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Macroeconomic Policy Analysis of Slovak Republic with Focus on Foreign Trade - A Dynamic Computable General Equilibrium (CGE) Approach

Karol KORONCZI*

Abstract

Slovak Republic is in the process of transformation from a centrally planned to a market economy. Aiming to enter the European Union（EU), the country will become part of a common internal market. In so doing, it will become part of a customs union applying free movement of goods and services within the member states, without any tariff or non-tariff barriers and a common foreign trade policy in relation to third countries. The objective of this paper is to analyze the impacts of a medium and long term macroeconomic, foreign trade policy of Slovak Republic; the period under evaluation is from year 1996 to 2006. This research aims to find out how the abolishment of tariffs and non-tariff barriers in relation to EU countries and the foreign trade policy unification will influence the development of Slovak Republic's balance of trade, aggregate domestic product and other macroeconomic indicators. In addition, the author also investigates the impacts of tax policy unification with the EU, owing to the existing differences. In particular, this article prepares a progressive, descriptive, and analytical tool called symmetric input-output（I-O）table, also referred to as Leontief-type of input-output table, for the Slovak economy. The data is then applied in a computable general equilibrium（CGE）model for analysis.

Tariff reduction consequential to EU accession has generally positive impacts to aggregate variables and also to sectoral development. However, it also creates pressure on trade balance deficit. It is recommended that foreign trade reform is linked with other policy measures. The impacts are moderate, not radical.

1. INTRODUCTION

Computable general equilibrium（CGE）modeling[1)] is a very progressive tool of policy analysis and policy control. Slovak Republic（Slovakia), as part of the former socialist block, has a 40-year history of central planning, and after 10 years of independence still lacks such economic tools[2)]. Scandizzo（2000）provides a CGE model for the Slovak economy, but it utilizes Social Accounting Matrix（SAM）data from early stages of transformation when Slovakia was still part of Czechoslovak federation, and therefore it is questionable how truly the model reflects the current situation. In Scandizzo's work, the SAM itself had been estimated and forecasts based on Italian input-output（I-O）data from 1984.

The research presented in this paper is, however, new in several respects, and in its substance can

＊Doctoral Student, Graduate School of International Development, Nagoya University
koronczi@euromail.sk

claim to be the first of its kind. This research utilizes I-O and other data that is most recent (benchmark year 1996) and very detailed (47 by 47 industrial sectors in their original version). Although the I-O coefficients are estimates, the bases of data and aggregate values are real, taken purely from Slovak economy; this data is compatible with the System of National Accounts (SNA) 1993 and the European System of Accounts (ESA) 1995. The CGE model in this research has been designed to make it possible to analyze the whole economy with any sector, and not only some specific one, e.g. agriculture.

Although the CGE model here is applied to foreign policy analysis, it is not the only possibility for application. Once the model is built, with slight adjustments it can be applied for various analyses. Although CGE models should not be considered as a nostrum, they can serve as policy laboratories within the process of broad policy analysis. According to Sadoulet, and de Janvry (1995, p. 362), the main linkages among the different economic and social sectors of the economy can help one understand the ramifications and trickle-down effects induced by a policy or shock.

By joining the European Union (EU)[3], Slovakia will become part of a common internal market. In so doing, Slovakia will become part of a customs union applying a free movement of goods and services within the member states, without any tariff or non-tariff barriers and a common foreign trade policy in relation to third countries.

The objective of this paper is to build a CGE model for the Slovak Republic in order to evaluate the medium and long term development of foreign trade after joining the EU, and to analyze future trends. The focus is on evaluating the impacts of foreign trade policy on the output, industrial structure and balance of payments, with special regard to the trade balance. The current general opinion is that economic impacts of European integration are positive; analysis provided in this paper should confirm this assumption. Developing and implementing a macroeconomic model reflecting the economical reality as truly as possible, facilitates the analysis of the impacts of changes in foreign trade policy, and whether these changes are positive, negative or relatively neutral in relation to the whole Slovak economy.

Even though the international trade of Slovakia is liberalized, this does not mean that it is compatible with the international trade of EU. Therefore, it will be necessary to find out how the impacts of abolishment of tariffs and non-tariff barriers in relation to EU countries and the impacts of foreign trade policy unification will influence the overall development of Slovakia's balance of payments, the balance of trade and the aggregate domestic product. In addition, the author also investigates the impacts of tax policy unification with the EU, owing to the existing differences.

The difficulty of building a CGE model for the Slovak economy is in collecting data necessary for the model. In order to build a CGE model, it was necessary first to create a database for the model, with as detailed data as possible. This step is the most difficult and critical point of building the Slovak model, because due to the transition the officially available data is scattered and most of the time

inconsistent from year to year. The macroeconomic data is collected by various central authorities using different methods and with different bases of data, and therefore their comparison and use for analysis is hardly possible. The data used in this study is adjusted only for this model, in order to create a database compatible with the double-entry system of accounting. In particular, this article prepares a symmetric I-O table for Slovakia; the data is then applied in a CGE model.

The structure of this article is as follows: In section 2, a brief overview of the Slovak economy during the transition period described by general macroeconomic indicators is given. Section 3 provides the analysis itself, where dynamic CGE modeling is applied, incorporating an I-O approach. Focusing on quantifiable measures, such as tariffs and taxes, section 4 evaluates the impacts of trade liberalization in Slovakia and the possible impacts of European integration, anticipated around year 2005 according to optimistic prognoses, and year 2010 according to more careful ones. An analysis of various economic policy impacts is provided, by setting up different patterns of strategies of macroeconomic development. Fortran computer code is applied for model implementation. In section 5, conclusions are drawn on the obtained results and suggestions for further policy implications made.

2. PERFORMANCE OF THE SLOVAK ECONOMY AFTER INDEPENDENCE

It has been 12 years since Slovakia started its transition process from the previous political and economical establishment, which was built on the central role of the government. Slovak reforms began in 1990 under the Czech and Slovak Federal Republic (CSFR). Stabilization policy was broadly maintained by the federal authorities in 1992 (OECD 1994, p. 7), although the implementation of structural policy, which was more influenced by the republics, slipped. The reforms were continued after Slovakia became a sovereign state on January 1, 1993. The reforms and the country's liberal trade rules have been effective and are complemented by the country's generally open direct investment regime (WTO 1995, p. 1).

A result of Slovakia's transition, the country's trade pattern has changed fundamentally since 1989. Czechoslovakia was more dependent on socialist trade than other central and eastern European countries, except for Bulgaria (OECD 1991, p. 13). Exports to and imports from socialist countries made up more than 60.0% of total exports and imports. Czechoslovakia was therefore more vulnerable to the collapse of Council for Mutual Economic Assistance (CMEA)[4] trade than Hungary and Poland. The collapse of CMEA trade was felt most strongly in 1991 and was replaced in 1992 by a positive impulse arising from the continuing increase in exports to the Organization for Economic Cooperation and Development (OECD) area. Most trade in 1989 was with the Soviet Union and other central and eastern European countries (WTO 1995, p. 1). Excluding trade with the Czech Republic, which is Slovakia's largest trading partner, the share of Slovakia's merchandise exports sold to industrialized countries in western Europe increased from 19.0% in 1989 to 71.0% in 1994. As much as 91.0% of all merchandise imports and exports are exchanged with European countries, including Russia.

Slovakia is an original member of World Trade Organization (WTO); it has joined the OECD as the 30th member country after Korea in fall 2000. It is said, that joining the OECD is the first step towards the EU, since all EU members are part of OECD. One of the results of political changes after 1989 was that Slovakia began the process of political and economical integration on the European continent (Kunová and Nováčková 2000, p. 5). The Slovak Republic formally applied for EU membership at the EU summit in Cannes in June 1995.

On the summit in Amsterdam[5] the EU made an agreement to develop a European Union, which will support mutual economic and social development, first of all by creating an area without borders, and by implementing an economic and monetary union (Nováčková 2000, p. 137). A common market is defined as market without internal borders, where there is, in harmony with the European Community Treaty (EC Treaty)[6], guaranteed free movement of goods, persons, services and capital. It creates a customs union, which unifies the system of tariffs between the member states. The goal of customs union is to introduce a unified customs policy in business relations to third countries, especially to apply a unified tariff system (Nováčková 2000, pp. 142-146). By joining the EU, Slovakia would also belong to the EC Treaty. According to Article 23 of the Treaty, it would become part of customs union, which covers all trade with goods and prohibits export and import tariffs and other fees with similar effect between the member countries, at the same time unifying the tariff system in relation to third parties.

A condition for successful functioning of the common market is the harmonization of tax policy within the EU. According to Article 90 of the EC Treaty, member countries shall not, directly or indirectly, subject the goods of other member countries to a regime of higher taxation than the one which is applied to similar domestic products (Nováčková 2000, p. 148). The member shall not apply an internal taxation on products of other members, which would provide indirect protection for domestic products. Article 28 makes quantitative limitation of imports or any other arrangements with similar effect prohibited between the member countries (Nováčková 2000, p. 149). Discrimination based on country of origin and quantitative restrictions of import are prohibited.

2.1 GENERAL ECONOMIC PERFORMANCE

Slovakia started its economic transition as part of CSFR after the Velvet Revolution on November 17th, 1989.

While before World War Two, Czechoslovakia was among the world's fifteen most developed economies with a per capita GDP comparably almost the same as that of Austria, in 1990 the per capita GDP was no more than two fifths of that of Austria (OECD 1999a, p. 1). If the Czech and Slovak Republics wanted to redevelop their economy, major structural changes were required. These kinds of changes have been taking place in the OECD nations for 40 years, while 40 years of central planning and close political and economic ties with the Soviet Union led to relative economic decline in

Czechoslovakia（OECD 1991, p. 9）.

While the Czech areas of the Federal Republic had a durable economic base from before the Second World War, the Slovak Republic's economy was more fragile, hastily constructed and dependent（OECD 1996, p. 127）. For the purpose of this study, January 1st, 1993, when Slovakia was established as an independent, sovereign state, will be the initial point of research, for the purpose of compatibility and comparability of data.

The performance of Slovak economy is generally summarized in Table 1.

Table 1: Selected indicators of economic development in Slovakia

	Note	Unit [7]	1993	1994	1995	1996	1997	1998	1999	2000
GDP at constant prices (1995=100)	1, 8	SKK billions	487.6	511.6	546.0	579.9	615.9	641.1	653.3	667.7
GDP at constant prices (1995=100)	2	USD millions	14,966	15,088	17,380	17,972	17,456	17,385	15,774	14,452
GDP per capita at constant prices (1995=100)	2	SKK	86,542	90,399	96,351	102,474	109,000	113,660	121,086	123,634
GDP per capita at constant prices (1995=100)	2	USD	2,811	2,822	3,240	3,344	3,243	3,225	2,924	2,676
GDP (const.) index (same period of previous year=100)	1, 8	index	96.3	104.9	106.7	106.2	106.2	104.1	101.9	102.2
GDP at current prices	1, 8	SKK billions	390.6	466.2	546.0	606.1	686.1	750.8	815.3	887.2
GDP at current prices	2	USD millions	11,988	13,749	17,380	18,785	19,452	20,356	19,685	19,203
GDP per capita at current prices	3	SKK	69,308	82,372	96,341	107,111	121,455	133,144	151,131	164,287
GDP per capita at current prices	2	USD	2,251	2,571	3,240	3,495	3,613	3,778	3,649	3,556
GDP (curr.) index (same period of previous year=100)	1, 8	index	111.1	119.4	117.1	111.0	113.2	109.4	108.6	108.8
Exchange rate SKK/USD	2	ratio	30.79	32.04	29.74	30.65	33.62	35.24	41.42	46.20
Consumer prices (end of period)	1, 4	index	125.1	111.7	107.2	105.4	106.4	105.6	114.2	108.4
Consumer prices (cumulative average)	1, 5	index	123.2	113.4	109.9	105.8	106.1	106.7	110.6	112.0
Industrial production index (end of period)	1, 4, 9	index	-	-	-	-	-	-	96.4	109.1
Industrial production index (cumulative average)	1, 5	index	117.2	110.0	109.0	104.1	104.5	103.3	103.8	109.5
Unemployment (end of period)	1, 6	thousands persons	368.1	371.5	333.3	329.7	347.8	428.2	535.2	506.5
Increase	1	thousands persons	107.8	3.4	-38.2	-3.6	18.1	80.4	107.0	-28.7
Unemployment rate	1, 6	percent	14.4	14.8	13.1	12.8	12.5	15.6	19.2	18.2
Change	1	percent	4.0	0.4	-1.7	-0.3	-0.3	3.1	3.6	-1.0

Notes:

1. Source: National Bank of Slovakia
2. Source: Statistical Office of the Slovak Republic
3. Calculated by author as GDP per capita at current prices in USD x exchange rate
4. 12 month rate of inflation (measured in December) - compared with December of previous year
5. Average figure since beginning of the year - compared with the cumulative figure of the previous year
6. On the last day of the period under review
7. SKK stands for Slovak Crown, USD for American Dollar
8. Data for 1997 - 2000 are preliminary
9. Preliminary data

Source:

National Bank of Slovakia and Statistical Office of the Slovak Republic

2.2 PERFORMANCE OF FOREIGN TRADE AND THE TRADE REGIME

Slovakia is a small economy with a strong dependence on the external sector (OECD 1999b, p. 10). On one hand, Slovakia was endowed in the pre-transition period with large production capacities in heavy industries that cannot at present possibly find outlets either in the domestic market or even in its former trade partner in Eastern Europe. The reason is that these countries also have excess capacity in the same sectors. These heavy industries have been a major source of export revenues from new markets in the West. On the other hand, Slovak consumers and enterprises have increasingly demanded more product variety and quality, which does not find a direct counterpart in domestic supply. Therefore, many consumption goods as well as investment goods have to be imported. This strong dependence on external trade implies growth to be export led; relying on domestic demand could easily generate macroeconomic imbalances.

The largest tradable item in Slovak Republic in recent years is machinery and transport equipment, and that in exports (37.4%) and imports (40.3%) (1998 data). Exports of this class have recently more than doubled, which might be a good sign of transformation of Slovak industry. The most probable reason for this increase was the orientation of the Slovak firms toward the OECD countries and a success on their markets. The second position in tradability is not so dominant. There are several items traded in very similar volumes. Among imports, fuels and related products, chemicals and related products, intermediate manufactured products and miscellaneous manufactured articles were traded in similar volumes. All together they account for almost 50.0% of total imports. On the export side, intermediate manufactured products take second position with 30.0%, miscellaneous manufactured articles third with 12.7%, and chemicals and related products take fourth position with 8.9%.

The direction of Slovak foreign trade has changed quite dramatically in the last decade. During the socialist period of the former Czechoslovakia, the major part of foreign trade was oriented to the Central and Eastern European countries and the former Soviet Union. There has been a great shift of trade from these markets to the markets of mostly OECD countries. Slovak companies were able to achieve this shift especially thanks to the change in the structure of their exports. Parallel to the change in export structure, a change in imports occurred. The total balance of foreign trade is negative; there have been quite significant increases in the volumes of traded goods and services. This is certain proof that the transformation process of Slovak companies is successful, since the Slovak companies are able to allocate their products to new developed markets.

As for the Slovak trade regime, the foreign trade was regulated through a foreign exchange plan. Therefore the tariffs were already at that time generally low, averaging about 5.0%. Since 1992, the tariff structure was reviewed several times, with a view to provide domestic industries with appropriate protection. These are in accordance with WTO, since the Slovak Republic is one of its

founding members. Slovak Republic grants at least m.f.n. (most favored nation) treatment to all WTO members, as well as to many other countries with which it has bilateral agreements calling for m.f.n. treatment (WTO 1996, p. 27).

Accession to the EU implies the adoption of the common external tariff of the EU by Slovak Republic. A comparison of the Slovak and EU m.f.n. tariff rates suggests that adoption of the common external tariff should not give rise to any major difficulties. The tariff rates are shown in Table 2.

Table 2: Sectoral comparison of m.f.n. tariffs, the Slovak Republic and the EU

Product	Slovak tariff	EU tariff	Difference
Animals, animal products	2.5	8.6	6.1
Vegetable products	1.8	6.5	4.7
Animal and vegetable oil	8.7	8.3	-0.4
Beverages, tobacco	9.4	20.1	10.7
Minerals and fuels	1.8	0.9	-0.9
Chemical products	4.6	4.3	-0.3
Plastics	5.6	6.0	0.4
Leather and hides	2.4	3.2	0.8
Wood products, excluding furniture	4.2	2.7	-1.5
Pulp and paper	8.7	5.1	-3.6
Textiles and clothing	7.9	9.6	1.7
Footwear and headgear	9.4	8.8	-0.6
Glass and cement	9.2	4.5	-4.7
Jewelery, precious metals	2.4	1.3	-1.1
Base metals and products	4.8	4.0	-0.8
Machinery and equipment	5.3	3.1	-2.2
Transport equipment	8.0	5.4	-2.6
Precision instruments	4.2	3.7	-0.5
Arms	3.2	3.5	0.3
Furniture, toys, miscellaneous manufactures	7.2	4.3	-2.9
Art works, antiques	1.4	0.0	-1.4
All products (8620 items)	5.8	6.0	0.2

Source: National tariff schedules. In: (World Bank 1998, p. 24)

Besides the tariff regime, the government of Slovak Republic quite frequently applies a so-called import surcharge. It is imposed on 80.0% to 20.0% of all imports with a flat rate. The hierarchy of measures related to foreign trade besides tariffs is presented in Table 3.

Table 3: Import surcharge applied by Slovak Republic and other measures

Period:	Measure taken:
1991. 01. 01.	Implementation of 20.0% import surcharge for a short time.
1994. 03. 03.	Implementation of 10.0% import surcharge.
1996. 07. 01.	Reduction of import surcharge to 7.5%.
1997. 01. 01.	Abolition of import surcharge.
1997. 05. 01.	Imposition of imports deposit scheme.
1997. 07. 21.	Implementation of 7.0% import surcharge.
1997. 08. 01.	Tightening the system of quality certificates of imports (more strict).
1998. 01. 01.	Reduction of import surcharge to 5.0%.
1998. 04. 01.	Reduction of import surcharge to 3.0%.
1998. 08. 01.	Exchange rate regime is set to floating.
1998. 10. 01.	Abolition of import surcharge.
1999. 01. 01.	Implementation of 7.0% import surcharge.
1999. 07. 01.	Abolition of import surcharge.
2001. 01. 01.	Abolition of industrial tariffs from EU.
2001. 01. 01.	Abolition of import surcharge system.

Source: Compiled by author from various sources

As part of non-tariff policies, non-automatic imports licensing is applied in the Slovak Republic. It is applied to only one significant product - coal (World Bank 1998, p. 24). Non-automatic export licensing is used to monitor and control the exports of narcotics, poisons, arms as well as a limited number of "sensitive" goods such as coal, meat, dairy products, wood and certain minerals. Licenses are allocated on a first-come, first-serve basis until the quantity limit specified in the relevant Ministerial decree has been reached. Under the Europe Agreement, all such restrictions were to be eliminated by 2002.

In order to meet its commitments under the Europe Agreement[7], Slovakia eliminated all tariffs on industrial imports from the EU by 2001, including the import surcharge.

3. CGE MODEL

The main point of this study is to build a CGE model for the Slovak economy. Slovak Republic, as part of the former socialist block has a 40-year history of central planning, this paper is the first attempt to build a CGE-type model after 10 years of independence. Due to transition of its economy, and the separation from the former Czechoslovakia, Slovakia had to undergo major changes in its system of statistics. In order to build a CGE model, it is necessary first to create a database for the model, with as detailed data as possible. This step is the most difficult and critical point of building the Slovak model, because, due to the transition, the officially available data is scattered and most of the time inconsistent from year to year.

3.1 Estimation and adjustment of data used in the model

This section covers summary of data needed for the model construction, the description of this data and listing of its sources. In areas, where data is insufficient for some reason, e.g. inconsistency, different base of data, and different data grouping, it is adjusted by recalculating this data by various coefficients. In areas where there is no data available, estimation is applied.

3.1.1 Input-output table estimation

I-O data, which can be obtained from I-O tables, create the core of data used as inputs for the model. The lack of an official symmetric I-O table of the Slovak Republic created a need to estimate this data[8].

Goods and services produced for sale in the market at economically significant prices may be valued either at basic prices or at producers' prices. Purchasers' price is the amount paid by the purchaser, excluding any deductible VAT or similar deductible tax, in order to take delivery of a unit of a good or service at the time and place required by the purchaser (UN 1999, pp. 55-56). The purchasers' price of a good includes any transport charges paid separately by the purchaser to take delivery at the required time and place. It should be noted that in business accounts, freight-in costs are normally separated from the purchased value of goods if these costs are paid separately. Producers' price is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any value added tax (VAT), or similar deductible tax, invoiced to the purchaser. It excludes any transport charges invoiced separately by the producer. Basic price is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output, minus any tax payable, and plus any subsidy receivable, on that unit as a consequence of its production or sale. It excludes any transport charges invoiced separately by the producer.

For simplicity it can be written:

basic price
+ taxes less subsidies
= producers' price
+ trade and transport margins
= purchasers' price

An I-O table can be compiled by converting the supply and use tables, both at basic prices. As base data in this research, adjusted supply and use tables are used, which were obtained by making adjusting the original supply and use tables (SO SR 2000c).

The product-by-product I-O table[9] at producers' prices is presented in Table 4. The final product-

Table 4: Input-output symmetric table of Slovak Republic 1996 (mill. SKK, producers' prices, product by product, 6 by 6 aggregated version)

	1 Agricul	2 Mining	3 Light M	4 Heavy M	5 Constr	6 Service	Nominal U	Subtotal	Priv Con	Gov Con	Fixed Inv	Inventory I	Exports	T Final Use	Imports	Output
1 Agricul	21,736	88	18,950	5,148	858	10,776	0	57,557	25,750	650	863	1,011	4,961	33,235	-11,033	79,759
2 Mining	445	1,300	828	64,647	1,959	3,335	0	72,514	2,367	0	0	-5,928	2,371	-1,190	-57,401	13,922
3 Light M	5,131	166	27,908	2,947	821	14,780	0	51,753	87,234	0	0	1,211	17,156	105,601	-32,520	124,833
4 Heavy M	11,588	3,119	12,339	236,941	39,668	105,999	0	409,653	59,003	8,304	89,464	21,221	204,972	382,963	-246,083	546,532
5 Constr	546	117	546	5,356	24,062	16,479	0	47,108	1,505	51	95,192	167	3,557	100,472	-2,852	144,728
6 Service	11,249	1,558	24,382	63,719	24,706	174,044	15,528	315,187	143,106	123,076	21,901	0	101,728	389,811	-54,906	650,091
Subtotal	50,696	6,348	84,954	378,758	92,074	325,414	15,528	953,772	318,965	132,080	207,420	17,681	334,744	1,010,890	-404,796	1,559,866
Wage	16,398	3,153	17,955	64,021	20,585	144,758	0	266,869								
Capital Inp	10,051	2,617	13,580	72,477	26,956	161,897	-15,528	272,050								
Ind T	2,835	1,963	7,418	27,387	4,634	21,658	0	65,896								
Other T - S	-221	-159	926	3,889	479	-3,635	0	1,280								
Total	79,759	13,922	124,833	546,532	144,728	650,091	0	1,559,866								

Notes:

Agricul - Agriculture

Mining - Mining

Light M - Light Manufacturing

Heavy M - Heavy Manufacturing

Constr - Construction

Service - Services

Capital Inp - Capital Inputs

Ind T - Indirect Taxes

Other T - S - Other Taxes less Subsidies

Nominal U - Nominal Unit

Priv Con - Private Consumption

Gov Con - Government Consumption

Fixed Inv - Fixed Investment

Inventory I - Inventory Investment

T Final Use - Total Final Use

Source:

Author's calculations, based on data from SO SR (2000a) and estimated data

by-product I-O table of the Slovak Republic for 1996 at producers' prices in its detailed (47 by 47) structure and all other data in the same structure are available from the author.

Several basic conclusions can be drawn by looking at the data of the I-O table. On the side of inputs, the biggest industrial sectors are heavy manufacturing, with largest intermediate inputs, and the service sector, with largest value added. Almost two-thirds of total output is used for intermediate inputs. The rest is distributed between private and government consumption (about 45.0% of final consumption), investment (about 22.0% of final consumption), and exports (about 33.0% of final consumption). Imports are greater than exports, which creates a negative trade balance. The absolute largest intermediate inputs are into the heavy manufacturing sector. More than half of all wages are paid in the service sector. These two sectors are the target for capital investment. Although the greatest value-added creator is the service sector, the largest VAT payer is the heavy manufacturing sector. On the other side, sectors such as mining and agriculture seem to be subsidized. In total, the largest output creators are the service sector in first, and heavy manufacturing in second place. Average indirect (net subsidy) tax rate is 4.3%. Average yearly salary is 132 536 Slovak Crowns (SKK)[10]. Average rate of gross profit is 15.6% and of net profit is 9.6%. GDP created can be calculated as the sum of value added and the amount of indirect taxes collected. GDP created by the Slovak Republic in 1996 is 606 095 mill. SKK. The bulk of all exports is carried out by heavy manufacturing, which is also the biggest absolute importer. In relative measures, mining is the biggest importing sector. The domestic demand ratio of composite goods is about 75.0%.

One objective of this paper was to build an analytical and descriptive tool in the form of an I-O table, which can be used for several kinds of analyses. The data in supply and use tables and the symmetric I-O table can be integrated into macro-economic models to provide the latter with detailed data. It may be found useful by economists in production analysis; analysis of structure of demand, export ratio, structure of capital formation, final consumption, etc.; cost structure and productivity; relationship between domestic production and the environment; imports of energy required; impact analysis of new technologies; sensitivity analysis of the effects of changes in tax rates and regulation; prices; employment; analysis of investment and capital; etc.

The strong point of the I-O data constructed in this article is that it is consistent and very detailed (in the original version). The weak point is that this is just a first attempt to create such data, and therefore includes many estimations made that would be more reliable, if made by the authorities with the power to collect real data. Also it would be more useful if there was such data available for several years in sequence, to make comparison and growth analyses possible.

By constructing a CGE model for the Slovak economy, the author's attempt was to demonstrate a way to apply this data for analysis of foreign trade issues. The data from the I-O table is used as core data for the model. This research also discusses data additional to this I-O data - estimation of capital stock and employment.

3.1.2 Employment data

Another group of data necessary to build a functioning CGE model is data on employment, which create the base for data of labor input, i.e. stock of labor force. Some countries report their data on labor stock as part of their I-O tables. Labor stock data presented in the Slovak Statistical Yearbook is not sufficient, because it is aggregated into only a few major groups. For this research, labor stock data has been obtained from a source whose name is not published but may be considered as official. The obtained data is grouped differently than the original 47 by 47 I-O table. Therefore, labor stocks have been redistributed into the 47 sectors based on an assumption of average wage within a group.

Data on stocks of labor in its structured classification is available directly from the author.

3.1.3 Data on stocks of fixed assets

This data is also unavailable from official sources in detailed grouping. Therefore we use data from the same source as the data on labor stock and consider it official. The original data is grouped almost exactly as our I-O table; therefore the only adjustment done is taking the average of fixed asset stock from the beginning and the end of the period under discussion. In our case, the average of stocks of fixed assets from the beginning of 1996 and the end of 1996 has been calculated.

Data on stocks of fixed assets in their structured classification is available directly from the author.

3.2 Equations of the model and description of the model

The CGE model of Slovak Republic presented in this paper is constructed for the benchmark year 1996. It consists of 6 sectors: 1) agriculture, 2) mining, 3) light manufacturing, 4) heavy manufacturing, 5) construction sector and 6) service sector. The basis is the estimated 1996 input-output table of 47 sectors, presented in section 3.1.1. The capital stock and labor input is also estimated to a certain level, as explained in sections 3.1.2 and 3.1.3.

The system of equations of the model is presented in the Appendix. This system is generally the same as the open economy model of Dervis, de Melo, and Robinson (1982), although, this paper constructs several versions of the model, especially with regard to labor market. The reason of so doing is that the labor market is one of the most critical areas of the Slovak economy, giving very high unemployment rates, leading to a thought, whether it is actually in equilibrium, as the Dervis, de Melo, and Robinson model. Because of data availability, our model also simplifies the original Dervis, de Melo, Robinson model by replacing production and composite goods functions of Constant Elasticity of Substitution (CES)[11] type by those of Cobb-Douglas (CD) type. Utility function is of CD type in both models. On the other hand, this model expands the Dervis, de Melo, Robinson model by introducing SNA related variables such as GDP, sectoral GDPs, implicit deflators etc. This system consists of five major markets for labor, capital stock, products of 6 industries, money (investment

fund), and the foreign exchange market, and includes about 190 variables (most of which are endogenous) and about 150 parameters. Among five markets, we have assumed only quantity adjustment for the market of capital stocks. The model can assume either price or quantity adjustment for the remaining four markets. Price adjustment means to attain supply-demand equilibrium by change in price. Quantity adjustment means to attain supply-demand equality by change in quantity with the level of price given exogenously.

The system of equations in the Appendix deviates from the Dervis, de Melo, Robinson model in formulation of labor market. This paper presents three versions of the model, referred to as Model 1, Model 2 and Model 3.

In case of Model 1, labor market is formulated similarly to the Dervis, de Melo, Robinson Model, assuming equilibrium between demand and supply of labor. In Model 2 and Model 3, the system does not assume equilibrium between labor demand and labor supply.

In Model 2, in each of the five non-agricultural sectors ($i=2,...,6$), nominal wage (W_i) is given exogenously as policy variable, and the marginal condition (equation A.6.2-1) determines demand for labor (L_i), while input of agricultural labor (L_1) is determined as residual by the difference between total supply of labor ($\bar{L}^s$) and total non-agricultural demand for labor (equation A.6.2-2). This formulation, which follows the dualistic development model of Lewis, is applied in order to get more realistic simulation of the Slovak economy with surplus labor in the market. Wage for the market with surplus labor is imputed by marginal productivity (equation A.6.2-3).

In Model 3, surplus labor is shifted to the service sector. Therefore in each of the five non-service sectors ($i=1,...,5$), nominal wage (W_i) is given exogenously as a policy variable, and the marginal condition (equation A.6.3-1) determines demand for labor (L_i), while input of service labor (L_6) is determined as residual by the difference between total supply of labor ($\bar{L}^s$) and total non-service demand for labor (equation A.6.3-2). This formulation appears to give quite realistic results. Wage for markets with surplus labor is imputed by marginal productivity (equation A.6.3-3).

The system of equations used here includes another deviation from the Dervis, de Melo, Robinson model, in the aggregate budget constraint leading to the Walras' Law[12] (equation A.46.), by which this model regards the balance between nominal savings (domestic savings (S) and foreign capital inflow (F)) and nominal investment (I^n+J^n) as the equilibrium condition that determines prices in their absolute levels. That is to say, the balance equation ($S+F-I^n-J^n=0$) is dropped as the redundant equilibrium condition in solving the system, so that the corresponding price of nominal investment (I^n+J^n) in SKK is set at the unitary level (SKK=1.0 naturally) as the price of numēraire, resulting in the determination of other prices in their absolute levels. In this model, the exchange rate (ER) or the price of US$ in SKK changes freely, to be determined at the absolute level with SKK as numēraire so as to attain equilibrium in the foreign exchange market (equations A.35 and A.46). Product prices (PX_i) also change freely to be determined at the absolute level with SKK as numēraire so as to attain

the equilibrium in the product markets (equations A.34 and A.46). Nominal wages are defined variously, in models 1 through 3. In Model 1, nominal wages are endogenous, so that they may appreciate or depreciate against SKK as numēraire. The investment-savings balance is thus the key equilibrium condition that determines all of the prices in terms of SKK absolutely.

4. EVALUATION OF OPUTPUTS FROM MODEL SCENARIOS

This section includes the actual outputs from the model; the method of calibrating the variables for standard scenarios of Model 1, Model 2 and Model 3; description of the standard scenario with structure of output data in the benchmark year 1996; description of various simulation scenarios; and the comparison of various outputs, which are generally divided between quantity variables and price variables. A few ideas to improve the possibilities of the model are presented in the final part of this paper.

4.1 Basic Model - Standard Scenario (1996 - 2006)

Considering the situation of Model 1, which is the main model in our simulations, this model attempts to obtain a standard scenario to be used as the basis of comparison. It gives the following growth rates of real output: 7.5% for agriculture, 6.5% for mining, 8.0% for light manufacturing, 7.5% for heavy manufacturing, 9.0% for construction and 8.0% for services, giving approximately 8.0% for real GDP in terms of value added. In this model, real GDP by sector is defined by method of double deflation (equations A.43 and A.44 in Appendix), so that growth rate of real production is identical with the growth rate of real GDP in each sector unless coefficients of intermediate inputs are changed. Nominal GDP in the model is defined by equation A.40-3, although all three equations (A.40) should give the same results. The Leontief-type fixed coefficients are assumed for intermediate inputs while CD type is assumed for primary factors in the definition of double deflation method. The results of the standard scenario are made close to the conditions of the real economy as much as possible by changing several selected exogenous variables and parameters. Selected columns of Table 6 and Table 7 present the results of the standard scenario; only selected variables are presented here, as there are around 200 of them in total.

In other words, the standard scenario is obtained by adopting the following assumptions: for the exogenous variables, 5.0% growth of labor supply, 8.0% growth of foreign capital inflow, 10.0% growth of nominal investment change is assumed for depreciation, private savings, government savings, and for the yearly Engel coefficient[13]. For the scale parameters of CD sectoral production functions and for the intermediate input coefficients, no changes are assumed in all of the six sectors. For the scale parameters of sectoral export functions, 10.0% in terms of growth rate are assumed respectively for each of the six sectors. For the other two models, some additional assumptions are made, such as 10.0% growth of non-agricultural nominal wages in case of Model 2, and 10.0% growth of non-service

nominal wages in case of Model 3. For the dynamic par of year-to-year changes, the standard scenario adopts a dynamic simulation by allocating more investment to industries with higher profit rates (equation A.48.1).

Solutions of the model, including the standard scenarios, are obtained by using the Gauss-Seidel method[14]. The convergence criterion is set strictly at the level of 10^{-16} in terms of mean squared errors, so that the number of iterations borders with 10 000 in each of the eleven years of the period under assumption. The system is quite robust, almost always giving converged solutions under various drastic shocks with this severe criterion. It is also clear that the basic scenario in this case satisfies the budget constraint that leads to the Walras' Law (equation A.46). The first two terms ($W \cdot L$, $R \cdot K$) must both be zero identically due to the adoption of quantity adjustment. The next six terms ($PX_i \cdot X_i$) for six industries and the last term ($ER \cdot \$$) for US dollars, in which the price adjustment is adopted by assuming the market equilibrium, are computed as almost zero within the range of unavoidable errors. The balance between savings and investment (or demand and supply equilibrium for money), on the other hand, was dropped as redundant in the computation of standard scenario because of Walras' Law. It is possible to confirm that the model solutions satisfy the equilibrium condition ($S+F-I^n=0$) within the range of unavoidable errors though the computation is made without using that condition; it is also possible to confirm that the computation was made without errors.

According to the standard scenario of Model 1, real GDP (YR) is projected to grow at 7.9%, which is in accordance with the target rate. Inflation in terms of GDP deflator (PY) is projected to be 2.2%, a little lower than the target rate, but its direction is correct. Employment growth rate is highest in construction (LD5) followed by light manufacturing (LD3). Growth in general is supported by growth in investment, which is exogenous. Nominal investment (IN), when assumed to grow at 10.0%, causes real investment (IR) to grow at 9.3%, which is an optimistic value. Part of this investment is expected to be financed by foreign capital (F$), which is assumed to grow at 8.0%. This inflow of foreign capital is projected to cause a small depreciation of the Slovak Crown (RE).

The standard scenario of Model 2 differs from that of Model 1 in solution of the labor market. Employment absorption by non-agriculture (LD 2 to LD 6) is very poor and creates a high growth rate in agriculture labor (LD1 of 22.9%). This is due to the decreasing imputed wage in agriculture (PL1), which after some time even crosses the zero line[15]. Values of all other key variables (GDP, inflation, etc.) are projected to be similar to those of Model 1.

The standard scenario of Model 3 differs from that of Model 1 also in solution of the labor market. Employment absorption by non-service (LD 1 to LD 5) is slightly better than that of agriculture in Model 2, and creates a high growth rate in service labor (6.6%). The imputed wage in services (PL6), with highest wage rate in the economy, increases more slowly than the non-service wage, generating an equalization trend in income distribution. Values of all other key variables (GDP,

inflation, etc.) are projected to be similar to those of Model 1.

4.2 Comparison of model scenarios

In this section, the paper presents a number varieties of dynamic simulation[16] that differ from the standard scenario by changing not only the method of extrapolating exogenous variables and parameters, but also the framework of the model. Focusing on the transformation period between 1996 and 2006, the paper covers analysis of the Slovak economy in the medium and long run, on the basis of dynamic CGE modeling. Three models, named Model 1, Model 2 and Model 3, were explained in the previous section. The same simulation in different models was assigned the same numbers. For example, gradual abolition of import tariffs and the import surcharge is designated to simulation number 5 in Model 1. Therefore, simulation number 5 in Model 2 and also in Model 3 has the same characteristics, examining the impacts of gradual import tariff and import surcharge abolition, but under different conditions rising from the definition of the given model.

The characteristics of standard scenario of Model 1 are as follows:

- simulation for years 1996 - 2006;
- competitive labor market (equilibrium wage for the economy) - Model 1;
- imputation of self-employed persons' wages;
- flexible exchange rate, endogenous exchange rate;
- growth of labor supply is 5.0%;
- growth of wage rate is 10.0%;
- depreciation rate is 0.0%;
- growth of foreign capital inflow is 8.0%, exogenous foreign capital inflow (F$);
- saving rates are constant;
- Engel coefficient growth is 0.0%;
- growth rate of nominal investment is 10.0%, nominal investment is exogenous; capital supply is the function of capital supply over time;
- real investment (IR) is endogenous;
- real change in stocks (JR) is endogenous;
- capital demand changes according to the capital supply (with the same pace as the capital supply); capital demand is the function of capital demand over time;
- money aspects are not relevant, because the model is analyzing real flows in the economy (no money flows are introduced in the model) - growth of money supply is 0.0%;
- growth rate of the scale parameter of Cobb-Douglas production function is 0.0% for each sector;
- intermediate input coefficients are constant, growth rate is 0.0%;
- growth rate of scale parameters of sectoral export function is 10.0%;
- benchmark scale parameters of exports, imports and production are calculated based on 1996 data;

- investment is allocated to industries with higher profit rates (equation A.48.1);
- price elasticity of export demand function is 1.0 for each sector.

The specifications of the standard scenario of Model 2 are the same as for Model 1, except for the following:

- non-competitive labor market (wage for the agricultural sector is determined endogenously, as a residual; assumption that excess labor goes to agricultural sector) - Model 2;
- growth of non-agricultural labor supply is 5.0%;
- imputation of all agricultural wages by marginal productivity.

The specifications of the standard scenario of Model 3 are also the same as for Model 1, except for the following:

- non-competitive labor market (wage for the service sector is determined endogenously, as a residual; assumption that excess labor goes to service sector) - Model 3;
- growth of non-service labor supply is 5.0%;
- imputation of service wages by marginal productivity.

As for the simulation specifications, they are the same in all of the three models. The differences between the standard scenarios and various simulation scenarios are specified in Table 5.

Table 5: Simulation scenarios[17]

Scenario	Contents
S1	Increase of foreign capital inflow growth to 15.0%
S2	Increase of nominal investment to 15.0%
S3	Abolition of import tariffs and import surcharge in 1997
S4	Adjustment of import tariffs and import surcharge to EU levels linearly for the period 1997-2006
S5	Abolition of import tariffs and import surcharge in 1997, under fixed exchange rate regime (exog. exchange rate, endog. foreign capital inflow)
S6	Decrease of corporate income tax by 15.0%
S7	Adjustment of price elasticity of export demand function to 1.0, 0.5, 0.6, 0.5, 0.8, 1.0 respectively for each sector
S8	S1 + S3 + S6 + S7
S9	S1 + S2 + S3 + S6 + S7
S10	Decrease of foreign capital inflow growth to 0.0%, decrease of nominal investment to 0.0% + S3 + S6 + S7

Source: Author

4.3 Model output evaluation

The outputs from all simulations are available in the same structure as for the baseline simulation, with detailed data on each variable in a numerical form. For convenience of comparison, this paper presents only the results compared with the baseline simulation of the given model by an index, in Table 6 and Table 7.

Results of simulation 1 show that an increase of foreign capital inflow into the Slovak economy causes all prices to go down, including the GDP deflator. Inflow of capital into the economy causes increase of imports and decrease of exports. The effect on the GDP is positive, where real GDP growth shows a slightly positive value.

Results from simulation 2 are readily comparable with common sense and also with the nature of the CGE model - an increase of nominal investment causes all prices to increase, with the result that all real variables remain unchanged, i.e. constant. Nominal GDP increases proportionally with increase of nominal investment.

Abolition of import tariffs in simulation 3 has just a minimal effect on the level of total imports. Usually, decrease of import tariffs leads to decrease in sectoral import prices, naturally resulting in increase of imports. In the case of floating exchange rate model of Slovakia, the results show that the exchange rate (which is set as means of reaching equilibrium in the system) is very elastic and highly sensitive to changes in tariffs. The abolition of tariffs causes the exchange rate to increase almost proportionally with the increase of import prices and with the decline of tariff rates. The table with figures founded to hundredths, shows almost no change in imports, although in fact imports do not remain constant. All other prices in the system decrease. Exports increase, real investment increases and there is again a slight increase of real GDP. Tariff reduction has a positive effect on real

production, which increases in all sectors, and decreases slightly in the service sector. The largest positive effect on real production can be observed in the mining and heavy manufacturing sectors. Labor force tends to shift from the service sector to all other sectors.

The nature of aggregate results in simulation 4 is very similar with those in simulation 3, but their size is smaller, because the aggregate change by adjusting the tariffs to the EU level is smaller than the effect of their total abolition. However, differences are expected on the sectoral level. Simulation 3 and simulation 4 were also carried out in Model 2 and Model 3. In Model 2, the impact on real GDP is negative; supporting the previous statement[18] that Model 2 does not always give acceptable results. Aggregate results of Model 3 are quite similar to those of Model 1, but they differ on the sectoral level.

Simulation 5 is designed to analyze a situation where the exchange rate is fixed. If the exchange rate is fixed, the effects of the reduction in import tariffs can be clearly seen. Price variables go down, except for the exchange rate and price of imports. Although the exchange rate is fixed, (i.e. set to be constant, in comparison with the baseline scenario, which is based on flexible exchange rate), it relatively increases. These price changes cause government consumption to decrease, as a result of decline in government revenues caused by decrease in tariff revenues. Real GDP increases quite rapidly; imports that increased due to the initial shock converge to their baseline values in the long run. Exports that increase sharply after the initial shock further increase, which means that the performance of the domestic industries improves in the long run. The effect on the current account of balance of payments is negative after the initial shock, causing the deficit to rise rapidly. However, in the long run, this development is reversed thanks to the positive development in the economy, causing a gradual decrease of this deficit, which measured in US$ even becomes a surplus in the 11-year period. The only variable giving negative values in its long-term development is the real investment, which decreases slightly after the initial positive shock.

To analyze the impacts of tax-reform, simulation 6 was carried out. Reducing the corporate income tax, government consumption naturally falls. All prices including the exchange rate decline, causing nominal product to decline too. The tax reduction has no effect on imports. All other quantity variables, including the real GDP, show positive development.

Simulation 7 was carried out to analyze situations where price elasticities of exporting industries are not identical. The results show that the productive industries are price-sensitive. This is explained by the fact that adjusting the export price elasticities of industries causes a slight decline in the real GDP.

Simulations 8, 9 and 10 are combinations of previous simulations. For the specific results arising from these simulations, please refer to Table 6 and Table 7.

Simulation results generally show that European integration accompanied with trade liberalization has positive impacts on the Slovak economy. The assumption of positive effect of joining the EU can

be confirmed from several aspects. All simulations show that reduction or total abolition of tariffs causes total real product to increase. Heavy manufacturing, construction sector, and in some cases light manufacturing constitute the main engine of production growth. On the other side, no sector shows big decline in production. Private consumption increases; government consumption therefore decreases, because of the decline in government revenues. Positive effect on economic performance is created by increased real investment. Exports increase; imports remain on almost the same level as before tariff reduction, which can be explained by the fact that equilibrium is reached by increase of the exchange rate, i.e. by depreciation of home currency. The foreign trade balance deficit therefore grows. The increasing trade balance deficit might be considered to have negative impact on economic development, but simulations show that this problem can be alleviated by tax reform. Although this research shows that impact of EU integration is positive, the impacts are moderate, confirming that the Slovak trade regime prior to the integration is liberal, and rather than a radical reform, it needs only adjustments in specific sectors.

Table 6: Short term results compared with baseline scenario (1997), ratios

Indicator (units)	Model 1 (competitive labor market)											Model 2 (agri. labor - residual)			Model 3 (serv. labor - residual)		
	Level, baseline	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Level, baseline	S3	S4	85130.167	S3	S4
XS1 (AGRIprod, real, mSKK)	85665.29	1.00	1.00	1.01	1.01	1.01	1.01	1.00	1.02	1.02	1.02	94150.57	1.22	1.13	85130.17	0.99	1.00
XS2 (MIN " " ")	14871.19	0.99	1.00	1.06	1.03	1.04	1.01	1.00	1.08	1.08	1.12	14616.17	1.02	1.00	14656.43	1.03	1.01
XS3 (L.M. " " ")	133838.91	1.00	1.00	1.01	1.01	1.02	1.02	1.00	1.02	1.02	1.02	135624.21	1.03	1.02	133278.43	1.00	1.00
XS4 (H.M. " " ")	588687.73	1.00	1.00	1.05	1.03	1.04	1.01	1.00	1.05	1.05	1.05	583356.24	1.02	1.02	584734.79	1.03	1.02
XS5 (CONS " " ")	156525.01	1.02	1.00	1.04	1.03	1.07	1.02	1.00	1.07	1.07	1.03	155594.08	1.02	1.02	156447.16	1.03	1.02
XS6 (SERV " " ")	708622.09	1.00	1.00	0.97	0.98	0.97	0.99	1.00	0.96	0.96	0.97	703338.93	0.95	0.97	711986.12	0.98	0.99
LD1 (AGRIlabor, phys.persn)	162632.40	1.00	1.00	1.01	1.01	1.01	1.02	1.00	1.03	1.03	1.03	188504.90	1.36	1.21	160978.05	0.99	1.00
LD2 (MIN " ")	21438.90	0.98	1.00	1.11	1.05	1.07	1.02	0.99	1.16	1.16	1.22	20781.90	1.04	1.00	20877.30	1.05	1.01
LD3 (L.M. " ")	162530.81	1.00	1.00	1.02	1.02	1.03	1.03	1.00	1.04	1.04	1.03	166168.77	1.05	1.03	161303.41	1.00	1.00
LD4 (H.M. " ")	458155.60	0.99	1.00	1.10	1.06	1.08	1.02	1.00	1.10	1.10	1.11	449566.09	1.05	1.03	451537.27	1.06	1.04
LD5 (CONS " ")	162633.86	1.04	1.00	1.09	1.06	1.17	1.04	1.00	1.16	1.16	1.06	160411.16	1.05	1.04	162301.60	1.07	1.05
LD6 (SERV " ")	1146411.53	1.00	1.00	0.94	0.96	0.93	0.98	1.00	0.92	0.92	0.93	1128377.91	0.90	0.94	1156813.03	0.97	0.98
LS (TotLabSup, phys.persn)	2113810.65	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2113810.65	1.00	1.00	2113810.65	1.00	1.00
KS (TotCapSto, real, mSKK)	1938478.25	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1939073.17	1.00	1.00	1939910.84	1.00	1.00
CR (RealPrivCons, mSKK)	344747.91	1.01	1.00	1.00	1.00	1.01	1.03	1.01	1.00	1.00	0.97	348844.38	1.02	1.01	347639.44	1.00	1.00
GR (RealGovrCons, ")	152290.99	1.00	1.00	0.64	0.78	0.65	0.88	1.00	0.51	0.51	0.50	151029.29	0.64	0.77	149882.24	0.65	0.78
IR (RealInvestment, ")	224373.87	1.02	1.00	1.05	1.03	1.09	1.02	1.00	1.09	1.09	1.03	223147.30	1.03	1.02	224351.51	1.04	1.03
JR (RealInventory, ")	17681.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	17681.00	1.00	1.00	17681.00	1.00	1.00
ER (RealExports, ")	360742.91	0.99	1.00	1.13	1.08	1.10	1.01	1.00	1.13	1.13	1.16	357907.84	1.11	1.07	360226.53	1.12	1.07
MR (RealImports, ")	443876.00	1.01	1.00	1.00	1.00	1.02	1.00	1.01	0.98	0.98	0.94	443875.47	1.00	1.00	443876.19	1.00	1.00
YR (RealGDP, ")	655960.67	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	654734.33	0.99	1.00	655904.53	1.00	1.00
RL (AveWage, nomi, mSKK)	0.13	0.99	1.04	0.94	0.96	0.91	0.96	1.00	0.87	0.91	0.82	0.14	0.94	0.96	0.17	0.93	0.96
RK (AveRent, nomi, mSKK/mSKK)	0.15	0.98	1.04	0.94	0.96	0.91	0.96	1.00	0.87	0.91	0.81	0.16	0.95	0.97	0.13	0.95	0.97
RE (ExchangeRate, '96=1.0)	1.06	0.96	1.05	1.07	1.04	1.00	0.98	0.99	1.06	1.11	1.07	1.00	1.06	1.03	1.00	1.07	1.04
PC (ConsDeflator, ")	0.94	0.98	1.05	0.94	0.96	0.90	0.97	1.00	0.90	0.94	0.87	1.01	0.92	0.95	1.02	0.94	0.96
PG (GovC " , ")	0.99	0.98	1.05	0.94	0.96	0.90	0.96	1.00	0.89	0.93	0.85	1.04	0.96	0.97	1.01	0.92	0.95
PI (Invs " , ")	0.99	0.98	1.05	0.95	0.97	0.92	0.98	1.00	0.92	0.96	0.89	1.02	0.97	0.98	1.02	0.96	0.97
PJ (Invn " , ")	0.94	0.97	1.05	0.94	0.96	0.89	0.98	1.00	0.91	0.95	0.89	1.01	0.94	0.96	1.01	0.95	0.97
PE (Expo " , ")	0.98	0.98	1.05	0.95	0.96	0.91	0.97	1.00	0.90	0.94	0.87	1.03	0.96	0.97	1.02	0.95	0.97
PM (Impo " , ")	1.06	0.96	1.05	1.07	1.04	1.00	0.98	0.99	1.06	1.11	1.07	1.00	1.06	1.03	1.00	1.07	1.04
PY (GDP " , ")	0.91	0.98	1.05	0.87	0.92	0.84	0.97	1.00	0.80	0.84	0.75	1.04	0.88	0.92	1.03	0.87	0.92
YN (GDP, nominal, mSKK)	592457.45	0.98	1.05	0.87	0.92	0.84	0.97	1.00	0.80	0.84	0.75	680252.91	0.87	0.92	674910.49	0.87	0.92
S (GNS, " , ")	164799.06	0.99	1.05	0.96	0.98	0.94	1.01	1.00	0.93	0.97	0.87	170528.61	0.97	0.98	170766.53	0.97	0.98
F (CurBOPdef,inSKK, mSKK)	80023.18	1.03	1.05	1.07	1.04	1.12	0.98	0.99	1.13	1.18	0.99	75432.46	1.06	1.03	75300.10	1.07	1.04
F$ (" ,US$, '96 mSKK)	75656.16	1.06	1.00	1.00	1.00	1.12	1.00	1.00	1.06	1.06	0.93	75656.16	1.00	1.00	75656.16	1.00	1.00
IN (Inv, nominal, mSKK)	228162.00	1.00	1.05	1.00	1.00	1.00	1.00	1.00	1.00	1.05	0.91	228162.00	1.00	1.00	228162.00	1.00	1.00

Source: Author's calculations

Table 7: Long term results compared with baseline scenario (2006), ratios

Indicator (units)	Model 1 (competitive labor market)											Model 2 (agri. labor - residual)			Model 3 (serv. labor - residual)		
	Level, baseline	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Level, baseline	S3	S4	Level, baseline	S3	S4
XS1 (AGRIprod, real, mSKK)	165389.83	1.03	1.00	1.02	1.02	1.03	1.02	1.00	1.07	1.07	1.01	383499.23	1.06	1.04	143054.88	1.00	1.00
XS2 (MIN " " ")	26157.12	0.95	1.00	1.08	1.04	1.10	1.03	0.97	1.04	1.04	1.11	19104.07	1.03	1.01	20420.51	1.04	1.01
XS3 (L.M. " " ")	265590.02	1.04	1.00	1.02	1.02	1.03	1.02	1.02	1.10	1.10	1.02	248327.73	1.00	1.00	231911.42	1.01	1.01
XS4 (H.M. " " ")	1141854.84	1.00	1.00	1.06	1.04	1.07	1.02	1.01	1.09	1.09	1.06	945724.65	1.03	1.02	997769.23	1.04	1.02
XS5 (CONS " " ")	334712.31	1.18	1.00	1.04	1.03	1.04	1.02	1.02	1.27	1.27	0.92	291.428.99	1.02	1.02	309286.99	1.03	1.02
XS6 (SERV " " ")	1409535.56	1.03	1.00	0.99	0.99	0.99	1.00	1.00	1.01	1.01	0.95	1190355.80	0.97	0.98	1498619.28	1.00	1.00
LD1 (AGRIlabor, phys.persn)	269594.96	1.00	1.00	1.02	1.01	1.02	1.02	1.00	1.04	1.04	1.04	1026759.13	1.08	1.05	217752.49	0.99	1.00
LD2 (MIN " ")	28656.98	0.86	1.00	1.12	1.05	1.14	1.04	0.95	0.97	0.97	1.25	16832.80	1.04	1.00	18762.48	1.06	1.01
LD3 (L.M. " ")	274046.85	1.01	1.00	1.02	1.01	1.02	1.03	1.03	1.08	1.08	1.06	251007.76	0.99	1.00	221617.07	1.00	1.00
LD4 (H.M. " ")	673743.66	0.93	1.00	1.10	1.06	1.10	1.02	1.02	1.05	1.05	1.17	476481.17	1.04	1.03	524229.66	1.06	1.03
LD5 (CONS " ")	279964.90	1.32	1.00	1.06	1.04	1.04	1.04	1.03	1.47	1.47	0.87	215019.72	1.03	1.02	241603.18	1.04	1.03
LD6 (SERV " ")	1764091.89	0.98	1.00	0.94	0.97	0.94	0.98	0.98	0.89	0.89	0.93	1293113.54	0.92	0.95	2055249.25	0.98	0.99
LS (TotLabSup, phys.persn)	3279214.13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3279214.13	1.00	1.00	3279214.13	1.00	1.00
KS (TotCapSto, real, mSKK)	4897248.06	1.08	1.00	1.03	1.02	1.04	1.02	1.01	1.13	1.13	0.96	4718051.11	1.02	1.01	4781882.00	1.02	1.01
CR (RealPrivCons, mSKK)	775777.75	1.11	1.00	1.00	1.00	1.00	1.03	1.08	1.18	1.18	0.96	835706.94	1.00	1.00	794133.75	1.01	1.01
GR (RealGovrCons, ")	315610.53	1.06	1.00	0.69	0.81	0.69	0.88	1.03	0.63	0.63	0.53	267436.18	0.70	0.82	342849.73	0.71	0.82
IR (RealInvestment, ")	494474.67	1.23	1.00	1.04	1.03	1.04	1.03	1.03	1.34	1.34	0.89	434732.40	1.03	1.02	452831.26	1.03	1.02
JR (RealInventory, ")	17681.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	17681.00	1.00	1.00	17681.00	1.00	1.00
ER (RealExports, ")	703225.94	0.92	1.00	1.14	1.08	1.15	1.02	1.01	1.07	1.07	1.20	595420.31	1.10	1.06	654786.06	1.13	1.08
MR (RealImports, ")	1019479.94	1.13	1.00	1.00	1.00	1.00	1.00	1.01	1.18	1.18	0.93	1019480.88	1.00	1.00	1019481.00	1.00	1.00
YR (RealGDP, ")	1287289.95	1.02	1.00	1.02	1.01	1.03	1.01	0.99	1.05	1.05	0.99	1131495.95	1.00	1.00	1242800.80	1.01	1.01
RL (AveWage, nomi, mSKK)	0.22	0.87	1.56	0.95	0.97	0.96	0.96	1.03	0.81	1.27	0.41	0.22	0.95	0.97	0.26	0.94	0.97
RK (AveRent, nomi, mSKK/mSKK)	0.15	0.81	1.56	0.92	0.95	0.91	0.95	1.02	0.72	1.12	0.42	0.17	0.94	0.96	0.13	0.95	0.97
RE (ExchangeRate, '96=1.0)	0.91	0.72	1.56	1.09	1.05	1.10	0.99	0.90	0.73	1.13	0.52	0.85	1.07	1.04	0.87	1.08	1.04
PC (ConsDeflator, ")	1.12	0.79	1.56	0.95	0.97	0.95	0.97	0.97	0.71	1.11	0.44	1.06	0.95	0.97	1.10	0.94	0.96
PG (GovC " , ")	1.15	0.80	1.56	0.94	0.96	0.94	0.96	0.98	0.71	1.11	0.43	1.36	0.97	0.98	1.02	0.92	0.95
PI (Invs " , ")	1.09	0.81	1.56	0.96	0.97	0.96	0.97	0.97	0.75	1.16	0.43	1.24	0.97	0.98	1.19	0.97	0.98
PJ (Invn " , ")	1.04	0.77	1.56	0.95	0.97	0.96	0.97	0.96	0.69	1.08	0.45	1.07	0.96	0.97	1.12	0.96	0.97
PE (Expo " , ")	1.12	0.79	1.56	0.95	0.97	0.96	0.97	0.98	0.72	1.12	0.44	1.24	0.97	0.98	1.16	0.95	0.97
PM (Impo " , ")	0.91	0.72	1.56	1.09	1.05	1.10	0.99	0.90	0.73	1.13	0.52	0.85	1.07	1.04	0.87	1.08	1.04
PY (GDP " , ")	1.28	0.85	1.56	0.87	0.92	0.87	0.95	1.03	0.72	1.13	0.39	1.48	0.90	0.94	1.33	0.89	0.93
YN (GDP, nominal, mSKK)	1647106.17	0.87	1.56	0.89	0.93	0.89	0.96	1.03	0.76	1.19	0.38	1673447.95	0.90	0.94	1651746.46	0.89	0.94
S (GNS, " , ")	419529.67	0.87	1.56	0.97	0.98	0.97	1.00	1.03	0.87	1.35	0.43	428109.49	0.98	0.99	426005.28	0.97	0.99
F (CurBOPdef,inSKK, mSKK)	136852.85	1.35	1.56	1.09	1.05	1.08	0.99	0.90	1.36	2.13	0.24	128764.33	1.07	1.04	131827.53	1.08	1.04
F$ (" ,US$, '96 mSKK)	151237.01	1.87	1.00	1.00	1.00	0.97	1.00	1.00	1.87	1.87	0.46	151237.01	1.00	1.00	151237.01	1.00	1.00
IN (Inv, nominal, mSKK)	537994.07	1.00	1.56	1.00	1.00	1.00	1.00	1.00	1.00	1.56	0.39	537994.07	1.00	1.00	537994.07	1.00	1.00

Source: Author's calculations

4.4 Model limitations

The CGE analysis presented in this paper has limitations in at least three directions, which also point to areas for future investigation. First, the outcome of the model depends on its closure. In Model 2 and Model 3, non-homogenous closure is adopted by determining agricultural and service labor respectively, as residual. In this case, money supply affects both real variables and prices. That is to say, money is not veil. Also, there are two kinds of exchange rate regime introduced in the simulations, the flexible exchange rate with equilibrium in the foreign exchange market assumed, and the fixed exchange rate causing foreign capital inflow to be defined endogenously. In case of fixed exchange rate, it may become necessary to explicitly introduce detailed financial aspects into the model such as foreign exchange reserves, capital export, fiscal balance, financial balance, etc.

Second is the elaboration of the present model, which was constrained by availability of data. CD type is adopted for all production, composite goods, and utility functions in the model. As Dervis, de Melo, and Robinson (1982) suggests, the first two should be replaced by CES type, while the consumption function should be replaced by LES (Linear Expenditure System)[19]. In the case of production function, for example, CD type may generate misleading outcomes concerning the nature of technology such as labor-intensive or capital-intensive type.

The third concerns the data itself. To build the model, actual data was combined with estimates on distribution of labor stocks and capital stocks by industries, productivity by industry (overtime changes), indirect taxes and industrial margins by industry, income in distribution by industry (wages and labor), linkage between income and consumption (consumption function, savings function), and various parameters such as export price elasticities. These limitations are the major tasks for investigation and improvement to be done in the near future. Though they should not be forgotten, the author is confident that the presented CGE analysis has clarified several important points at issue for the medium and long term economic development of Slovakia. And it must be emphasized that those points are derived by the comparison of dynamic paths for the 11 year period of, not by the often-used comparative static methods.

5. CONCLUSION

European integration and the subsequent trade liberalization were shown to have positive impacts on the Slovak economy. Aggregate real production and sectoral production increases; this is achieved through increase in real investment. Final consumption of the private sector also shows slight growth, while due to decline in government revenues, government consumption declines. As for price development, simulation results show that equilibrium is reached through depreciation of the exchange rate, which, reacting to tariff reduction, increases quite rapidly (defined as units of SKK for one unit of USD). Most other prices decline, including consumer prices and GDP deflator. Although

import tariffs are reduced or abolished, due to the depreciation of the exchange rate, total imports do not show significant fluctuations. However, export performance shows quite considerable improvements, on sectoral and aggregate levels. This creates even bigger pressure on the already negative trade balance. Therefore, as a policy implication, it is recommended to simultaneously take other policy measures, such as linking trade liberalization with tax system reform. Another recommendation to the government is to increase the ratio of foreign capital with investment likely to stay in the economy for longer time, e.g. to increase the inflow of FDI.

The simulation results show that abolition of all import tariffs has the biggest positive impacts on sectors that are suffering most during the transformation period, in particular heavy manufacturing. By liberalizing the trade regime, the highest increase in production can be achieved in the heavy manufacturing, construction and mining sectors. These sectors account for the highest unemployment rates since the transformation began. Thanks to trade liberalization and the subsequent improvement in production efficiency, labor force seems to flow to these sectors. Therefore it is recommended that the tariff reduction is done at once with a flat rate for all sectors, without trying to introduce protective measures for "weak" industries. Such measures might have the opposite effect, as has been experienced several times in the past. Sudden abolition of tariffs is recommended, since it does not appear to create extreme shocks to the economy.

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APPENDIX

Price relations:

$$PM_i = \overline{PM\$}_i \cdot (1+\overline{tm}_i) \cdot ER \qquad \text{(A.1)}$$

$$PE\$_i = \frac{PX_i \cdot (1+\overline{te}_i)}{ER} \qquad \text{(A.2)}$$

$$P_i = \frac{(PX_i \cdot D_i \cdot PM_i \cdot M_i)}{Q_i}, \qquad \text{(A.3-1)}$$

where $Q_i = \overline{B}_i \cdot M_i^{\beta_i} \cdot D_i^{1-\beta_i}$ (A.3-2)

$$PN_i = PX_i - \sum P_j \cdot \overline{a}_{ji} - PX_i \cdot \overline{td}_i \qquad \text{(A.4)}$$

Production function:

$$X_i^S = \overline{A}_i \cdot L_i^{\alpha_i} \cdot K_i^{1-\alpha_i} \qquad \text{(A.5)}$$

Labor market conditions:

For Model 1 (assuming perfect competition on labor market):

$$L_i = \frac{\alpha_i \cdot PN_i \cdot X_i^S}{W_i}, \qquad \text{(A.6.1-1)}$$

where $i=1,...,6$

$W_i = \lambda_i \cdot W$ and $L_i^* = \lambda_i \cdot L_i$ (A.6.1-2)

where $i=1,...,6$

$$\sum_{i=1}^{6} L_i^* = L^S \text{ and } W = W^e \qquad \text{(A.6.1-3)}$$

where W^e is equilibrium wage

For Model 2 (assuming that unemployed workers go to agricultural sector - 1; non-competitive labor market):

$$L_i = \frac{\alpha_i \cdot PN_i \cdot X_i^S}{W_i}, \qquad \text{(A.6.2-1)}$$

where W_i is exogenous, $i=2,...,6$

Residual determination of agricultural labor:

$$L_1 = \overline{L^S} - \sum_{i=2}^{6} L_i \qquad \text{(A.6.2-2)}$$

Wage imputation by marginal productivity:

$$W_1 \frac{\alpha_1 \cdot PN_1 \cdot X_1^S}{L_1} \qquad \text{(A.6.2-3)}$$

$$W = \frac{\sum W_i \cdot L_i}{\overline{L^S}} \qquad \text{(A.6.2-4)}$$

For Model 3 (assuming that unemployed workers go to service sector - 6; non-competitive labor market):

$$L_i = \frac{\alpha_i \cdot PN_i \cdot X_i^S}{W_i}, \qquad \text{(A.6.3-1)}$$

where W_i is exogenous, $i = 1,...,5$

Residual determination of agricultural labor:

$$L_6 = \overline{L^S} - \sum_{i=1}^{5} L_i \qquad \text{(A.6.3-2)}$$

Wage imputation by marginal productivity:

$$W_6 = \frac{\alpha_6 \cdot PN_6 \cdot X_6^S}{L_6} \qquad \text{(A.6.3-3)}$$

$$W = \frac{\sum W_i \cdot L_i}{\overline{L^S}} \qquad \text{(A.6.3-4)}$$

Capital market conditions:

$$K_i = \overline{K_i} \qquad \text{(A.7)}$$

$$R_i = \frac{(1-\alpha_i) \cdot PN_i \cdot X_i^S}{K_i} \qquad \text{(A.8)}$$

$$R = \frac{\sum R_i \cdot K_i}{\overline{K^S}}, \qquad \text{(A.9-1)}$$

where $\overline{K^S} = \sum \overline{K_i}$ (A.9-2)

Income and saving:

$$Y_L = (1-\overline{t_L}) \cdot W \cdot \overline{L^S} \tag{A.10}$$

$$Y_K = (1-\overline{t_K}) \cdot R \cdot \overline{K^S} \tag{A.11}$$

$$Y_G = \overline{t_L} \cdot W \cdot \overline{L^S} + \overline{t_K} \cdot R \cdot \overline{K^S} + \sum \overline{td_i} \cdot PX_i \cdot X_i^S + \sum \overline{tm_i} \cdot \overline{PM\$_i} \cdot M_i \cdot ER + \sum te_i \cdot PX_i \cdot E_i \tag{A.12}$$

$$S = \overline{s_p} \cdot (Y_L + Y_K) + s_G \cdot Y_G, \tag{A.13-1}$$

$$\text{where} \quad \overline{s_P} = \overline{s_L} + \overline{s_K} \tag{A.13-2}$$

Consumers:

$$C_i = \frac{\gamma_{ci} \cdot \left[(1-\overline{s_P}) \cdot (Y_L + Y_K)\right]}{P_i}, \tag{A.14-1}$$

$$\text{where} \quad \sum \gamma_{ci} = 1 \tag{A.14-2}$$

$$C = \sum C_i$$

$$PC = \frac{(1-\overline{s_P}) \cdot (Y_L + Y_K)}{C}, \tag{A.15-1}$$

$$\text{where} \quad PC \cdot C \equiv \sum P_i \cdot C_i \tag{A.15-2}$$

Government:

$$G = \frac{(1-\overline{s_G}) \cdot Y_G}{PG} \tag{A.16}$$

$$G_i = \overline{b_{Gi}} \cdot G, \tag{A.17-1}$$

$$\text{where} \quad \sum \overline{b_{Gi}} = 1 \tag{A.17-2}$$

$$PG = \sum \overline{b_{Gi}} \cdot P_i, \tag{A.18}$$

$$\text{where} \quad PG \cdot G \equiv \sum P_i \cdot G_i \tag{A.19}$$

Capital formation:

$$I = \frac{I^n}{PI}, \qquad \text{(A.20-1)}$$

where I^n is exogenous

$$I_i = \overline{b_{Ii}} \cdot I, \qquad \text{(A.21-1)}$$

where $\sum \overline{b_{Ii}} = 1$ (A.21-2)

$$PI = \sum \overline{b_{Ii}} \cdot P_i, \qquad \text{(A.22-1)}$$

where $PI \cdot I \equiv \sum P_i \cdot I_i$ (A.22-2)

$$J = \frac{J^n}{PJ}, \qquad \text{(A.23)}$$

where J^n is exogenous

$$J_i \overline{b_{Ji}} \cdot J, \qquad \text{(A.24-1)}$$

where $\sum \overline{b_{Ji}} = 1$ (A.24-2)

$$PJ = \sum \overline{b_{Ji}} \cdot P_i, , \qquad \text{(A.25-1)}$$

where $PJ \cdot J \equiv \sum P_i \cdot J_i$ (A.25-2)

Foreign capital inflow:

$$F = \overline{F\$} \cdot ER, \qquad \text{(A.26-1)}$$

or $F = I^n + J^n - S$ (A.26-2)

$$\overline{F\$} = \frac{F}{ER} \qquad \text{(A.27)}$$

Demand components:

$$Q_i = \sum \overline{a_{ij}} \cdot X_j^S + C_i + G_i + I_i + J_i \qquad \text{(A.28)}$$

$$d_i = \frac{1}{\overline{B_i}} \left(\frac{\beta_i}{1-\beta_i} \cdot \frac{PX_i}{PM_i} \right)^{\beta_i}, \qquad \text{(A.28-1)}$$

where $d_i = \frac{D_i}{Q_i}$ (A.28-2)

$$D_i = d_i \cdot Q_i \qquad \text{(A.29)}$$

$$M_i = \frac{1}{\overline{B_i}} \left(\frac{\beta_i}{1-\beta_i} \cdot \frac{PX_i}{PM_i} \right) \cdot D_i \qquad \text{(A.30)}$$

$$E_i = \overline{E_i^o} \cdot \left(\frac{\prod_i}{PE\$_i} \right)^{\eta i}, \qquad \text{(A.31-1)}$$

where $\sum \prod_i = 1$ (A.31-2)

$$X_i^D = D_i + E_i \qquad \text{(A.33)}$$

Equilibrium conditions:

$$X_i^D = X_i^S, \text{ and } PX_i = PX_i^e, \qquad \text{(A.34)}$$

where PX^e is equilibrium price

$$\sum \overline{PM\$_i} \cdot M_i - \sum PE\$_i \cdot E_i - \overline{F\$} = 0, \text{ and } ER = ER^e, \qquad \text{(A.35)}$$

where ER^e is equilibrium rate

GDP identity:

$$E = \sum E_i \qquad \text{(A.36)}$$

$$PE = \frac{\sum PX_i \cdot \left(1 + \overline{te_i}\right) \cdot E_i}{E} \qquad \text{(A.37)}$$

$$M = \sum M_i \qquad \text{(A.38)}$$

$$PM = \frac{\sum \frac{PM_i}{1+tm_i} \cdot M_i}{M} \tag{A.39}$$

$$GDP^n = Y_L + Y_K + Y_G, \tag{A.40-1}$$

or

$$GDP^n = \sum \left(PX_i - \sum P_j \cdot \overline{a_{ji}} \right) \cdot X_i^S + \sum \overline{tm_i} \cdot \overline{PM\$_i} \cdot ER \cdot M_i + \sum \overline{te_i} \cdot PX_i \cdot E_i, \tag{A.40-2}$$

or

$$GDP^n = PC \cdot C + PG \cdot G + PI \cdot I + PJ \cdot J + PE \cdot E - PM \cdot M \tag{A.40-3}$$

$$GDP = C + G + I + J + E - M \tag{A.41}$$

$$PGDP = \frac{GDP^n}{GDP} \tag{A.42}$$

$$GDP_i^n = \left(PX_i - \sum P_j \cdot \overline{a_{ji}} \right) \cdot X_i^S \tag{A.43}$$

$$GDP_i = \left(1 - \sum \overline{a_{ji}} \right) \cdot X_i^S \tag{A.44}$$

$$PGDP_i = \frac{GDP_i^n}{GDP_i} \tag{A.45}$$

Walras' Law:

$$W \cdot \left(L^D - \overline{L^S} \right) + R \cdot \left(\sum K_i - \overline{K^S} \right) \sum PX_i \cdot \left(X_i^D - X_i^S \right) + \left(S + F - I^n - J^n \right) + ER \cdot \left(\sum \overline{PM\$_i} \cdot M_i - \sum PE\$_i \cdot E_i - \overline{F\$} \right) \equiv 0 \tag{A.46}$$

Intertemporal change for time $t\left(t = 1(1996),...,11(2006)\right)$:

$$\overline{K_{t+1}^S} = \overline{K_t^S} + I_t - \delta \cdot \overline{K_t^S} \tag{A.47}$$

$$\left(\frac{K_i}{\overline{K^S}} \right)_{t+1} = \left(\frac{K_i}{\overline{K^S}} \right)_t, \left(1 + \mu_{i,t} \cdot \frac{R_{i,t} - R_t}{R_t} \right), \tag{A.48.1-1}$$

where $\sum \mu_{i,t} = 1,$ (A.48.1-2)

or

$$\left(\frac{K_i}{K^S}\right)_{t+1} = \theta_i, \qquad \text{(A.48.2)}$$

where θ_i is policy parameter.

Notes:

1. Super-bar "¯¯" means exogenous variable.
2. Suffix "*i*" means industry *i*.
3. Notation of the system is as follows:

Price variables:

PX_i output price
PM_i import price
$PM\$_i$ import price in US dollars
$PE\$_i$ export price in US dollars
P_i price of composite goods
PN_i price of net output (value added)
W_i wage rate
W overall average wage rate
R_i rental rate of capital
R overall average rental rate of capital
ER exchange rate per US dollar
PC deflator for private consumption expenditure
PG deflator of government consumption expenditure
PI deflator of gross capital formation
PJ deflator of changes in stocks
PE deflator of exports
PM deflator of imports
$PGDP$ deflator of GDP

Quantity variables:

X_i^S supply of gross output
X_i^D demand for gross output
L_i demand for labor (in original units)
L_i^* demand for labor in efficiency units
K_i existing capital or demand for capital
C_i private consumption demand for gross output

G_i government consumption demand for gross output

I_i investment demand for gross output

J_i change in stocks of physical capital

Q_i quantity of composite goods

D_i domestic demand for gross output

M_i import demand

E_i export demand by foreign countries

L^S total supply of labor (in original units)

L^D total demand for labor (in original units)

K^S total supply of physical capital

K^D total demand for physical capital

C real private consumption expenditure

G real government consumption expenditure

I real gross capital formation

J real change in stocks

E real exports

M real imports

GDP real GDP

Rate variables:

d_i domestic demand ratio of composite goods

Value variables:

Y_L labor income

Y_K capital income

Y_G government income

S gross national saving

I^n nominal gross capital formation

GDP^n nominal GDP

F net capital inflow (deficit in the current balance of payments)

$F\$$ net capital inflow in US dollars

Functional parameters:

A_i scale factor of Cobb-Douglas production function

α_i labor share of Cobb-Douglas production function

λ_i efficiency parameter for labor input (W_i / W_n, $i=1,...,6$ for Model 1, $i=2,...,6$ for Model 2, and

i=1,...,5 for Model 3)

a_{ji} intermediate input coefficient of good j in industry i

B_i scale factor of Cobb-Douglas composite goods function

β_i import share of Cobb-Douglas composite goods function

B_i scale factor of export demand function

η_i price elasticity of export demand function

γ_{Ci} share parameter of Cobb-Douglas utility function

Shares and ratios:

b_{Gi} quantity ratio to real government consumption

b_{Ii} quantity ratio to real investment

b_{Ji} quantity ratio to changes in stocks

s_P private saving rate (labor plus capital)

s_G saving rate of government income

Tax parameters:

tm_i rate of import tariff

te_i rate of export tax (no data applied)

td_i indirect (net of subsidy) rate in production

t_L rate of tax on individual income

t_K rate of tax on corporate income and profit

1) CGE refers to economic models of microeconomic behavior in multiple markets of one or more economies, solved computationally for equilibrium values or changes due to specified policies. Equations are anchored with data from countries being modeled, while behavioral parameters are either empirically estimated or adapted from estimates elsewhere. For details, see e.g. Dervis, K., J. de Melo, and S. Robinson (1982); Dinwiddy, C. L., and F. J. Teal (1988).

2) An earlier work on a related subject has been published by Scandizzo (2000), providing a CGE analysis and modeling tools for a transition economy. However, the work applies to agricultural reform, and utilizes Slovak SAM data that is estimated for 12 industrial sectors, covering years 1991 and 1993.

3) EU was established on February 7th, 1992 by the signing of the Treaty of European Union in Maastricht, by a group of European countries that have chosen to integrate many of their economic activities, including forming a customs union and harmonizing many of their rules and regulations; it was preceded by European Economic Community (EEC) and European Community (EC). As of September 2002, the EU had 15 member countries.

4) CMEA, also referred to as COMECON or MEA, was an international organization active between 1956 and

1991 for the coordination of economic policy among certain nations with centrally planned economies. Although it was formed in 1949, a formal charter was not ratified until 1959. The charter gave CMEA an international status of a Common Market, but the structure was controlled by heads of states.

5) In 1997, the Treaty of Amsterdam was signed, coming into force on May 1st, 1999.

6) First signed on March 25th, 1957 in Rome, establishing the European Economic Community (EEC Treaty); it was amended by Maastricht Treaty; and again by the Amsterdam Treaty.

7) An agreement between the Slovak Republic and the European Communities and their member countries was signed on October 4th, 1993 in Bruxelles, creating free trade areas and establishing additional forms of political and economic cooperation in preparation for the eventual membership in the EU. It came into force on February 1st, 1995.

8) For details on I-O table compilation, see UN (1999).

9) Also referred to as symmetric I-O table, or Leontief I-O table.

10) The approximate exchange rate in 1996 was 30 SKK/USD.

11) CES function is used for production and utility functions; it has the properties of homogeneity, constant elasticity between capital and labor, and the possibility of different elasticities for different industries. For details see Arrow, K. J., et al. (1961, pp. 225-251).

12) Walras' Law is the property of a general equilibrium that if all but one of the markets are in equilibrium, then the remaining market is also in equilibrium, automatically. This follows from the budget constraints of the market participants, and it implies that any one market-clearing condition is redundant and can be ignored.

13) Engel coefficient expresses the share of food consumption on total consumption.

14) Gauss-Seidel method is a technique for interpolating irregularly spaced data points. An iteration of several equations, in which for each function evaluation, values from the current iteration are used if they are available; each function evaluation depends on the previous function evaluations so it cannot be executed in parallel.

15) Negative agricultural wage imputed by marginal productivity (PL1, or W_1) is caused by negative net output price (PN_1); that is caused by low agricultural output price (PX_1) and high price of composite goods ($P_2,...,P_6$) - equation A.6.2-3. In a real economy, increase in labor supply causes decline in wages. However, the simulation results show that shifting the excess labor to a relatively small sector of agriculture, creates an extreme situation impossible in a real environment, where the equilibrium is reached through increase of agricultural production (supply), creating a downward pressure on agricultural prices.

16) Dynamic meant in the sense that it includes variables and behavior that at one time, depend on variables or behavior at another time. However, the model is formulated in discrete time periods, not in continuous time - also referred to as semi-dynamic.

17) The export demand function elasticities are from Ezaki, M., and K. Itakura (1996).

18) Discussed in section 4.1, as the standard scenario of Model 2.

19) Linear Expenditure System is the most frequently used system in empirical analyses of demand. It derives from the Stone-Geary utility function with a form $p_i q_i = c_i p_i + b_i(y - \Sigma c_j p_j)$. where $c_i p_i$ is the committed level of expenditures, and $y - \Sigma c_j p_j$ is the uncommitted income.