$

$$GFCFG = PI^{-1} \cdot \alpha GI \cdot CGBUD \qquad (B.36)$$

$$SGP = TAXR\text{-}CGBUD\text{-}TRFG \cdot GDPDEF\text{-}trep \cdot PL \cdot UNEMP\text{-}TRO \cdot INDEX\text{-} \sum_i \left[P_i \cdot C_i \cdot tsc_i + XD_i \cdot PD_i \cdot tsp_i\right] \qquad (B.37)$$

$$SGC = SGP\text{ -}INTR \qquad (B.38)$$

$$INTR = GDEBTD_{-1} \cdot RGD \cdot intf + GDEBTD_{-1} \cdot RGD \cdot inth + GDEBT_{-1} \cdot RGE \cdot ER \qquad (B.39)$$

$$SGCDEF = (SGC/GDPC) \cdot 100 \qquad (B.40)$$

$$SGPDEF = (SGP/GDPC) \cdot 100 \qquad (B.41)$$

B.4. External sector

$$E_i = XD_i \cdot (\gamma T1_i / PE_i)^{\sigma T_i} \cdot PD_i^{\sigma T_i} \qquad (B.42)$$

$$XDD_i = XD_i \cdot (\gamma T2_i / PDS_i)^{\sigma T_i} \cdot PD_i^{\sigma T_i} \qquad (B.43)$$

$$PD_i \cdot XD_i = PE_i \cdot E_i + PDS_i \cdot XDD_i \qquad (B.44)$$

$$M_i = X_i \cdot (\gamma A1_i / PM_i)^{\sigma A_i} \cdot P_i^{\sigma A_i} \qquad (B.45)$$

$$XDD_i = X_i \cdot (\gamma A2_i / PDD_i)^{\sigma A_i} \cdot P_i^{\sigma A_i} \qquad (B.46)$$

$$P_i \cdot X_i = PM_i \cdot M_i + PDD_i \cdot XDD_i \qquad (B.47)$$

$$SW = \sum_i PWEZ_i \cdot E_i - \sum_i PWMZ_i \cdot M_i + TRHW + TRGW + LW \cdot PLWZ - TRWF - GDEBT_{-1} \cdot RGE \qquad (B.48)$$

B.5. Investments

$$S = SH + SF + SGC + GFCFG \cdot PI \text{ -}SW \cdot ER + \sum_i DEP_i \cdot PI \qquad (B.49)$$

$$DEP_i = d_i \cdot KSK_i \qquad (B.50)$$

$$SV_i = svr_i \cdot X_i \qquad (B.51)$$

$$I_i = \alpha I_i \cdot \left[(1+vatinv_i) \cdot P_i\right]^{-1} \cdot (S - \sum_j SV_j \cdot P_j) \qquad (B.52)$$

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B.6. Price equations

$$INDEX = \sum_i \left[P_i \cdot CZ_i \cdot (1+vat_i) \cdot (1+tc_i) \cdot (1-tsc_i) \right] \Big/$$
$$\sum_i \left[PZ_i \cdot CZ_i \cdot (1+vat0_i) \cdot (1+tc0_i) \cdot (1-tsc0_i) \right] \tag{B.53}$$

$$PI = \prod_i \left[P_i \cdot (1+vatinv_i) / \alpha I_i \right]^{\alpha I_i} \tag{B.54}$$

$$PE_i = PWEZ_i \cdot ER - \sum_{ct} tcoe_{ct,i} \cdot P_{ct} - \sum_{ctpr} tcroe_{ctpr,i} \cdot P_{ctpr} -$$
$$\sum_{ctpa} tcaoe_{ctpa,i} \cdot P_{ctpa} - \sum_{ctpw} tcwoe_{ctpw,i} \cdot P_{ctpw} \tag{B.55}$$

$$PM_i = (1+tm_i) \cdot ER \cdot PWMZ_i + \sum_{ct} tcom_{ct,i} \cdot P_{ct} + \sum_{ctpr} tcrom_{ctpr,i} \cdot P_{ctpr} +$$
$$\sum_{ctpa} tcaom_{ctpa,i} \cdot P_{ctpa} + \sum_{ctpw} tcwom_{ctpw,i} \cdot P_{ctpw} \tag{B.56}$$

$$PDD_i = PDS_i + \sum_{ct} tcod_{ct,i} \cdot P_{ct} + \sum_{ctpr} tcrod_{ctpr,i} \cdot P_{ctpr} +$$
$$\sum_{ctpa} tcaod_{ctpa,i} \cdot P_{ctpa} + \sum_{ctpw} tcwod_{ctpw,i} \cdot P_{ctpw} \tag{B.57}$$

$$GDPDEF = GDPC/GDP \tag{B.58}$$

$$INDEXI = \sum_i \left[(1+vatinv_i) \cdot P_i \cdot IZ_i \right] \Big/ \sum_i \left[(1+vatinv0_i) \cdot PZ_i \cdot IZ_i \right] \tag{B.59}$$

$$INDEXE = \sum_i \left[PE_i \cdot EZ_i \right] \Big/ \sum_i \left[PEZ_i \cdot EZ_i \right] \tag{B.60}$$

$$INDEXM = \sum_i \left[PM_i \cdot MZ_i \right] \Big/ \sum_i \left[PMZ_i \cdot MZ_i \right] \tag{B.61}$$

$$RINT = \sum_i (RK_i \cdot KSK_i) \Big/ \sum_i KSK_i \tag{B.62}$$

$$RGD = RINT \cdot RISK \tag{B.63}$$

B.7. Labor market

$$(PL/INDEX)/(PLZ/INDEXZ)-1 = beta \cdot \left[(UNEMP/LSR)/(UNEMPZ/LSRZ)-1 \right] \tag{B.64}$$

$$LSR = LSRZ \cdot ((PL \cdot INDEXZ)/(PLZ \cdot INDEX))^{elasLS} \tag{B.65}$$

$$\sum_i LSK_i = LSR - UNEMP \tag{B.66}$$

$$LS = LSR + LW \tag{B.67}$$

B.8. Market clearing

$$C_{nct} + I_{nct} + SV_{nct} + \sum_i io_{nct,i} \cdot XD_i + CG_{nct} = X_{nct} \tag{B.68}$$

$$C_{ct} + I_{ct} + SV_{ct} + \sum_i io_{ct,i} \cdot XD_i + CG_{ct} + MARG_{ct} = X_{ct} \tag{B.69}$$

$$C_{ctpr} + I_{ctpr} + SV_{ctpr} + \sum_i io_{ctpr,i} \cdot XD_i + CG_{ctpr} + MARGR_{ctpr} = X_{ctpr} \tag{B.70}$$

$$C_{ctpa} + I_{ctpa} + SV_{ctpa} + \sum_i io_{ctpa,i} \cdot XD_i + CG_{ctpa} + MARGA_{ctpa} = X_{ctpa} \tag{B.71}$$

$$C_{ctpw} + I_{ctpw} + SV_{ctpw} + \sum_i io_{ctpw,i} \cdot XD_i + CG_{ctpw} + MARGW_{ctpw} = X_{ctpw} \tag{B.72}$$

$$MARG_{ct} = \sum_i (tcod_{ct,i} \cdot XDD_i + tcom_{ct,i} \cdot M_i + tcoe_{ct,i} \cdot E_i) \tag{B.73}$$

$$MARGR_{ctpr} = \sum_i (tcrod_{ctpr,i} \cdot XDD_i + tcrom_{ctpr,i} \cdot M_i + tcroe_{ctpr,i} \cdot E_i) \tag{B.74}$$

$$MARGA_{ctpa} = \sum_i (tcaod_{ctpa,i} \cdot XDD_i + tcaom_{ctpa,i} \cdot M_i + tcaoe_{ctpa,i} \cdot E_i) \tag{B.75}$$

$$MARGW_{ctpw} = \sum_i (tcwod_{ctpw,i} \cdot XDD_i + tcwom_{ctpw,i} \cdot M_i + tcwoe_{ctpw,i} \cdot E_i) \tag{B.76}$$

$$C_{en} + I_{en} + SV_{en} + \sum_i ENINP_{en,i} + CG_{en} = X_{en} \tag{B.77}$$

$$XD_i = XDD_i + E_i \qquad \text{if } XDD_i = 0 \text{ or } E_i = 0 \tag{B.78}$$

$$X_i = XDD_i + M_i \qquad \text{if } XDD_i = 0 \text{ or } M_i = 0 \tag{B.79}$$

B.9. Other macroeconomic indicators

$$\begin{aligned}GDP = \sum_i \big[& C_i \cdot PZ_i \cdot (1+vat0_i) \cdot (1+tc0_i) \cdot (1-tsc0_i) + CG_i \cdot PZ_i \cdot (1+vatg0_i) + \\ & I_i \cdot PZ_i \cdot (1+vatinv0_i) + SV_i \cdot PZ_i + E_i \cdot PWEZ_i \cdot ERZ - M_i \cdot PWMZ_i \cdot ERZ \big] \end{aligned} \tag{B.80}$$

$$\begin{aligned}GDPC = \sum_i \big[& C_i \cdot P_i \cdot (1+vat_i) \cdot (1+tc_i) \cdot (1-tsc_i) + CG_i \cdot P_i \cdot (1+vatg_i) + \\ & I_i \cdot P_i \cdot (1+vatinv_i) + SV_i \cdot P_i + E_i \cdot PWEZ_i \cdot ER - M_i \cdot PWMZ_i \cdot ER \big] \end{aligned} \tag{B.81}$$

$$CT = \sum_i \big[P_i \cdot C_i \cdot (1+vat_i) \cdot (1+tc_i) \cdot (1-tsc_i) \big] / INDEX \tag{B.82}$$

$$IT = \sum_i \big[(1+vatinv_i) \cdot P_i \cdot I_i \big] / INDEXI \tag{B.83}$$

$$ET = \sum_i \big[PE_i \cdot E_i \big] / INDEXE \tag{B.84}$$

$$MT = \sum_i \big[PM_i \cdot M_i \big] / INDEXM \tag{B.85}$$

B.10. Incorporation of recursive dynamics

$$ROR_{ng,t} = -1 + [\, RK_{ng,t} / PI_t + (\, 1 - d_{ng}\,)\,] / [\, 1 + RINT_t / GDPDEF_t\,] \tag{B.86}$$

$$
\begin{aligned}
INV_{ng,t} = KSK_{ng,t} \cdot &\Big\{ \big[\, \alpha ROR_{ng,t} \cdot KSKg\,max_{ng} \cdot (\, KSKtrend_{ng} - KSKg\,min_{ng}\,) + \\
& KSKg\,min_{ng} \cdot (\, KSKg\,max_{ng} - KSKtrend_{ng}\,) \big] / \big[\, \alpha ROR_{ng,t} \cdot (\, KSKtrend_{ng} - \\
& KSKg\,min_{ng}\,) + (\, KSKg\,max_{ng} - KSKtrend_{ng}\,) \big] + 1 \Big\} - KSK_{ng,t} \cdot (\, 1 - d_{ng}\,)
\end{aligned}
\tag{B.87}
$$

$$\alpha ROR_{ng,t} = e^{\, B_{ng} \cdot (\, ROR_{ng,t} - RORZ_{ng,t}\,)} \tag{B.88}$$

$$K_{ng,t+1} = (1 - d_{ng}\,) \cdot K_{ng,t} + INV_{ng,t} \tag{B.89}$$

$$KSK_{gov,t+1} = (1 - d_{gov}\,) \cdot KSK_{gov,t} + GFCFG_t \tag{B.90}$$

$$INV_{ng,T} = (\, g + d_{ng}\,) \cdot KSK_{ng,T} \tag{B.91}$$

$$INV_{gov,T} = (\, g + d_{gov}\,) \cdot KSK_{gov,T} \tag{B.92}$$

$$GDEBTD_{t+1} = GDEBTD_t \cdot GDPDEF_t - SGC_t \cdot shdebtd \tag{B.93}$$

$$GDEBT_{t+1} = GDEBT_t \cdot ER_t - SGC_t \cdot (1 - shdebtd) \tag{B.94}$$

$$GDEBTT_{t+1} = GDEBTD_{t+1} + GDEBT_{t+1} \tag{B.95}$$

$$PVVL = \sum_t \frac{VL_t}{(1+g)^t \cdot (1+\rho\,)^t} + \frac{VL_T}{\rho \cdot (1+g)^T \cdot (1+\rho\,)^T} \tag{B.96}$$

$$PVVL0 = \sum_t \frac{VL0_t}{(1+g)^t \cdot (1+\rho\,)^t} + \frac{VL0_T}{\rho \cdot (1+g)^T \cdot (1+\rho\,)^T} \tag{B.97}$$

$$PVEV = (PVVL - PVVL0) \cdot \prod_i \left[\frac{PZ_i \cdot (\, 1 + vat0_i\,) \cdot (\, 1 + tc0_i\,) \cdot (\, 1 - tsc0_i\,)}{\alpha H_i} \right]^{\alpha H_i} \tag{B.98}$$

B.11. List of endogenous variables

CBUD households disposable budget for consumption

CGBUD government disposable budget for purchases of goods and services and capital expenditures

CG_i government demand for commodity i

C_i households' demand for commodity i

CT households' total demand for commodities

DEP_i depreciation in sector i

E_i export supply of sector i

$ENER_c$ demand for energy composite (coal-oil-natural gas-electricity) in sector c

$ENEROG_c$ demand for non-electric energy composite (coal-oil-natural gas) in sector c

$ENINP_{en,i}$ demand for energy input en in sector i

ER exchange rate

ET total exports supply

EV	equivalent variation in income
GDEBT$_{-1}$	government foreign debt in the previous year
GDEBTD$_{-1}$	government domestic debt in the previous year
GDEBTD$_t$	government domestic debt in year *t*
GDEBT$_t$	government foreign debt in year *t*
GDEBTT$_t$	total government debt in year *t*
GDP	gross domestic product in constant prices
GDPC	gross domestic product at current market prices
GEXP	total government expenditures
GFCFG	government capital expenditures
I$_i$	demand for investment commodity *i*
INDEX	consumer price index (Laspeyres type)
INDEXE	price index for exports (Laspeyres type)
INDEXI	price index for investment commodities (Laspeyres type)
INDEXM	price index for imports (Laspeyres type)
INTR	total interest payments on government debt
INV$_{i,t}$	investment carried out in sector *i* in year *t*
IT	total demand for investment commodities
KE$_c$	demand for capital-energy composite in sector *c*
KLE$_c$	demand for capital-labor-energy composite in sector *c*
KL$_l$	demand for capital-labor bundle in sector *l*
KSK$_i$	capital demand in sector *i*
LS	total labor supply
LSK$_i$	labor demand in sector *i*
LSR	domestic labor supply
MARGA$_{ctpa}$	transport margins by land transport sector *ctpa*
MARG$_{ct}$	trade margins by wholesale and retail sector *ct*
MARGR$_{ctpr}$	transport margins by railway transport sector *ctpr*
MARGW$_{ctpw}$	transport margins by water transport sector *ctpw*
M$_i$	import demand for commodity *i*
MT	total imports demand
PDD$_i$	producer price of domestic output of sector *i* delivered to domestic market (including trade margins)
PD$_i$	price of domestic output
PDS$_i$	producer price of domestic output of sector *i* delivered to domestic market (excluding trade margins)
PE$_i$	domestic price of exports of sector *i*
PEN$_c$	price of energy composite (coal-oil-natural gas-electricity) in sector *c*
PEOG$_c$	price of non-electric energy composite (coal-oil-natural gas) in sector *c*
PI	price of composite investment good
P$_i$	price of commodity *i* (excluding VAT, excises and subsidies)
PKE$_c$	return to capital-energy bundle in sector *c*

PKLE$_c$	return to capital-labor-energy bundle in sector *c*
PKL$_l$	price of capital-labor in sector *l*
PL	national average wage rate
PM$_i$	domestic price of imports of commodity *i*
PVEV	present value of equivalent variation in income
PVVL	present value of indirect utility level in the counter-factual equilibrium (policy scenario) prices
RGD	domestic interest rate on public debt
RINT	domestic interest rate
RK$_i$	rental rate of capital in sector *i*
ROR$_{ng,t}$	rate of return in sector *ng* in year *t*
S	national savings
SF	firms' savings
SGC	government conventional budget balance
SGCDEF	conventional deficit to GDP ratio
SGP	government primary budget balance
SGPDEF	primary deficit to GDP ratio
SH	households' savings
SV$_i$	changes in inventories of commodity *i*
TAXR	total government revenues
TRHG	total government transfers to the households
UNEMP	unvoluntary unemployment (number of unemployed)
VL	households' indirect utility level in the counter-factual equilibrium (policy scenario) prices
XDD$_i$	domestic production of commodity *i* delivered to domestic market
XD$_i$	gross domestic output of sector *i*
X$_i$	domestic sales of commodity *i* from domestic production and imports
YF	total firms' income
YFI	firms' taxable income
YH	total households' income
YHI	households' taxable income
αROR$_{ng,t}$	notation of the exponential function for the rate of return in sector *ng* in year *t*

B.12. List of exogenous variables

CBUDZ	households disposable budget for consumption in the benchmark
CZ$_i$	benchmark households' consumption level for commodity *i*
ERZ	benchmark level of exchange rate
EZ$_i$	benchmark export supply level of sector *i*
GDPDEF	GDP deflator
INDEXZ	benchmark level of consumer price index (Laspeyres type)
IZ$_i$	benchmark level for investment commodity *i*

$KSKgmax_{ng}$	maximum possible growth rates of capital in sector ng
$KSKgmin_{ng}$	minimum possible growth rates of capital in sector ng
$KSKtrend_{ng}$	historically normal growth rate in sector ng
$LSRZ$	benchmark level of domestic labor supply
LW	labor supply to external sector
MZ_i	benchmark import level for commodity i
PEZ_i	benchmark domestic price of exports of sector i
$PLWZ$	wage rate in foreign currency on labor supplied to external sector
PLZ	benchmark national average wage rate
PMZ_i	benchmark domestic price of imports of commodity i
$PVVL0$	present value of indirect utility level in the benchmark prices
$PWEZ_i$	world price of exports
$PWMZ_i$	world price of imports
PZ_i	benchmark price of commodity i (excluding VAT, excises and subsidies)
RGE	foreign interest rate
$RORZ_{ng,t}$	benchmark rate of return in sector ng in year t
SW	balance of the balance of payments
$TRFG$	net transfers received by firms from government
$TRGW$	net transfers received by government from external sector
$TRHF$	net transfers of firms to households
$TRHW$	net transfers received by households from external sector
TRO	other transfers received by households from external sector (excluding unemployment benefits and interest payments on government debt)
$TRWF$	net transfers of firms to external sector
$UNEMPZ$	benchmark level of unvoluntary unemployment (number of unemployed)
$VL0$	households' indirect utility level in benchmark prices

B.13. List of parameters

$aich$	share parameter of capital income received by the households
$aKLE_c$	efficiency parameter of Leontief production function in sector c
$aL1_l$	efficiency parameter for capital-labor bundle of Leontief production function in sector l (first nest in the nested production structure in sector l)
$aL2_{en,l}$	efficiency parameter for energy input en of Leontief production function in sector l (first nest in the nested production structure in sector l)
$beta$	parameter in the wage curve
B_{ng}	sensitivity of capital growth in sector ng to variations in its equilibrium expected rate of return
d_i	depreciation rate in sector i
$elasLS$	parameter in the labor supply curve

g	steady-state growth rate
govsh	share of government disposable budget for purchases of goods and services and capital expenditures in GDP at current market prices
intf	share of interest payments on government domestic debt received by firms
inth	share of interest payments on government domestic debt received by households
$io_{i,j}$	technical coefficients
mps	average propensity to save of households
shdebtd	share of conventional budget deficit financed from domestic sources
svr_i	share of inventories of commodity *i* in domestic sales
$tc0_i$	benchmark average excise duty rate on households' consumption of commodity *i* (to be used in consumer price index and indirect utility in benchmark prices)
$tcaod_{ctpa,i}$	quantity of commodity *ctpa* as land transport input per unit of commodity *i* produced and sold domestically
$tcaoe_{ctpa,i}$	quantity of commodity *ctpa* as land transport input per exported unit of commodity *i*
$tcaom_{ctpa,i}$	quantity of commodity *ctpa* as land transport input per imported unit of commodity *i*
tc_i	average excise duty rate on households' consumption of commodity *i*
$tci_{i,j}$	average excise duty rate on consumption of commodity *i* by sector *j*
$tcod_{ct,i}$	quantity of commodity *ct* as trade input per unit of commodity *i* produced and sold domestically
$tcoe_{ct,i}$	quantity of commodity *ct* as trade input per exported unit of commodity *i*
$tcom_{ct,i}$	quantity of commodity *ct* as trade input per imported unit of commodity *i*
$tcrod_{ctpr,i}$	quantity of commodity *ctpr* as railway transport input per unit of commodity *i* produced and sold domestically
$tcroe_{ctpr,i}$	quantity of commodity *ctpr* as railway transport input per exported unit of commodity *i*
$tcrom_{ctpr,i}$	quantity of commodity *ctpr* as railway transport input per imported unit of commodity *i*
$tcwod_{ctpw,i}$	quantity of commodity *ctpw* as water transport input per unit of commodity *i* produced and sold domestically
$tcwoe_{ctpw,i}$	quantity of commodity *ctpw* as water transport input per exported unit of commodity *i*
$tcwom_{ctpw,i}$	quantity of commodity *ctpw* as water transport input per imported unit of commodity *i*
tm_i	average tariff rate on commodity *i*
tp_i	average tax rate on production of sector *i*
trep	replacement rate out of the gross national wage (used to calculate unemployment benefits)
$tsc0_i$	benchmark average subsidy rate on commodity *i* (to be used in consumer price index and indirect utility in benchmark prices)

tsch	average social security contributions tax rate paid by the self employed members of the households
tsc_i	average subsidy rate on commodity i
tsh_i	average social security contributions rate paid by the employers in sector i
tsp_i	average subsidy rate on production of sector i
ty	average tax rate on households' income
tyf	average corporate tax rate
$vat0_i$	benchmark average VAT rate on households' consumption of commodity i (to be used in consumer price index and indirect utility in benchmark prices)
$vatg0_i$	benchmark average VAT rate on government consumption of commodity i
$vatg_i$	average VAT rate on government consumption of commodity i
vat_i	average VAT rate on households' consumption of commodity i
$vati_{i,j}$	average VAT rate on consumption of commodity i by sector j (non-deductible VAT)
$vatinv0_i$	benchmark average VAT rate on investment commodity i
$vatinv_i$	average VAT rate on investment commodity i
$wdif_i$	wage rate differential of sector i with respect to the national average wage rate
αGI	income elasticity of government demand for capital
αG_i	income elasticity of government demand for commodity i
αH_i	income elasticity of households' demand for commodity i
αI_i	income elasticity of demand for investment commodity i
$\gamma A1_i$	distribution parameter for imports of commodity i in the Armington function
$\gamma A2_i$	distribution parameter for domestic demand from the domestic market of commodity i in the Armington function
$\gamma L11_l$	distribution parameter for capital in the CES production function of sector l (second nest in the nested production structure in sector l)
$\gamma L12_l$	distribution parameter for labor in the CES production function of sector l (second nest in the nested production structure in sector l)
$\gamma P11_c$	distribution parameter for capital-energy bundle in the CES production function of sector c (first nest in the nested production structure in sector c)
$\gamma P12_c$	distribution parameter for labor in the CES production function of sector c (first nest in the nested production structure in sector c)
$\gamma P21_c$	distribution parameter for capital in the CES production function of sector c (second nest in the nested production structure in sector c)
$\gamma P22_c$	distribution parameter for energy bundle in the CES production function of sector c (second nest in the nested production structure in sector c)
$\gamma P31_c$	distribution parameter for non-electric energy composite in the CES production function of sector c (third nest in the nested production structure in sector c)

$\gamma P32_{el,c}$	distribution parameter for electricity (el) in the CES production function of sector c (third nest in the nested production structure in sector c)
$\gamma P4_{l,c}$	distribution parameter for non-electric energy input l in the CES production function of sector c (fourth nest in the nested production structure in sector c)
$\gamma T1_i$	distribution parameter for exports of sector i in the CET production function
$\gamma T2_i$	distribution parameter for domestic deliveries to domestic market of sector i in the CET production function
μH_i	subsistence households' consumption of commodity i
ρ	consumer's time preference rate
σA_i	elasticity of substitution between imports and domestic demand from domestic market for commodity i in the Armington function
$\sigma L1_l$	elasticity of substitution between capital and labor in sector l (second nest in the nested production structure in sector l)
$\sigma P1_c$	elasticity of substitution between capital-energy bundle and labor in sector c (first nest in the nested production structure in sector c)
$\sigma P2_c$	elasticity of substitution between capital and energy composite in sector c (second nest in the nested production structure in sector c)
$\sigma P3_c$	elasticity of substitution between electricity and other non-electric energy inputs in sector c (third nest in the nested production structure in sector c)
$\sigma P4_c$	elasticity of substitution between non-electric energy inputs in sector c (fourth nest in the nested production structure in sector c)
σT_i	elasticity of transformation in the CET production function

B.14. List of sets and subsets used in the model

c	a subscript for one of the production sectors, except coal, oil and natural gas sectors (32 sectors) and also a subscript for one of the commodities except coal, oil and natural gas (32 commodities)
ct	a subscript for wholesale and retail trade sector (1 sector) and also a subscript for wholesale and retail trade commodity (1 commodity)
$ctpa$	a subscript for land transport sector (1 sector) and also a subscript for land transport commodity (1 commodity)
$ctpr$	a subscript for railways transport sector (1 sector) and also a subscript for railways transport commodity (1 commodity)
$ctpw$	a subscript for water transport sector (1 sector) and also a subscript for water transport commodity (1 commodity)
el	a subscript for electricity sector (1 sector) and also a subscript for electricity commodity (1 commodity)
en	a subscript for one of the coal, oil, natural gas and electricity sectors (4 sectors) and also a subscript for one of the coal, oil, natural gas and electricity commodities (4 commodities)
gov	a subscript for the public administration sector (1 sector)
i	a subscript for one of the production sectors (35 sectors) and also a subscript for one of the commodities (35 types of commodities)

j	the same as *i* (used for exposition purposes)
l	a subscript for one of the coal, oil and natural gas sectors (3 sectors) and also a subscript for one of the coal, oil and natural gas commodities (3 commodities)
nct	a subscript for one of the production sectors except wholesale and retail trade sector, railways transport sector, land transport sector and water transport sector (31 sectors) and also a subscript for one of the commodities except wholesale and retail trade services, railways transport services, land transport services and water transport services (31 commodities)
nen	a subscript for one of the production sectors, except coal, oil, natural gas and electricity sectors (31 sectors) and also a subscript for one of the commodities, except coal, oil, natural gas and electricity (31 commodities)
ng	a subscript for one of the production sectors, except public administration sector (34 sectors)
t	a subscript for year *t* (current year)
T	a subscript for year T (last period in the model)
-1	a subscript for previous year (used in the description of the static setting of the model)