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A General Equilibrium Evaluation of Trade and Industrial Policy Changes in Austria and Hungary

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Abstract

Two linked static CGE models - based on 1990 data - are used to study effects of trade liberalization, problems of migration and changes in industrial policy in Austria and Hungary. Generally, Hungary is weakly endowed with capital relative to labour. In Austria the situation is the reverse. This gives Hungary a relatively strong competitive position in the production and export of low wage products. Austria, on the other hand should have comparative advantages in products with high capital content when trading with Hungary. Because of the huge differences in factor endowment Heckscher-Ohlin arguments may be more suitable to explain trade between Austria and Hungary than the industrial organization approach. Although trade liberalization helps to improve welfare, much stronger effects follow from factor migration and capital accumulation through the process of transformation in Hungary.

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1. Introduction

The fall in the "iron curtain" has dramatically altered the previous clear-cut international order of trade relations between the East and the West. In the process of transformation, the "Visegrad" countries have redirected their trade focus from the former CMEA countries to western markets, helped by free trade treaties with the EC and EFTA. In this paper we examine these new trade situations, looking at Austria and Hungary. After examining comparative costs, we use linked CGE models to simulate different aspects of trade liberalization, migration and industrial policy changes. Generally, Hungary is weakly endowed with capital relative to labour. The reverse is true in Austria. This gives Hungary a relatively strong competitive position in the production and export of low wage products. Austria, on the other hand should have comparative advantage in products with high capital content when trading with Hungary. Although trade liberalization helps to improve welfare, much stronger effects follow from factor migration and capital accumulation through the process of transformation in Hungary. The paper starts with a description of the comparative economic position of Austria and Hungary. Then the CGE models are described. This is followed by the empirical evaluation of the effects of different scenarios of liberalization, migration and capital accumulation.

2. The Comparative Economic Position of Austria and Hungary

Austria is a high income country and is a member of EFTA. It is currently seeking full membership in the EC. Hungary on the other hand is relatively low income country which is still in a process of transformation. GDP per capita is 3 1/2 times higher in Austria than in Hungary. The comparison of a highly industrialized country with one newly re-industrializing country may seem unfair. However, in this case of the neighbours Austria and Hungary, the comparison has not only didactical but very practical purpose. The opening up of the borders between East and West bilateraly and multilaterally via the free trade treaties of the EC and EFTA reveals the comparative advantages of both countries. Hungary has suddenly become a potent competitor due to low wages and therefore is attracting capital from Austria.

Whereas the trade of equally developed industrial countries is to a large extent of an intra-industry nature, trade between high and low income countries is mostly on an inter-industry basis. Although in the former case new theoretical approaches (IO, preference similarity) are needed, trade between Austria and Hungary can be best explained by traditional Heckscher-Ohlin arguments. The degree of openess is higher in Austria (40% of GDP) than in Hungary (around 30%). In 1990, Hungary still traded one quarter of total trade with the Ruble area (former CMEA).

The overall and the sectoral differences in the factor endowment are significant (see **table 1**). Austria's capital stock in 1990 was nearly ten times as high as in Hungary. The labour endowment was 1 1/2 times higher in Hungary than in Austria, more than the population difference. Overall capital intensity is fifteen times higher in Austria than in Hungary. This huge difference in factor endowment is also mirrored in the relative factor costs. Wages are on average six times lower in Hungary than in Austria. Capital is 1 1/2 times more expensive in Hungary. The relative wage/rent costs are nine times higher in Austria than in Hungary.

From these large differences in factor endowment and factor costs one can easily conclude that Hungary is a very strong competitor in low wage and low capital intensive products. Austria on the other hand should have comparative advantage in high wage, high-tech and high capital intensive products. Nevertheless, one must consider that the bilateral trade relations are of different importance (see **table 1**). For Hungary, Austria is a more important trading partner than the other way round. Nearly 10% of Hungary's total exports go the Austria and 14% of total imports come from Austria. The export and import shares of Austria's trade with Hungary amount to no more than 1 1/2% of total trade. This asymmetry in the bilateral trade relations has to be kept in mind if one evaluates the trade liberalization experiments in the next chapter. In nearly all experiments Hungary gains more from liberalization than Austria. Recently, Austria has increased its export and import share with Hungary to over 3% and 2% respectively. Since the breakdown of the COMECON Austria profited from trade with Hungary. This is documented by the increase in the surplus of the trade balance. In 1988 trade Austria's trade surplus with Hungary amounted to only 0,5 bill.AS. Since then the surplus increased dramatically (1989 0,8, 1990 1,7, 1991 3,0, 1992 3,2 bill.AS).

A comparison of the sectoral structure reveals the high importance of the basic industry sectors (mining, food, agriculture, metallurgy) in Hungary (see **tables 2** and **3**). In Austria, on the other hand, the more service oriented sectors (commerce, transport and communication, private services, bank, public services) dominate. Austria, as a rule, levies higher tariffs on imports from Hungary than on other countries. Most other trade is with the EC and EFTA countries - the trade with which is tariff free. Indirect taxes are higher in Austria than in Hungary. Subsidies are still higher in Hungary than in Austria.

The sectoral indicators on comparative advantages according to H-O arguments are gathered in **table 4**. As shown in other studies (Aiginger, 1993), wage costs in Austria are higher than in Hungary in all sectors. In particular, Austria has comparative disadvantage (measured by the relative wage/rent ratio of more than 10) in the mining, chemicals, energy, building materials, stone, metallurgy (steel), machinery and transportation sectors. Labour productivity is higher in al sectors in Austria compared to Hungary. Very big differences can be found in the energy, agriculture, building materials, stone, construction, transportation and communication sectors.

Table 1

Macroeconomic Data, Factor Endowment and Factor Prices: Austria - Hungary, 1990

I. Macroeconomic Data:

	GDP US$ bill. c.p.	Population millions	GDP per capita US$ bill. c.p.	Exports US$ bill.	of which CMEA %	Imports US$ bill.	of which CMEA %	Exports in % of GDP	Imports in % of GDP
Austria	158.278	7.7	14.932	63.917	-	63.006	-	40.4	39.8
Hungary	32.714	10.6	4.249	10.552	25.8	9.353	28.2	32.3	28.6

II. Factor Endowment and Factor Costs:

	Capital stock US$ bill. c.p.	Employment 1.000	Capital intensity 1000US$-K/L	Wage costs wages/labour 1000US$-w/L	Capital costs rent/capital 1000US$-r/K	Labour Productivity(L/GDP) 1000US$
Austria	744.555	2905.849	256.226	28.555	72.689	54.469
Hungary	78.941	4467.300	17.671	4.486	103.973	7.323

III. Relative Factor Endowment and Relative Factor Costs:

	Relative capital intensity K/L	Relative Wage cost w/L	Relative Capital cost r/K	Relative wage/rent cost w/r
Austria/Hungary	14.500	6.365	0.699	9.105

IV. Bilateral Trade Relations and Exchange Rates:

	Export share in % of total	Import share in % of total	Exchange rates	
Austria with Hungary	1.50	1.30	AS/100-FT	17.874
Austria with ROW	98.50	98.70	AS/US$	11.332
Hungary with Austria	9.70	14.10	FT/AS	5.595
Hungary with ROW	90.30	85.90	FT/US$	63.399

c.p. = current prices, ROW = rest of the world.

Table 2

Sector Structure, Austria 1990

	Gross output % of total	Employment % of total	Exports % of total	Imports % of total	Import tariff rates % AU-HU	Import tariff rates % AU-ROW	Indirect tax rates %	Indirect subsidy rates %
MIN	0,15	0,29	0,14	2,00	2,80	0,00	4,50	3,40
FOO	6,77	3,33	3,06	4,94	15,00	4,20	16,80	4,10
CHM	4,70	2,45	11,44	15,97	4,90	1,30	23,30	0,50
ENE	4,63	1,30	1,91	0,49	10,70	0,30	4,60	0,90
COM	15,02	18,64	7,88	3,24	0,00	0,70	6,90	0,80
AGF	3,25	0,95	1,40	4,40	15,10	1,30	3,30	2,00
LMN	8,22	7,96	20,81	14,72	7,70	2,20	10,50	0,60
BLD	2,22	1,49	3,81	2,80	5,00	1,70	6,00	0,70
MET	1,76	1,62	7,14	6,04	3,80	0,90	6,60	0,70
MAC	10,96	10,97	29,37	41,21	6,00	1,80	10,70	0,50
CON	8,37	7,69	0,91	0,25	7,10	0,20	10,10	1,20
TCM	8,55	7,84	10,74	2,83	0,00	0,00	2,80	6,60
PRS	13,22	13,50	0,97	0,87	0,00	0,00	7,60	0,30
PBS	12,18	21,98	0,43	0,26	0,00	0,00	2,80	0,60
Total	100,00	100,00	100,00	100,00	8,00	1,20	8,30	1,44
					Total import tariff rate %	1,71		

AU = Austria, HU = Hungary, ROW = Rest of the World.
Exports are inclusive export subsidies, imports are inclusive import tariffs.

MIN = Mining, FOO = Food, CHM = Chemicals and Petrol, ENE = Electricity and Water,
COM = Internal and external Trade, Commerce and Lodging, AGF = Agriculture and Forestry,
LMN = Light and other Manufacturing, Textil, Wood and Paper, BLD = Building Materials, Stone,
MET = Metallurgy, MAC = Machinery, CON = Construction, TCM = Transport and Communications,
PRS = Private Services, Bank and other Services, PBS = Public Services, Health Administration.

Table 3

Sector Structure, Hungary 1990

	Gross Output % of total	Em-ployment % of total	Exports		Imports		Import tariff rates % HU-AU	Import tariff rates % HU-ROW	Import tariff rates Ruble %	Indirect tax rates %	Indirect subsidy rates %
			% of total	% of which with Rubel area	% of total	% of which with Rubel area					
MIN	1,81	2,95	0,54	37,48	9,21	48,56	0,60	0,60	100,93	1,50	6,60
FOO	10,04	5,77	13,51	15,58	4,94	16,34	10,10	10,10	5,10	15,90	4,90
CHM	8,66	2,08	15,57	20,85	18,46	20,62	9,10	9,10	60,90	14,60	0,40
ENE	3,67	3,78	0,11	21,68	1,80	100,00	0,00	0,00	7,50	1,10	4,50
COM	12,76	6,90	2,19	24,33	4,92	12,68	1,00	1,00	0,00	19,50	7,30
AGF	15,88	15,34	9,37	19,93	3,15	8,22	10,90	10,90	31,90	1,30	1,60
LMN	5,83	3,87	10,72	20,19	10,42	25,01	8,10	8,10	23,60	7,00	0,60
BLD	1,44	5,08	1,34	6,79	1,42	28,21	15,60	15,60	16,70	10,50	0,20
MET	3,76	3,19	11,06	6,10	4,85	45,73	8,20	8,20	133,20	6,00	0,20
MAC	9,38	5,95	27,10	48,09	37,12	27,77	13,60	13,60	5,80	5,70	0,60
CON	6,09	11,92	1,78	17,36	0,45	28,59	9,00	9,00	0,00	8,10	0,40
TCM	5,06	8,64	4,49	16,80	1,70	30,23	2,80	2,80	0,00	–0,20	9,90
PRS	5,25	3,93	0,11	31,17	0,00	0,00	0,00	0,00	0,00	3,80	5,40
PBS	10,39	20,61	2,10	36,30	1,57	15,34	0,00	0,00	0,00	–1,40	0,40
Total	100,00	100,00	100,00	25,80	100,00	28,18	9,55	9,55	41,52	7,93	3,09

Table 4

Relative Factor Endowment, Relative Factor Costs, Relative Labour Productivity

Austria/Hungary 1990

	Relative capital intensity AU/HU - K/L	Relative wage costs ASU/HU - w/L	Relative capital costs AU/HU - r/K	Relative wage/capital costs AU/HU - w/r	Relative labour productivity AH/HU - X/L
MIN	14,589	6,098	0,378	16,116	5,107
FOO	11,005	4,542	1,633	2,782	7,301
CHM	21,458	14,568	0,646	22,550	2,874
ENE	64,099	14,892	0,372	40,032	22,958
COM	37,940	4,665	0,965	4,834	2,722
AGF	147,029	5,245	0,936	5,604	20,704
LMN	8,823	4,502	0,626	7,188	4,289
BLD	10,712	19,083	0,641	29,775	32,682
MET	18,046	21,366	0,568	37,624	5,789
MAC	2,864	13,833	1,242	11,134	3,961
CON	5,261	6,460	0,903	7,151	13,316
TCM	16,956	10,166	0,576	17,655	11,638
PRS	5,430	4,145	1,214	3,415	4,577
PBS	16,764	5,789	0,799	7,246	6,864
Total	14,500	6,365	0,699	9,104	6,248

3. Model Description

The model is a 14-sector, three-country, static computable general equilibrium model made up of single-country CGE models of Hungary and Austria linked by trade flows (the model equations can be found in the appendix). To these are added a set of export-demand and import-supply equations to represent the rest of the world. The Austria model is based on a 1976 model first constructed at the Austrian Institute for Economic Research (WIFO; Breuss and Tesche, 1991). The Hungary model is based on the 1977 model by Tesche (1993), which was updated to 1986 in Breuss and Tesche (1991). Other CGE models of Hungary include Kis, Robinson, and Tyson (1990), Zalai (1983, 1984, 1992) and Zalai and Revesz (1992). Both models here are based on 1990 data. The Austrian input-output table was updated (RASed) from 1976 to 1990 and the Hungarian model is based on the 1990 input-output table (Central Statistical Office, 1991 and Ministry of Finance, 1992). The multi-country application was initially developed by Hinojosa and Robinson (1991) with a model of the US and Mexico and used for Hungary, Austria and the EC by Hinojosa, Robinson and Tesche (1993).

Each country model follows the standard theoretical specifications of trade-focused full competition static CGE models. Each of the 14 sectors produce a composite commodity made up of imports and domestic production. This is sold on the domestic market or exported through a constant elasticity of transformation (CET) function. Output is produced according to a CES production function in labor and capital, with fixed input-output coefficients for intermediate inputs. Prices and quantities adjust to clear markets. Each country model traces the flow of income from producers to households, government, and investors, and back to demand for goods in product markets.

Personal consumption, intermediate demand, government expenditure and investment make up domestic demand. Consumer demand is based on Cobb-Douglas utility functions, which generate fixed expenditure shares. Households pay income taxes to the government and save a fixed proportion of their income. Real government demand and real investment are fixed exogenously.

Full employment is assumed. Aggregate supplies of both factors are set exogenously. Sectoral distortions in factor markets appear in the differences between sectoral wages and the economy average. We assume that both factors are mobile within each country only. This is a long-run view. Migration of either factor between countries is exogenous.

There are three main macro balances in each country model: the government deficit, aggregate investment and savings, and the balance of trade. In 1990 Hungary still had separate ruble area trade. The ruble area trade group, COMECON was disbanded in 1991. Since enterprises supplying this market could not be considered to be maximizing profits, and contracts tended to be long-term, this trade is considered exogenous. Ruble imports are treated as another source of supply. The surplus or deficit in this trade was simply financed by the government. Government savings is the difference between revenues and expenditures, with real spending fixed exogenously but revenue depending on tax revenues. The government deficit is therefore determined endogenously. Real investment is set exogenously, and aggregate private savings is determined residually to achieve the nominal savings-investment balance. Enterprise savings rates are assumed to adjust to achieve the necessary level of aggregate savings in each country. The balance of trade for each country is set exogenously, valued in world prices. The real exchange rate for each country with the rest of the world adjusts. The Austrian shilling/Hungarian forint exchange rate is determined implicitly. The GDP deflator is the numeraire in each country model, and the currency of the rest of the world (dollars) defines the international numeraire.

Sectoral export supply and import demand functions are specified for each country. The model solves for a set of world prices that achieve equilibrium in world markets. Demanders in each country differentiate goods by country of origin and exporters differentiate goods by country of destination (Armington assumption).

Often in trade-focused CGE models, it is assumed that domestic and imported goods are imperfect substitutes and a constant elasticity of substitution (CES) import aggregation function is specified. In a multi-country model, the function aggregates imports from all countries of origin, in this case from the trading partner and the rest of the world. The use of CES functions in multi-country trade models with imperfect substitution has led to empirical problems due to their restrictive nature. Here import demand equations based on the Almost Ideal Demand System (or AIDS) are used. The AIDS specification is based on that in Robinson, Soule, and Weyerbrock (1992) (see also Deaton and Muellbauer, 1980 and Green and Alston, 1990). The Stone price index is used. The specification of import demand with the AIDS function was incorporated into the USDA/ERS CGE model (Robinson, Kilkenny, and Hanson, 1990) by Hanson, Robinson, and Tokarick (1989). The parameters of the AIDS functions are calibrated from sectoral expenditure and substitution elasticities for each country. Since the substitution elasticities are assumed to be equal for goods from both countries, the AIDS functions are similar to multi-country CES functions with expenditure elasticities which differ from one.

4. Policy Simulations

We use the linked Austria-Hungary CGE model for policy simulations of bilateral interest. First, we study trade liberalization - unilaterally, bilaterally and globally. For Hungary a very important issue is the redirection of trade from the former COMECON towards western Europe. Because of the large differences in factor endwoment and factor prices between the countries, we also investigate Heckscher-Ohlin like questions: how factor movements between countries change comparative cost advantages overall and sectorally. Industrial policy questions (changes in indirect taxation and subsidization) are dealt with at the end of this chapter.

4.1 Trade Liberalization

Free trade treaties now exist between Hungary and both the EC and the EFTA. In both cases trade liberalization takes place in an asymmetric manner. That means that the EC and the members of EFTA reduce tariffs on imports from Hungary faster than Hungary does for imports from the EC and the EFTA. We have tried to capture this asymmetry by starting with one-sided liberalization (Austria versus Hungary) following by Hungary toward Austria. Then we move on to bilateral liberalization and lastly full liberalization.

The largest *overall welfare effects* for Hungary are in the case of assymetric liberalization by Austria (see **table 5**). Except in the case of full liberalization, Hungary gains more from liberalization than Austria. This is due to Hungary's greater trade share with Austria. Austria has the highest welfare gains from full liberalization. Nevertheless, the absolute welfare impact of liberalization is very modest, less than 1% for all simulations. These are standard results for static, full employment, CGE models. The bilateral trade shares do not change very much after liberalization, although exports increase overall. The biggest change can be found in the case of asymmetric liberalization of Hungary toward Austria (Hungary's import share increases by 1,6 percentage points).

For Hungary, a much bigger challange consists in the redirection of trade from the former CMEA to western European markets (see **table 6**). Hungary's ruble trade hade already decreased significantly from 50% in 1986 to 25% in 1990. A complete elimination of the Ruble trade would result in considerable production and welfare losses. The forint would devalue against the Austrian shilling by 5% in order to increase exports.

Table 5

Simulation Experiments:
Trade Liberalization I

	Austria liberalizes toward HU		Hungary liberalizes toward AU		Bilateral liberali-zation		Full liberali-zation	
	AU	**HU**	**AU**	**HU**	**AU**	**HU**	**AU**	**HU**
GDP (nominal)	-0,023	+0,052	+0,010	-0,209	-0,013	-0,156	-0,365	-1,041
Gross output	+0,011	-0,055	+0,011	-0,033	+0,017	-0,031	+0,068	-0,031
Hicks CV	+0,006	+0,345	+0,043	+0,107	+0,031	+0,220	+0,048	-0,029
Export shares:								
AU (1,5)	-	1,5	-	1,6	-	1,6	-	1,7
HU (9,7)	10,3	-	9,6	-	10,3	-	10,1	-
Import shares:								
AU (1,3)	-	1,4	-	1,3	-	1,4	-	1,4
HU (14,1)	14,3	-	15,7	-	15,7	-	14,3	-
Factor returns:								
Labour	+0,018	+0,073	+0,019	+0,214	+0,036	+0,287	+0,430	+1,667
Capital	+0,003	+0,072	-0,004	+0,200	-0,001	+0,271	+0,228	+1,577
AS/FT	+0,089	-	-0,672	-	-0,234	-	-0,208	-
Terms of Trade								
AU	-	1,000	-	1,025	-	1,025	-	1,008
HU	1,027	-	0,994	-	1,021	-	1,004	-

AU = Austria, HU = Hungary.
The figures for Gross output, Hicks compensating variation (CV), Factor returns and AS/FT are percentage changes compared to the base line scenario. An increase of AS/FT (change of the Austrian shilling against the Hungarian Forint) means that Austria devalues. The export/import shares in parenthesis are the base line values. Hicks CV = compensating variation in % of GDP. Terms of Trade are indices of export/import prices.

Table 6

Simulation Experiments:
Trade Liberalization II

	Elimination of Ruble trade in HU		Elimination of Ruble trade and bilateral trade liberalization	
	AU	**HU**	**AU**	**HU**
GDP (nominal)	+0,023	-3,097	+0,010	-3,285
Gross output	-0,000	-1,274	+0,011	-1,244
Hicks CV	+0,074	-3,745	+0,087	-3,796
Export shares:				
AU (1,5)	-	1,7	-	1,8
HU (9,7)	9,6	-	10,2	-
Import shares:				
AU (1,3)	-	1,3	-	1,5
HU (14,1)	14,6	-	15,9	-
Factor returns:				
Labour	+0,029	-0,374	+0,068	-0,078
Capital	+0,021	-0,016	+0,020	+0,260
AS/FT	-5,277	-	-5,162	-
Terms of Trade				
AU	-	1,034	-	1,060
HU	0,959	-	0,979	-

AU = Austria, HU = Hungary.
The figures for Gross output, Hicks compensating variation (CV), Factor returns and AS/FT are percentage changes compared to the base line scenario. An increase of AS/FT (change of the Austrian shilling against the Hungarian Forint) means that Austria devalues. The export/import shares in parenthesis are the base line values. Hicks CV = compensating variation in % of GDP. Terms of Trade are indices of export/import prices.

One could argue that Ruble trade is not comparable to trade with the West. Therefore any welfare measure must be inadequat. Products traded with the CMEA were often of lower quality than products exported to the EC. One should keep this in mind when using the Hicks compensating welfare measure. However, even if true, replacing ruble markets as a source of supply and finding Western markets for ruble exports causes a large shock to the economy and decrease in GDP and welfare.

The *sectoral* changes with trade liberalization follow from the base tariff levels. Thoses sectors with the highest tariffs have larger increases in imports, and therefore the partner's exports, after liberalization. For Austria the highest tariffs towards Hungary are in the food and agriculture (15%), and energy (11%) sectors (see **table 2**). Hungary's exports to Austria in these sectors increase more than 10% after Austria unilaterally liberalizes trade. Hungary's exports ot the rest of the world decline slightly (around 1%), so there is a small amount of trade diversion. Hungary does not differentiate tariffs by country (other than CMEA/non-CMEA), but has higher levels overall. Tariffs are over 9% in the food, chemicals, agriculture, machinery, and building and construction sectors **(table 3)**. After Hungary liberalizes toward Austria, Austria's exports increase in these sectors, with little change in exports to the rest of the world. With bilateral liberalization, each country's exports increase in the same sectors as with asymmetric liberalization. Exports to the rest of the world are little changed, so no trade is diverted in this case. In the case of full liberalization, Hungary has a much larger increase in imports from the rest of the world in the sectors with the highest starting tariffs.

Although ruble trade was around 25% of total trade in Hungary, it was particularly important in certain sectors. Nearly 50% of machinery exports, the largest export sector, went to ruble area markets **(table 3)**. More than 15% of exports from the food, chemicals, agriculture and light manufacturing sectors, each of which accounted for more than 10% of exports, are also to COMECON. Ruble imports make up nearly half of mining and metallurgy imports. 28% of machinery imports, which make up 37% of total imports, and more than 20% of chemicals and light manufactures also are from the ruble area. The sectoral impact of eliminating this trade is therefore quite large. Replacing this source of supply causes large increases in imports and domestic production of mining and metallurgy, especially. Imports decrease in sectors where domestic production was higher to start with: food, commerce and agriculture. With a devaluation of the forint against the shilling and the dollar, exports increase in all sectors, but especially in metallurgy. Mining and energy exports also increase greatly, but from a small base. For Austria, exports to Hungary show large increases in some sectors (metallurgy and machinery), but decrease in food, agriculture and communications. If Austria and Hungary liberalize bilateral trade along with the elimination of ruble area trade, the results are in the same direction. The increases in exports are larger to the partner and smaller to the rest of world.

4.2 Factor Movements between Austria and Hungary

After the regime change in 1989, Hungary suddenly became a very potent competitior for Austria for a variety of low-wage products. Aside from export competition, the low wages in Hungary is attracting capital from Austria. In the last two years, several firms formerly located in the eastern provinces of Austria and protected against competitors from Eastern-Europe by the "iron curtain", have closed their plants in Austria and invested directly in Hungary. On the one hand the low wages in Hungary attract Austrian capital, on the other hand high wages in Austria attract Hungarian labour.

A two-country Heckscher-Ohlin model with common world prices and factor price equalization would solve for an equilibrium of factor allocation (capital, labour) within both countries. In our linked two-country CGE model total supply of production factors is exogenous. Full mobility is allowed only among sectors. We therefore simulated the effects of factor movements between Austria and Hungary by changing the supply of factors accordingly. In the first case (see **table** 7) 2,5% of Hungarian labour migrates to Austria, output and welfare increases in Austria and decreases in Hungary. Change in factor prices are as one would expect; factor price equalization takes place. Labour becomes cheaper in Austria and more expensive in Hungary. The reverse is true for capital. Bilateral trade flows would not be affected very much. If, on the other hand, 2,5% Austrian capital migrates to Hungary, production increases in Hungary and decreases in Austria. Factor price equalization takes place, as expected. A combination of both migration scenarios results in stronger factor price equalization but weaker effects in output and welfare (see **table 7**). Note that combined migration has a negative effect on output and welfare in Hungary. The increase in capital does not compensate for the loss of labour.

If 2,5% of the Hungarian labour force migrates to Austria, Austrian GDP and labour demand increase the most in metallurgy, which has the highest relative wage. The increases in GDP for the other sectors are around 1-2%. In Hungary, the decrease in output is 1-3% in all sectors. A transfer of capital from Austria to Hungary causes a fairly even increase in output and capital demand by sector in Hungary of 1-3% and 4-5%, respectively. The decrease in Austria is also fairly even by sector. The combination of both migrations (capital migrates to Hungary, labour migrates to Austria) mirrors the effects of both single changes.

Table 7

Simulation Experiments:
Factor Movements between Austria and Hungary

	2,5% HU labour migrates to AU		**2,5% AU capital migrates to HU**		**2,5% AU capital migrates to HU and 2,5% labour migrates to AU**	
	AU	**HU**	**AU**	**HU**	**AU**	**HU**
GDP (nominal)	+2,224	-1,609	-1,027	+1,269	+1,170	-0,365
Gross output	+2,308	-1,761	-0,961	+1,201	+1,317	-0,527
Hicks CV	+2,625	-1,518	-1,100	+1,500	+1,529	-0,236
Export shares:						
AU (1,5)	-	1,5	-	1,6	-	1,5
HU (9,7)	9,9	-	9,6	-	9,8	-
Import shares:						
AU (1,3)	-	1,2	-	1,3	-	1,2
HU (14,1)	14,4	-	14,3	-	14,4	-
Factor returns:						
Labour	-1,833	+0,998	-1,077	+1,353	-2,896	+2,359
Capital	+2,590	-1,808	+1,532	-2,953	+4,162	-4,713
AS/FT	+0,530	-	-0,872	-	-0,012	-
Terms of Trade						
AU	-	0,987	-	1,006	-	0,993
HU	1,014	-	0,992	-	1,007	

AU = Austria, HU = Hungary.
The figures for Gross output, Hicks compensating variation (CV), Factor returns and AS/FT are percentage changes compared to the base line scenario. An increase of AS/FT (change of the Austrian shilling against the Hungarian Forint) means that Austria devalues. The export/import shares in parenthesis are the base line values. Hicks CV = compensating variation in % of GDP. Terms of Trade are indices of export/import prices.

4.3 Change in Factor Endowment in Hungary - The Case of Transformation

During the transformation process one can expect an increased accumulation of capital and consequent increase in productivity in Hungary. In the long run this should narrow the capital endowment gap between Austria and Hungary (see **table 1**). To shed some light on such a transformation process, we first increased the capital stock in Hungary (see **table 8**). Output and welfare increase accordingly. The biggest impact on the bilateral trade share would result in the case where a capital increase (by 200%) is combined with a four-fold increase in total factor productivity (TFP). This is the only experiment where Austria would increase its export share to Hungary dramatically. Similar experiments by Markusen and Wigle (1990) came to the conclusion that the North-South trade volume can be increased the most if one assumes a complete "catch up" of the South (i.e., the South is given the same purchasing power as the North).

As a consequence of the transformation process in Hungary, the Austrian shilling would revalue dramatically against the Forint and Austria would improve its terms of trade with Hungary.

With a 200% increase in capital in Hungary, GDP increases by more than 50% in mining and metallurgy and by more than 20% in most other sectors. Exports to Austria increases the most (around 50%) in the mining, chemicals and metallurgy sectors. Import from Austria increase the most in mining, food, commerce, agriculture and metallurgy. Trade with the rest of the world increases even more than with Austria and has the same sector structure. If capital stock is increased 15 times, the same sectoral changes can be observed, but they are much larger. GDP in metallurgy increases by 548% and mining and chemicals by more than 250%. Exports from these three sectors increase more than 200% to Austria and even more to the rest of the world. The largest effects are when total factor productivity is increases 4 times along with 200% increase in capital in Hungary. The largest sector increase in GDP and exports to Hungary is in metallurgy with 2513% and 749%, respectively. Ther increases in the other sectors are in the range of 200-500% for GDP and 100-200% for exports. Imports from Austria increase greatly, especially of mining and metallurgy.

Table 8

Simulation Experiments:
Change in Factor Edowment (Capital Stock) in Hungary

	Increase in capital in HU by 200%		Increase in capital in HU by 1500%		Increase in capital in HU by 200% and increase in TFP 4 times	
	AU	HU	AU	HU	AU	HU
GDP (nominal)	+0,058	+23,192	+0,306	+112,342	+0,872	+359,548
Gross output	+0,015	+23,393	+0,055	+131,829	+0,105	+393,198
Hicks CV	+0,142	+19,751	+0,678	+57,046	+1,983	+85,758
Export shares:						
AU (1,5)	-	1,9	-	3,8	-	8,4
HU (9,7)	9,3	-	6,7	-	3,6	-
Import shares:						
AU (1,3)	-	1,5	-	2,1	-	2,3
HU (14,1)	13,9	-	13,1	-	13,2	-
Factor returns:						
Labour	+0,060	+25,007	+0,306	+125,176	+0,804	+396,811
Capital	+0,045	-39,652	+0,232	-86,892	+0,754	+144,047
AS/FT	-3,244	-	+4,158	-	-15,318	-
Terms of Trade						
AU	-	1,069	-	1,331	-	1,705
HU	0,917	-	0,770	-	0,622	

AU = Austria, HU = Hungary.
The figures for Gross output, Hicks compensating variation (CV), Factor returns and AS/FT are percentage changes compared to the base line scenario. An increase of AS/FT (change of the Austrian shilling against the Hungarian Forint) means that Austria devalues. The export/import shares in parenthesis are the base line values. Hicks CV = compensating variation in % of GDP. Terms of Trade are indices of export/import prices. TFP = total factor productivity.

4.4 Industrial Policy

Our model does not capture imperfect competition or IO features such as economies of scale. Therefore industrial policy experiments are restricted to questions of harmonization of subidization and indirect taxation (see **tables 2** and **3**). Indirect tax rates, on average, are higher in Austria than in Hungary, but the level of subsidization is higher in Hungary (see **tables 2** and **3**).The biggest impact on output and welfare (positive in both countries) would result from the rationalization of net indirect taxes in both Austria and Hungary (see **table 9**). This would equalize sectoral net indirect taxation (indirect tax rates minus indirect subsidy rates). In both countries factor returns would decrease by similar amounts. The shilling would revalue against the Forint. Bilateral trade shares would not be affected very much.

In Austria indirect taxes range from around 2% to 17% for food. Indirect subsidies range from 0,5% to 6,6% in transport and communications. In Hungary indirect taxes are negative in the transport and communications and public service sectors. The top rates are 20% for commerce and around 15% for food and chemicals. Indirect subsidies are also the highest for food and commerce (5% and 7%), with mining also at 7%. The net indirect tax rates which yield the same revenue as the previous net taxes are 14,7% for Austria and 11,7% for Hungary. After equalization, output increases in those sectors with high starting net indirect taxes and decreases in thoses with lower starting levels. In Hungary output increases the most in chemicals and commerce and decreases in metallurgy, machinery and transport. In Austria output increases the most in chemicals and much less in mining and food. Output decreases in light manufactures, building, metallurgy, machinery and transport. The forint devalues against the shilling and the dollar, so export increase in Hungary, but the trade share with Austria increases only slightly. Austria increases exports to Hungary only in chemicals, mining and food.

When Hungary decreases indirect subsidies to Austria's levels, the impact is not as great. Both countries keep the distorted structure of indirect taxes, but Hungary decreases subsidy levels and adopts Austria's structure. The net effect is an increase in net indirect taxes in most cases. Output increases slightly in thoses sectors where net indirect taxes decrease, but the changes are only 1-2%.

Table 9

Simulation Experiments:
Industrial policy harmonization

	AU and HU equalize net indirect taxes (ind. taxes minus subsidies)		HU reduces subsidies to AU level	
	AU	**HU**	**AU**	**HU**
GDP (nominal)	+0,711	-0,649	+0,001	-0,550
Gross output	+4,696	+0,845	+0,006	+0,027
Hicks CV	+2,856	+1,332	+0,022	+0,047
Export shares:				
AU (1,5)	-	1,3	-	1,5
HU (9,7)	10,5	-	9,7	-
Import shares:				
AU (1,3)	-	1,2	-	1,2
HU (14,1)	14,3	-	14,4	-
Factor returns:				
Labour	-17,187	-19,534	+0,002	-4,130
Capital	-16,005	-20,225	+0,001	-4,606
AS/FT	-6,419	-	+0,632	-
Terms of Trade				
AU	-	1,075	-	1,001
HU	1,022	-	0,996	-

AU = Austria, HU = Hungary.
The figures for Gross output, Hicks compensating variation (CV), Factor returns and AS/FT are percentage changes compared to the base line scenario. An increase of AS/FT (change of the Austrian shilling against the Hungarian Forint) means that Austria devalues. The export/import shares in parenthesis are the base line values. Hicks CV = compensating variation in % of GDP. Terms of Trade are indices of export/import prices.

5. Conclusions

We used two linked static CGE models to study effects of trade liberalization, problems of migration and changes in industrial policy. Trade liberalization, whether asymmetric, bilateral, or overall has a positive effect on output and welfare for both Hungary and Austria, but is generally stronger for Hungary. However, the changes are quite small compared with some of the other simulations. The elimination of Ruble area trade, rationalizing net indirect tax systems and the long term buildup of Hungary's capital stock and productivity have much larger impacts on both Hungary and Austria.

The elimination of Ruble area trade happened suddenly in 1991 when COMECON was disbanded. It has had a negative impact on output in Hungary, as indicated by the simulations in this paper. However, Hungary has been remarkably successful in switching exports to western markets. The combination of eliminating ruble trade and bilateral liberalization increases Hungary's export share to Austria, but increases Austria's export share to Hungary even more. The migration of labour and capital between the two countries has a beneficial effect on the country which receives the labour or capital. The results from both liberalization and migration indicate that there are small effects in Austria, but that these policies (with the exception of labour migration to Austria) can be of substantial benefit to Hungary. Labour migration to Austria increases GDP there, but lowers that in Hungary. The long term build up of capital and increase in productivity in Hungary will, of course, have a large impact on output and exports in Hungary, but also provides a much larger market for Austria's exports. It is clear, that both countries will gain as Hungary continues to develop.

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Appendix: Trade Linked CGE Models of Austria and Hungary

The appendix lists the model equations in the same format that is used for the program used to solve the equations. GAMS, or the "General Algebraic Modeling System" is described in Brooke, Kendrick, and Meeraus (1988).

In this listing, all variables appear in upper case. Variable names with a suffix 0 represent base-year values and are specified as parameters (or constants) in the model. Lower case is used for parameters. Set names are all in lower case.

In the GAMS language:

Parameters are treated as constants in the model and are defined in separate "PARAMETER" statements.
"SUM" represents the summation operator, sigma.
"PROD" represents the product operator, pi.
"LOG" is the natural logarithm operator.
"$" introduces a conditional "if" statement.
The suffix .FX indicates a fixed variable.
The suffix .L indicates the level or solution value of a variable.
The suffix .LO indicates the lower bound of a variable.
The suffix .UP indicates the upper bound of a variable.
An asterisk (*) in column one indicates a comment. Some alternative treatments are shown commented out.
A subset is denoted by the subset name followed by the name of the larger set in parentheses. In statements, the subset name is then used by itself.
A semicolon (;) terminates a GAMS statement.
Items betweeen slashes ("/") are data.

```
*## SET DECLARATION
 SETS
  CTY1 UNIVERSE            /AU   AUSTRIA
                      HU   HUNGARY
                      RT   REST /

  K(CTY1) COUNTRIES        /AU   AUSTRIA
                      HU   HUNGARY /

 I SECTORS OF PRODUCTION /
          MIN   MINING
          FOO   FOOD
          CHM   CHEMICALS AND PETROL
          ENE   ELECTRICITY AND WATER
          COM   INT AND XTL TRADE  COMMERCE AND LODGING
          AGF   AGRICULTURE AND FORESTRY
          LMN   LIGHT AND OTHER MANU  TEXTIL WOOD AND PAPER
          BLD   BUILDING MATERIALS       STONE
          MET   METALLURGY
          MAC   MACHINERY
          CON   CONSTRUCTION
          TCM   TRANSPORT AND COMMUNICATIONS
          PRS   PRIVATE SERVICES      BANK AND OTHER SVCS
          PBS   PUBLIC SERVICES   HEALTH ADMIN       /

 IFF  FACTORS OF PRODUCTION / CAPITAL    CAPITAL
                      LABOR      LABOR   /

 INS  Institutions         /labr    Labor
                      ent      Enterprises / ;
```

```
ALIAS(I,J) ;
ALIAS(K,L) ;
ALIAS(CTY1,CTY2,cty3) ;
ALIAS(la,lb) ;
ALIAS(iff,f) ;

*################# VARIABLE DECLARATION #############

*## PRICE BLOCK
 EXR(k)          EXCHANGE RATE, DOMESTIC CURRENCY PER DOLLAR
 EXRR(k)          RUBLE EXCHANGE RATE
 P(i,k)          PRICE OF COMPOSITE GOODS
 PD(i,k)          DOMESTIC PRICES
 PE(i,k,cty1)     DOMESTIC PRICE OF EXPORTS
 PINDEX(k)          GDP DEFLATOR
 PM(i,k,cty1)      DOMESTIC PRICE OF IMPORTS
 PMR(i,k)          DOMESTIC PRICE OF IMPORTS RUBLE
 PER(i,k)          DOMESTIC PRICE OF EXPORTS RUBLE
 PWE(i,cty1,cty2) WORLD PRICE OF EXPORTS
 PWM(i,cty1,cty2) WORLD PRICE OF IMPORS
 PX(i,k)          AVERAGE OUTPUT PRICE
 PVA(i,k)          VALUE ADDED PRICE INCLUDING SUBSIDIES

*## PRODUCTION BLOCK
 E(i,cty1,cty2)    EXPORTS
 M(i,cty1,cty2)    IMPORTS BY REGION
 MR(i,k)          IMPORTS, RUBLE
 ER(i,k)          EXPORTS, RUBLE
 X(i,k)          COMPOSITE GOODS SUPPLY
 XD(i,k)          DOMESTIC OUTPUT
 XXD(i,k)          DOMESTIC SALES
 XXDD(i,k)          DOMESTIC SALES NET OF RUBLE TRADE
 INT(i,k)          INTERMEDIATE DEMAND
 VA(k)          TOTAL REAL VALUE ADDED
 SMQ(i,k,cty1)     IMPORT VALUE SHARE IN TOTAL SECTORAL DEMAND

*## FACTOR BLOCK
 FS(iff,k)          FACTOR SUPPLY
 FDSC(i,iff,k)     FACTOR DEMAND BY SECTOR
 WF(iff,k)          AVERAGE FACTOR PRICE
 YFCTR(iff,k)      FACTOR INCOME
 WFDIST(i,iff,k)   FACTOR DIFFERENTIAL

*## INCOME AND EXPENDITURE BLOCK
 CDD(i,k)          FINAL DEMAND FOR PRIVATE CONSUMPTION
 FSAV(k,cty1)      NET FOREIGN SAVINGS
 FBAL(k)          CURRENT ACCOUNT BALANCE
 INDTAX(k)          INDIRECT TAX REVENUE
 INDSUB(k)          INDIRECT SUBSIDY EXPENDITURE
 SSTAX(k)          FACTOR TAXES
 TARIFF(k,cty1)    TARIFF REVENUE
 TARIFFR(k)          TARIFF REVENUE RUBLE
 ESUB(k,cty1)      EXPORT SUBSIDY EXPENDITURE
 ESUBR(k)          EXPORT SUBSIDY EXPENDITURE RUBLE
 YH(k)          HOUSEHOLD INCOME
 YINST(ins,k)      INSTITUTIONAL INCOME
 RGDP(k)          REAL GDP
 GDPVA(k)          VALUE ADDED IN MARKET PRICES GDP
 WELFARE          SUMMATION OF AU PLUS HUNICAN INCOMES
 WALRAS2(k)          WALRAS LAW FOR EACH COUNTRY
 GDTOT(k)          GOVERNMENT REAL CONSUMPTION
 GD(I,k)          GOVERNMEND DEMAND BY SECTOR
```

```
GOVSAV(k)        GOVERNMENT SAVING
GOVREV(k)        GOVERNMENT REVENUE
HHT(k)           GOVT TRANSFERS TO HOUSEHOLDS
GPROF(k)         DISTRIBUTED PROFITS TO GOVERNMENT
DIVDND(k)        DISTRIBUTED PROFITS TO HOUSEHOLDS
ENTT(k)          GOVT TRANSFERS TO ENTERPRISES
ID(I,k)          INVESTMENT DEMAND BY GOODS
DST(I,k)         INVENTORY INVESTMENT DEMAND
ZTOT(k)          AGGREGATE NOMINAL INVESTMENT
ZFIX(k)          FIXED AGGREGATE REAL INVESTMENT
HSAV(k)          AGGREGATE HOUSEHOLD SAVINGS
REMIT(k)         REMITTANCE INCOME TO HOUSEHOLDS
FKAP(k)          FOREIGN CAPITAL FLOW TO ENTERPRISES
FBOR(k)          FOREIGN BORROWING BY GOVERNMENT
FSAVE(k)         FOREIGN SAVINGS
FSAVRE(k)        FOREIGN SAVINGS RUBLE
ENTSAV(k)        ENTERPRISE SAVINGS
ESR(k)           ENTERPRISE SAVINGS RATE
VATAX(k)         VALUE ADDED TAXES
ENTAX(k)         ENTERPRISE TAXES
HTAX(k)          HOUSEHOLD TAXES

*#################### Definition of parameters #################

PARAMETERS
tm(i,k,cty1)       tariff rates on imports
te(i,k,cty1)       subsidy rates on exports
tmr(i,k)           import tariff rates ruble
ter(i,k)           export subsidy rates ruble
pxdwt(i,k)         price index weights

io(i,j,k)          input output coefficients by country

rhoc (i,k)         CES import aggregation parameter
rhot(i,k)          CET export transformation parameter
etae(i,k)          export demand elasticity for rest of world
ac(i,k)            CES import function shift parameter
ad(i,k)            production function shift parameter
alpha(i,iff,k)     Cobb-Douglas factor share parameter
at(i,k)            CET export function shift parameter
delta(i,k,cty1)    CES import function share parameter
gamma(i,k,cty1)    CET export function share parameter

smq0(i,k,cty1)     share parameter in Stone price index
aqs(i,k)           constant in Stone price index

amq(i,k,cty1)      constant in AIDS function
betaq(i,k,cty1)    income coefficient in AIDS function
gammaq(i,k,cty2)   price coefficient in AIDS function

cles(i,hh,k)       household consumption shares
gles(i,k)          governmentt expenditure shares
zshr(i,k)          investment demand shares
sintyh(hh,ins,k)   institution to household income mapping shares
mps(hh,k)          savings propensities by households
esr(k)             enterprise savings rates
sstr(iff,k)        factor income tax rate
hhtr(hh,k)         household income tax rate
entr(k)            enterprise income tax rate
vatr(i,k)          value added tax rate
itax(i,k)          indirect tax rate
```

EQUATIONS

*## PRICE BLOCK
PMDEF(i,k,cty1) DOMESTIC IMPORT PRICES
PEDEF(i,k,cty1) DOMESTIC EXPORT PRICES
PDDEF(i,k,cty1) Domestic export price for substitutes
ABSORPTION(i,k) VALUE OF DOMESTIC SALES
SALES2(i,k) Domestic sales net of ruble trade
SALES(i,k) VALUE OF DOMESTIC OUTPUT
PINDEXDEF(k) DEFINITION OF GENERAL PRICE LEVEL
ACTP(i,k) Value added price inclusive of subsidies

*## PRODUCTION BLOCK
ACTIVITY(i,k) PRODUCTION FUNCTION
INTEQ(i,k) Intermediate demand
PROFITMAX(i,iff,k) FIRST ORDER CONDITIONS FOR PROFIT MAXIMUM
CET(i,k) CET FUNCTION
CET2(i,k) Output with infinite elastic transformation
ESUPPLY(i,k,cty1) EXPORT SUPPLY
EDEMAND(i,k) Export demand from rt
ARMINGTON(i,k) COMPOSITE GOOD AGGREGATION FUNCTION
COSTMIN(i,k,cty1) F.O.C. FOR COST MINIMIZATION OF COMPOSITE GOOD
PDAIDS(i,k) PRICE TRANSFORMATION FOR AIDS
STONEP(i,k) Stone price index
AIDS(i,k,cty1) AIDS IMPORT SHARE EQUATION
AIDS2(i,k,cty1) Definition of import expenditure shares
AIDS3(i,k) Demand for domestic good
AIDS4(i,k) Sum of AQ constraint
SUMTEST(i,k) Test on sum of betaq

*## INCOME BLOCK
YFCTREQ(iff,k) FACTOR INCOME
HHY(k) HOUSEHOLD INCOME
TARIFFDEF(k,cty1) TARIFF REVENUE
ESUBDEF(k,cty1) EXPORT SUBSIDY EXPENDITURE
ESUBRDEF(k) EXPORT SUBSIDY EXPENDITURE RUBLE
INDTAXDEF(k) INDIRECT TAXES ON DOMESTIC PRODUCTION
INDSUBDEF(k) INDIRECT SUBSIDIES ON DOMESTIC PRODUCTION
YINST1(k) Labor institution income equation
YINST2(k) Enterprise institution income equation
ENTAXEQ(k) ENTERPRISE TAXES EQUATION
SSTAXEQ(k) SOCIAL SECURITY TAX EQUATION
HTAXEQ(k) HOUSEHOLD TAXES EQUATION
VATAXEQ(k) VALUE ADDED TAX EQUATION
GOVREVEQ(k) GOVERNMENT REVENUE EQUATION
GOVSAVEQ(k) GOVERNMENT SAVINGS EQUATION
HSAVEQ(k) HOUSEHOLD SAVINGS EQUATION
ENTSAVEQ(k) ENTERPRISE SAVINGS EQUATION
TOTSAVE(k) Total savings
FORSAVE(k) Foreign savings
INVEST(i,k) Fixed investment demand by sector
INVEST2(k) Total investment demand

*## EXPENDITURE BLOCK
CDDEQ(i,k) PRICE CONSUMPTION BEHAVIOR
GDEQ(i,k) Government expenditure

*## MARKET CLEARING
EQUIL(i,k) GOODS MARKET EQUILIBRIUM
FMEQUIL(iff,k) FACTOR MARKET EQUILIBRIUM
CAEQ(k,cty1) CURRENT ACCOUNT BALANCES
FBALEQ(k) FBAL DEFINITIONS

```
*## GROSS NATIONAL PRODUCT
  GDPY(k)          TOTAL VALUE ADDED INCLUDING INDTAX
  GDPR(k)          REAL GDP

*###### EQUATION ASSIGNMENT #####

*## PRICE BLOCK

 PMDEF(i,k,cty1)..  PM(i,k,cty1) =E= PWM(i,k,cty1)*EXR(k)
                          *(1 + tm(i,k,cty1) ) ;

 PEDEF(i,k,cty1)..  PE(i,k,cty1) =E= PWE(i,k,cty1) * EXR(k)
                          *(1 + te(i,k,cty1) );

 PDDEF(i,k,cty1)..  PE(i,k,cty1) =E= PD(i,k);

 ABSORPTION(i,k)..  P(i,k)*X(i,k) =E= PD(i,k)*XXDD(i,k) +
                 SUM(cty1, (PM(i,k,cty1)*M(i,k,cty1)));

 SALES(i,k)..       PX(i,k)*XD(i,k) =E= PD(i,k)*XXD(i,k) +
                 SUM(cty1, (PE(i,k,cty1)*E(i,k,cty1)));

 SALES2(i,k)..      XXDD(i,k) =E= XXD(i,k) - ER(i,k) ;

 PINDEXDEF(k)..     PINDEX(k) =E= SUM(i, pxdwt(i,k)*PX(i,k)) ;

 ACTP(i,k)..        PVA(i,k) =E= (1.0 - (itax(i,k)-isub(i,k)) )*PX(i,k)
                     - SUM(j, io(j,i,k)*P(j,k)) ;

*## PRODUCTION BLOCK
*Cobb-Douglas Production Function

 ACTIVITY(i,k)..    XD(i,k) =E= ad(i,k)*PROD(iff,
              FDSC(i,iff,k)**alpha(i,iff,k));

 PROFITMAX(i,iff,k).. WF(iff,k)*WFDIST(i,iff,k)*FDSC(i,iff,k)
              =E= XD(i,k)*(1 -
                vatr(i,k))*PVA(i,k)*alpha(i,iff,k) ;

 INTEQ(i,k)..       INT(i,k)  =E= SUM(j, io(i,j,k)*XD(j,k));

 CET(i,k)..         XD(i,k) =E= at(i,k)*(SUM(cty1, gamma(i,k,cty1)
                 *E(i,k,cty1)**(-rhot(i,k)))
                 + (1-SUM(cty1, gamma(i,k,cty1)))*XXD(i,k)
                 **(-rhot(i,k)))**(-1/rhot(i,k)) ;

 CET2(i,k)..        XD(i,k) =E= XXD(i,k) + SUM(cty1, E(i,k,cty1)) ;

 ESUPPLY(i,k,cty1).. E(i,k,cty1)/XXD(i,k) =E= (PD(i,k)/PE(i,k,cty1)
              *gamma(i,k,cty1)/(1 - SUM(cty2,
              gamma(i,k,cty2))))**(1/(1+rhot(i,k))) ;

 EDEMAND(i,k)..     E(i,k,"rt") =E= E0(i,k,"rt")* (PWE(i,k,"rt")
                     /PWE0(i,k,"rt"))**(-etae(i,k));

 ARMINGTON(i,k)..   X(i,k) =E= ac(i,k)*(SUM(cty1, delta(i,k,cty1)
                   *M(i,k,cty1)**(-rhoc(i,k)))
                   +(1- SUM(cty1, delta(i,k,cty1)))
                   *XXDD(i,k)**(-rhoc(i,k)))**(-1/rhoc(i,k)) ;
```

```
COSTMIN(i,k,cty1).. M(i,k,cty1)/XXDD(i,k) =E= (PD(i,k)/PM(i,k,cty1)
                    *delta(i,k,cty1)/(1 -SUM(cty2,delta(i,k,cty2))))
                    **(1/(1+rhoc(i,k))) ;

PDAIDS(i,k)..   PM(i,k,k) =E= PD(i,k) ;

TRLOGP(i,k)..   LOG(P(i,k)) =E= aq(i,k) + SUM(cty2, amq(i,k,cty2)
                *LOG(PM(i,k,cty2))) + (1/2)*SUM((cty1,cty2)),
                gammaq.L(i,k,cty1,cty2)*LOG(PM(i,k,cty1))
                *LOG(PM(i,k,cty2))) ;

STONEP(i,k)..   LOG(P(i,k)) =E=  LOG(aqs(i,k)) + SUM(cty2,
               SMQ0(i,k,cty2)*LOG(PM(i,k,cty2))) ;

AIDS(i,k,cty1).. SMQ(i,k,cty1) =E= amq(i,k,cty1) +betaq(i,k,cty1)
               *LOG(X(i,k)) + SUM(cty2$smq0(i,k,cty2),
               gammaq.L(i,k,cty1,cty2)*LOG(PM(i,k,cty2)));

AIDS2(i,k,cty1)..  PM(i,k,cty1)*M(i,k,cty1) =E=
                         smq(i,k,cty1)*P(i,k)*X(i,k) ;

AIDS3(i,k)..   PD(i,k)*XXDD(i,k) =E= (1-sum(cty1, smq(i,k,cty1)))
                        *X(i,k)*P(i,k) ;

AIDS4(i,k)..      SUM(cty1, amq(i,k,cty1)) =E= 1 ;


*## INCOME BLOCK

YFCTREQ(iff,k)..   YFCTR(iff,k) =E= SUM(i,WF(iff,k)*WFDIST(i,iff,k)
                      *FDSC(i,iff,k));

TARIFFDEF(k,cty1).. TARIFF(k,cty1) =E= SUM(i,tm(i,k,cty1)*M(i,k,cty1)
                        *PWM(i,k,cty1))*EXR(k);

ESUBDEF(k,cty1)..  ESUB(k,cty1) =E= SUM(i,te(i,k,cty1)*E(i,k,cty1)
                        *PWE(i,k,cty1))*EXR(k);

ESUBRDEF(k)..     ESUBR(k) =E= SUM(i, -P(i,k)*MR(i,k) +PD(i,k)*ER(i,k) );

INDTAXDEF(k).. INDTAX(k) =E= SUM(i, itax(i,k)*PX(i,k)*XD(i,k)) ;

INDSUBDEF(k).. INDSUB(k) =E= SUM(i, isub(i,k)*PX(i,k)*XD(i,k)) ;

YINST1(k)..   YINST("labr",k) =E= SUM(la, (1.0 -sstr(la,k))*YFCTR(la,k));

YINST2(k)..   YINST("ent",k) =E=YFCTR("capital",k)
                 *(1.0-sstr("capital",k)) + EXR(k)*FKAP(k)
                 - ENTSAV(k) -ENTAX(k) + ENTT(k)
                 - GPROF(k) - DIVDND(k)
                 - SUM(i,XD(i,k) *(1 - vatr(i,k))*PVA(i,k));

HHY(k)..   YH(k)  =E= SUM(ins, YINST(ins,k)) + EXR(k)*REMIT(k)
                 + HHT(k) + DIVDND(k) ;

ENTAXEQ(k)..  ENTAX(k)  =E= ENTR(k)*(YFCTR("capital",k) +ENTT(k)) ;
SSTAXEQ(k)..  SSTAX(k)  =E= SUM(iff, sstr(iff,k)*YFCTR(iff,k));
HTAXEQ(k)..   HTAX(k)   =E=  hhtr(k)*YH(k) ;
VATAXEQ(k)..  VATAX(k)  =E= SUM(i, vatr(i,k)*PVA(i,k)*XD(i,k)) ;
GOVREVEQ(k).. GOVREV(k) =E= SUM(cty1,TARIFF(k,cty1)) + INDTAX(k)
               -INDSUB(K) + SSTAX(k) + HTAX(k) + GPROF(k)
               + ENTAX(k) + VATAX(k) + FBOR(k)*EXR(k);
```

```
GOVSAVEQ(k)..  GOVSAV(k) =E= GOVREV(k) - SUM(i, GD(i,k)*P(i,k)) -HHT(k)
           - ENTT(k) - SUM(cty1, ESUB(k,cty1)) - ESUBR(k) ;

HSAVEQ(k)..  HSAV(k)  =E=  mps(k)*((1.0-hhtr(k))*YH(k));

ENTSAVEQ(k)..  ENTSAV(k) =E= esr(k)*YFCTR("capital",k) ;

TOTSAVE(k)..  ZTOT(k) =E= GOVSAV(k) + HSAV(k) + ENTSAV(k)
               + EXR(k)*FSAVE(k);

FORSAVE(k)..  FSAVE(k) =E= FBAL(k)-FKAP(k)-FBOR(k)-REMIT(k);


*## EXPENDITURE BLOCK

CDDEQ(i,k)..  P(i,k)*CDD(i,k) =E= cles(i,k)*YH(k)*(1.0-hhtr(k))
                       *(1.0-mps(k));

GDEQ(i,k)..   GD(i,k) =E= gles(i,k)*GDTOT(k) ;

INVEST(i,k)..  ID(i,k) =E= zshr(i,k)*ZFIX(k) ;

INVEST2(k)..  ZTOT(k) =E= SUM(i, P(i,k)*(ID(i,k)+DST(i,k))) +WALRAS2(k) ;


*## MARKET CLEARING
*## PRODUCT MARKETS

 EQUIL(i,k)..  X(i,k) + MR(i,k) =E=
                 INT(i,k)+CDD(i,k)+GD(i,k)+ID(i,k)+DST(i,k) ;
*## FACTOR MARKETS

FMEQUIL(iff,k)..  SUM(i, FDSC(i,iff,k)) =E= FS(iff,k) ;

*## BALANCE OF TRADE

CAEQ(k,cty1)..      SUM(i, PWM(i,k,cty1)*M(i,k,cty1)) =E=
                      SUM(i, PWE(i,k,cty1)*E(i,k,cty1))
                      + FSAV(k,cty1) ;

FBALEQ(k)..  FBAL(k) =E= SUM(cty1, FSAV(k,cty1)) ;


*## GROSS NATIONAL PRODUCT

GDPY(k)..    GDPVA(k) =E= SUM(i, PVA(i,k)*XD(i,k)) +INDTAX(k)
            - INDSUB(k)  + SUM(cty1, TARIFF(k,cty1))
            - SUM(cty1, ESUB(k,cty1)) -  ESUBR(k) ;

GDPR(k)..    RGDP(k) =E= SUM(i, CDD(i,k) + GD(i,k) +ID(i,k) +DST(i,k))
                + SUM((i,cty1), E(i,k,cty1)*PE(i,k,cty1))
                - EXR(k)*SUM((i,cty1), M(i,k,cty1) *
                PWM(i,k,cty1)) ;

*################# MODEL CLOSURE ################################

*## FACTOR MARKET CLOSURE

*## Factors are fully mobile with factor returns adjusting, base year
* factor distortions (WFDIST) fixed
  FS.FX(iff,k)          = FS0(iff,k) ;
```

```
 WFDIST.FX(i,iff,k)      = WFDIST0(i,iff,k) ;

*## FOREIGN MARKET CLOSURE

*## The foreign balance (current account balance) is fixed exogenously
* and the exchange rate is the equilibrating variable.  Each country has
* one exchange rate variable and one balance of trade constraint (FBAL).
* FBAL is defined for each country with respect to the aggregate of trade
* balances with all trading partners.  Cross exchange rates are implictly
* set by arbitrage conditions.  Bilateral trade banaces are not fixed.
* The model has variables to finance the balance of trade (FBOR, REMIT,
* FKAP and FSAVE).  FSAVE is determined residually.

 FBAL.FX(k)       = FBAL0(k) ;
 FBOR.FX(k)       = FBOR0(k) ;
 REMIT.FX(k)      = REMIT0(k) ;
 FKAP.FX(k)       = FKAP0(k) ;

*## RUBLE TRADE CONSTRAINTS
* Ruble trade flows are fixed exogenously

 ER.FX(i,k)       = ER0(i,k) ;
 MR.FX(i,k)       = MR0(i,k) ;

*## GOVERNMENT CLOSURE
* Real government spending (GDTOT) is fixed exogenously, the government
* deficit (GOVSAV) is determined residually.

 GDTOT.FX(k)      = GDTOT0(k) ;
 GD.FX(i,k)       = GD0(i,k) ;
 HHT.FX(k)        = HHT0(k) ;
 ENTT.FX(k)       = ENTT0(k) ;
 GPROF.FX(k)      = GPROF0(k) ;
 DIVDND.FX(k)     = DIVDND.L(k) ;

*## INVESTMENT CLOSURE
* Total real investment is fixed exogenously, savings adjusts.
* The inventory component of investment (DST) is fixed exogenously.

 DST.FX(i,k)      = DST0(i,k) ;
 ID.FX(i,k)       = ID0(i,k) ;
 ZFIX.FX(k)       = ZFIX0(k) ;

*## NUMERAIRE PRICE INDEX

 PINDEX.FX(k)     = PINDEX0(k) ;
```

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