

The effects of multinationals on host economies: A CGE approach

(Preliminary version)

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Abstract

The aim of this paper is analysing the effects on a host economy of the entry of multinational enterprises (MNEs). Our empirical methodology makes use of the computable general equilibrium (CGE) analysis, through an extension of the Global Trade Analysis Project (GTAP) model that includes MNEs. We have paid a special attention to a mostly neglected aspect of the impact of MNEs, namely, profit repatriation. The empirical analysis is applied to the case of the Czech Republic, a country that has received substantial inflows of foreign direct investment in the last few years.

Key words: Multinational firms, Foreign direct investment, Computable general equilibrium

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1. Introduction

Most applied trade models have not considered the presence of multinational enterprises (MNEs), which seems to be largely due to data constraints on their activities. But more generally, at the theoretical level, it is probably fair to say that the introduction of MNEs has posed an important challenge to trade models for a long time (Markusen, 2002).

It is clear, however, that MNEs are behind many trade flows. So, for instance, according to the UNCTAD's 2000 *World Investment Report*, (i) one-third of the volume of world trade is made of transactions where MNEs are in one of the two sides of the exchange; and (ii) another one-third is intra-firm trade (i.e., trade within the MNEs, between the parent and the subsidiary, or between affiliates). Accordingly, including MNEs in the picture should improve, in a significant manner, our understanding of international trade flows.

The aim of this paper is analyzing the effects on host countries of the entry of MNEs, for the case of the Czech Republic, a country that has received substantial foreign direct investment (FDI) inflows in the last few years. In addition, the data on MNEs for the Czech Republic are particularly detailed, allowing for a quite detailed degree of sectoral aggregation. We have paid a special attention to a mostly neglected aspect of the impact of MNEs, namely, profit repatriation. Our results suggest that the negative effects of profit repatriation are of an important amount, and might even offset the positive impact of an increase in the capital stock caused by the entry of MNEs in the host economy.

Our empirical methodology makes use of an extension of the GTAP model (Hertel, 1997) to include MNEs. GTAP stands for Global Trade Analysis Project, i.e., the name of a team of researchers working at Purdue University, Indiana, USA, on computable general equilibrium (CGE) models, which allow for the use of a unique database of the world economy for general equilibrium

simulations, namely, the GTAP database. A particular advantage of this extension is that allows us to utilize OECD's (2005) data on MNEs activities. In addition, CGE simulations yield quantitative outcomes and not just qualitative intuitions regarding the effects of MNEs on a specific host economy. This can be particularly useful, giving the existing controversy on the MNEs impact on host countries.

The rest of the paper is organised as follows. The model is briefly summarized in section 2. The simulations performed and the data are described in section 3. The results from the simulations, both at the aggregate and sectoral levels, are presented in section 4. Finally, section 5 concludes.

2. The model

Until very recently, the study of the effects of MNEs on host countries has been based mainly on both econometric techniques and descriptive studies. Although still providing helpful results, these studies constitute a body of research mostly fragmented into separate parts according to the particular effect analyzed. The use of a general equilibrium framework, instead, allows to concentrate on a set of effects arising from the presence of MNEs, and derive their economy-wide impact in a unified framework.

Our approach is based on a walrasian CGE model, which incorporates real data into a rigorous theoretical framework. These models are based on the Arrow-Debreu general equilibrium model with some potential extensions, where the interactions among economic agents are presented as a system of equations derived from microeconomic optimisation theory (Shoven and Whalley, 1984, 1992). These microeconomic optimisation decisions are embedded in a framework representing national accounts identities, i.e., the model also rests on the usual progression of the circular flow of the economy: production, income distribution, and domestic and foreign demand.

Thus, a CGE model yields macroeconomic predictions stemming from its microeconomic aggregation (Devarajan and Robinson, 2005).

In the rest of this section we provide a summary description of the model used for simulations. A more detailed explanation can be found in Latorre (2007). The full set of equations, a complete list of endogenous and exogenous variables and parameters used in the model, together with their definitions are shown in the Appendix at the end of the paper.

As mentioned above, the particular model built for our analysis is a 2-region, 2-factor, 20-sector version of the GTAP model, extended to incorporate MNEs. This extension of the GTAP model considers a host region (the Czech Republic) where MNEs are introduced, and a rest-of-the-world (ROW) region where, in contrast, MNEs are absent, due to lack of data. There is a representative household in each region, whose income stems from the remuneration of all factors of production, together with fiscal revenues from several taxes. In the simulation considering profit repatriation, however, a portion of the remuneration of the foreign capital is deducted from the income of the representative household of the host region and added to that in ROW. In any case, the representative household fully spends his income in investment, private consumption, and public consumption. To simplify, the real levels of investment and public consumption do not change after MNEs entry, but private consumption does.

Regarding firms' behaviour, two main departures from the GTAP standard model arise due to the presence of MNEs. On the one hand, each good in the host economy will be produced not only by domestic firms but also by MNEs. On the other hand, capital, as a factor of production, now can be either foreign or domestic, i.e., the capital stock in the host country can be owned either by domestic firms or by MNEs. Capital is modelled as a specific factor in order to satisfy the extended conclusion in the literature that MNEs have a "very distinctive bundle of capabilities" (Barba

Navaretti and Venables, 2004, p. 278), “proprietary assets” (e.g., Caves, 1996, chapters 1 and 2), and, in general, the idea that MNEs have some “ownership advantages” (Dunning, 1977, 2000), which provide them with a different and superior technology as compared to domestic firms.

For each i good and sector there are, after introducing MNEs, two different “varieties” –a foreign and a domestic one. Thus, in the country hosting MNEs, our model duplicates the sources of production of each good and combines both varieties into a unique composite good i –the “domestic” good, i.e., that available for either final or intermediate consumption. Both MNEs and domestic firms produce under constant returns to scale, using as inputs both domestically-produced and imported intermediate goods, as well as two primary factors, labour and capital. However, both kinds of firms possess different technologies, with MNEs being more capital intensive, and showing a greater reliance on imported intermediates as compared to domestic firms.

Technology would also differ between MNEs and domestic firms due to the assumption of specific capital. So, capital will therefore exhibit a different price according not only to the type of good for which it is used for production, as in the standard GTAP model, but also according to whether it is used for production of either the foreign or the national variety of that particular good. This implies, in turn, that the costs of MNEs versus those of domestic firms will be different so that, in equilibrium, the prices of the different varieties of the same good will also differ. Such a disparity in prices across varieties of the same good implies that goods are not homogenous within the same sector. This violates the condition of homogenous goods necessary for perfect competition to hold, thus creating a climate of competition more appropriate for the presence of MNEs.

The standard GTAP model (and this extension) offers a detailed description of international trade, by taking into account not only the volume of commodities traded, but also transport and

insurance services associated with trade flows. Furthermore, trade flows are subject to export subsidies and import tariffs which are specified at the level of commodities and region.

Some final comments relate to primary factor endowments. Labour is fully mobile across sectors and its endowment is fixed. Capital endowments, in turn, will vary according to MNEs' entry, which is modelled as leading to changes in the capital stock held by foreign MNEs already installed in the host economy.

3. Simulations and data

Two simulations will be run:

- 1) An increase in the foreign share of the capital stock of a particular sector, due to the entry of MNEs, while the capital stock in the rest of sectors remains fixed. Notice that in the case of transition economies, such as the Czech Republic, the idea of MNEs leading to an increase in the capital stock, rather than a mere change in ownership, seems appropriate for at least three reasons. First, because the share of greenfield investments on total FDI inflows is higher than for developed countries (Schöllmann, 2001). Second, due to the evidence of large amounts of obsolete capital stocks in the transition economies, so that even the flows linked to acquisitions need to replace the existing capital stock (Kroska, 2001; Bornstein, 2001). And third, since foreign investors in the Czech Republic have been found to exhibit the highest propensities to invest in gross capital formation (Lizal and Svegner, 2002). On the other hand, the amount by which foreign capital will be increased in this simulation is 50 per cent, over the capital stock previously held by MNEs in each particular sector. Although such increase might seem excessively high at a first sight, it would not appear to be so extreme, however, if one recalls the growth of FDI inflows in the Czech Republic since transition began.

- 2) A combination of an increase in the capital stock with the effect of repatriation of the remuneration of the extra capital that the entry of MNEs adds. In particular, we still assume a 50 per cent increase in the capital stock of a particular sector as in the previous simulation, but now its remuneration will not be part of the income of the representative household of the host economy, increasing instead the income of ROW. Notice that, even though “profit repatriation” should be called, strictly speaking, “income repatriation”, we prefer to use that more common term (and will do it henceforth) once it is clear what we really denote.

Regarding the data, and as explained before, our model is an extension of a 2-region, 2-factor, 20-sector version of GTAP. The two regions are the Czech Republic and ROW, the two factors are labour and capital, and the 20 sectors appear in Table 1. Disaggregating to this level was made using the GEMPACK software, resulting in the maximum possible sectoral disaggregating in order to use three different sources of data. The main data source is the GTAP6 Data Base (Dimanaran and McDougall, 2005). Most of the production data for the Czech Republic, however, has been split into a foreign and a national part, where the information to assign each part to national firms and MNEs has been found in OECD (2005) and Czech National Bank (2004).

Table 1 shows the relative importance on the whole Czech economy, of the 20 sectors used in the analysis (in terms of gross output, total capital¹, imports, and exports), as well as the destination of each sector’s production (percentage of its production that goes to intermediates, investment, exports, private consumption, and public consumption), and the sectoral weight of MNEs (in terms of gross output and capital). All the data refer to the year 2001 (i.e., the last year for which the GTAP database is available). It is particularly remarkable the important weight of MNEs in nearly all sectors of the economy; for the economy as a whole, the weights of MNEs in gross production and capital amount to 29.1 and 28.5 per cent, respectively.

¹ Strictly speaking, “capital” stands for what national accounts statistics denote “property income”.

The two simulations have been run in five particular sectors of the Czech economy, i.e., a) Chemicals, rubber and plastics (Chemicals, henceforth); b) Motor vehicles; c) Electronics; d) Trade, repair; hotels and restaurants (Trade, henceforth); and e) Finance, insurance, real estate, business activities (Finance, henceforth). The choice of sectors has tried to combine their importance as FDI recipients, as well as their relative weight in the overall Czech economy. Also, we incorporate into the analysis not only manufacturing but also services sectors, which is rather uncommon in the empirical literature; and, in the case of manufactures, the particular sectors chosen represent mostly dynamic activities, i.e., they are classified as medium- and high-technology sectors.

Finally, regarding the values of the elasticities needed to calibrate and simulate the model, the elasticity of substitution between labour and capital is set at 10^{-6} in order to fulfil the specific capital assumption². In turn, the elasticity of substitution between national and foreign production is given the same value to that between domestic and imported goods, as supplied by GTAP. For the rest of elasticities, the GTAP values, computed by the GTAP team from econometric evidence, have been also taken; see Hertel (1997) and Dimanaran and McDougall (2005, chapter 20) for details. Finally, due to the Walrasian nature of the model, the monetary variables (values and prices) are set with respect to a numeraire; and, following the usual practice, the Consumer Price Index (CPI) has been taken as the numeraire³.

4. Empirical results

In this section we present the results from the two simulations performed, i.e., the entry of MNEs with and without profit repatriation, which will be denoted in the tables below as “MNEs’ entry”

² Notice that this elasticity is set at a 10^{-6} , instead of 0, in order to facilitate the computation of the model.

³ The GTAP6inGAMS selects by default a different variable as the numeraire. This variable is the budget available for private consumption in ROW ($raINC_{Row}$, see equation (23)). The interpretation of the results with respect to this numeraire would be complex, though. Therefore, in our results, we present all values and monetary variables in terms of the CPI, i.e. using the CPI as the numeraire, instead of the default numeraire. The only exception is, however, the CPI itself, which continues to be expressed in terms of the default numeraire.

and “Profit Rep”, respectively. We first discuss the results on the main aggregate variables, and then the sectoral effects.

4.1 Aggregate results

Table 2 shows the effects of the two simulations on the main aggregate variables, where each column gives the percentage change in real terms with respect to the benchmark (i.e., the initial data set) in a particular aggregate variable. The variables considered are: the real wage –the same in all sectors due to the assumption of full labour mobility; the real rental rate of capital –a weighted average of its price in all sectors; the real GDP measured at factor costs; welfare, proxied by the change in real private consumption⁴; the CPI⁵; and the real value of imports and exports, both measured at international prices.

In nearly all cases the entry of MNEs brings about a decrease in the rental rate of capital together with an increase in the aggregate wage (see columns 1 and 2). A higher volume of capital involves a lower marginal productivity of this production factor (i.e., its real rental rate decreases) and a higher marginal productivity of labour (i.e., a higher real wage). These results are consistent with the theory of international trade under the assumption of specific capital; see, e.g., Jones (1971, 2000, 2002), Mussa (1974), or Neary (1978).

When profit repatriation is included into the simulation, a reduction of the income available for the representative household appears compared to the case with no profit repatriation, since the

⁴ Hertel (1997, chapter 1) explains that percentage changes in welfare can be proxied in this model by the variation in real private consumption, when investment and public consumption are fixed in real terms, as is the case in our simulations. Additionally, the evolution of real private consumption is modelled using a Cobb-Douglas function. Income elasticity is unitary in this type of functions so that increases in private consumption show the same percentage as do variations in the households’ income.

⁵ As mentioned in footnote 3, the CPI is the numeraire for the rest of variables in the model, although the CPI itself is expressed with respect to the default numeraire set by GTAP6inGAMS, i.e., with respect to $raINC_{row}$. This means that values in this column, strictly, cannot be interpreted as a standard CPI. But note that, for the particular simulation performed here (MNEs’ entry) the impact on $raINC_{row}$ is negligible, since shocks in the Czech Republic are unlikely to affect ROW in an important extent. So, in this case, eventually, the evolution of the CPI in terms of $raINC_{row}$ should be a good proxy for the evolution of a standard CPI.

circular flow of the economy implies that now there is less income available for the remuneration of the domestic representative consumer. Hence, with profit repatriation lower factor remunerations are obtained, i.e., the increase in the wage is smaller, and the decrease in the rental rate of capital is higher. This evolution of factor prices is an important force driving the results for GDP and welfare.

As can be seen for GDP and welfare (columns 3 and 4), both variables experience a small increase in all sectors after the entry of MNEs when there is no profit repatriation, but fall unambiguously in all cases when there is profit repatriation. The less favourable (or more unfavourable) results are those for Motor vehicles, since in this case the amount of capital whose benefit is repatriated is the highest among all sectors (see Table 1).

The generalized reduction in the CPI (column 5) associated with profit repatriation and the differentiated result, depending on the sector, in the simulation with no profit repatriation, will be of importance for sectoral results. Finally, the impact of profit repatriation on exports and imports (columns 6 and 7) would depend on the share of imports of the sector where MNEs entry, on the aggregate imports of the whole economy (see Table 1). The impact on foreign trade for manufactures is higher than for the services sectors. Note also, that the impact of profit repatriation on foreign trade is small.

Summing up, the introduction of profit repatriation leads to a very different panorama compared to the mere entry of MNEs. Under profit repatriation, the entry of MNEs may still benefit workers whose wages increase (except for the case of Motor vehicles). However, at the aggregate level the benefits of higher wages are offset by a larger fall in the remuneration of capital. This results in a decrease in GDP and welfare, whose magnitude slightly differs across sectors. Profit repatriation, however, does not affect the volume of external trade.

4.2 Sectoral results

Tables 3, 4, and 5 show, respectively, the effects on production, exports and imports of the 20 sectors representing the Czech economy, following the entry of MNEs in each of the five sectors selected, with and without profit repatriation. As it would seem obvious, the first and main impact of the shock takes place in the sector receiving MNEs. To begin with, we look at the evolution of this particular sector.

The results are not significantly affected by the presence or absence of profit repatriation. In both cases the impact is rather clear. The amount of capital used by the sector receiving MNEs increases significantly as a result of the shock, so its production would always rise (Table 3). Increases in production are of a considerable magnitude except for the case of Finance, which has to do with the fact that the MNEs' share on gross output and capital in Finance is the smallest among the five sectors considered (Table 1). On the other hand, the price of the good sold by the sector receiving MNEs will decrease⁶: The increase in the capital stock strongly reduces its rental rate, driving costs of production and prices down in that sector (notice that sectoral prices in this Walrasian model resemble costs, see equation (4*)). Because of the fall in its price, the export competitiveness of the sector will improve, which results in a significant increase in its exports (Table 4). Finally, note that production in each sector relies to an important extent on intermediates from the same sector. As a consequence, imports of the sector receiving MNEs also experience an increase (Table 5), since an important amount of intermediates from that sector are imported in order to get its increase in production.

The impact on the rest of sectors tends to be small. The demand side of the model explains the responses of those sectors not receiving MNEs. The evolution of demand, in turn, boils down to the impact of MNEs on two variables, namely, the CPI (which determines exports) and the

⁶ The prices of the goods sold by the sector receiving MNEs would show the following percentage variations, for the cases of no profit repatriation and profit repatriation, respectively: Chemicals, -2.33 and -2.21; Motor vehicles, -3.44 and -3.26; Electronics, -1.92 and -1.83; Trade, -2.75 and -2.84; and Finance, -1.48 and -1.54.

aggregate level of income (which determines private consumption). There are two broad patterns. One is for most manufacturing sectors, which are highly responsive to the evolution of their own exports –as most of their production is indeed devoted to exports (Table 1). The other applies to most services sectors as well as to Food and Petroleum, whose production responds to the evolution of private consumption.

So, profit repatriation decreases production (Table 3), in those sectors more dependent on private consumption –Food, Petroleum, and most services sectors, on reducing the income available for private consumption. This contrasts with the simulation considering no profit repatriation, where these private-consumption-oriented sectors increase their production. The reason would be that the remuneration of the new capital brought by the MNEs goes now to the representative household, increasing the income available for private consumption.

The pattern is quite different for most manufactures, which are, in general, more export-oriented. In the simulation including profit repatriation these sectors have higher levels of production than in the other case, since repatriation tends to depress the general price level in the host economy (see the CPI in Table 2), so enhancing the export competitiveness of these sectors (Table 4). On the contrary, in the simulation without profit repatriation, the particular sector where that entry takes place is determinant for the evolution of the CPI. As a consequence, export competitiveness depends on the sector where the shock originates, and manufacturing sectors may increase or reduce production after the entry of MNEs.

Finally, imports tend to follow the production pattern of the corresponding sector (Table 5). For those sectors more responsive to private consumption imports decrease with profit repatriation, while they use to increase in the simulation without profit repatriation. The same applies to most manufactures, whose imports tend to move along with their respective production levels.

To sum up, the entry of MNEs leads to significant effects in the particular sector where they come, with a rather clear pattern: production, exports and imports increase, and the price falls. In turn, the effects on the rest of sectors of the economy tend to be small, with some clear patterns arising according to the demand side of the model.

A sensitivity analysis on the values of several elasticities of the model has been also performed. In general, the above results, both at the aggregate and sectoral levels, are mainly unaffected when moving from a higher to a lower value of those elasticities. The detailed results are presented in Latorre (2007).

5. Concluding remarks

In this paper we have analyzed the effects of the entry of MNEs on a particular host economy, the Czech Republic, which has received significant amounts of FDI in the last few years. The empirical methodology makes use of a CGE model, which is a 2-region, 2-factor, 20-sector version of the GTAP model, extended to incorporate MNEs. Two simulations have been performed: a 50 per cent increase in the capital stock of a particular sector, and a combination of the same increase in the capital stock with the repatriation of the remuneration of the extra capital that the entry of MNEs adds. The two simulations have been run in five sectors, namely, Chemicals, Motor vehicles, Electronics, Trade, and Finance.

The main result found is that the positive effects on GDP and welfare, both at the aggregate and sectoral levels, following the entry of MNEs, might be offset if the extent of profit repatriation is large. This suggests that profit repatriation would be an important issue when analyzing the economic effects of MNEs, despite being mostly neglected in the available empirical literature.

In addition, the results from the simulations show the differential impact of MNEs across sectors, which has two relevant features. The first one is related to the particular sector in which the entry of MNEs takes place, and the second one is related to the different patterns of adjustment to the shock across sectors. Regarding the first one, our results show that patterns are rather similar across sectors with and without profit repatriation, but the size of the effects is related to the particular sector in which MNEs enter. In particular, our empirical analysis suggests that the most unfavourable results for GDP and welfare are those of Motor vehicles, which should provide relevant information for the policy-maker.

With respect to the second aspect, the model shows that the sectoral patterns of responses to the shock across sectors are related to the demand side of the model. The entry of MNEs will increase the income of the representative household if there is no profit repatriation, but will decrease that income if there is profit repatriation. So, the level of income will determine private consumption, and lead the evolution of those sectors more responsive to private consumption –Food, Petroleum, and most services sectors. On the other hand, the entry of MNEs may rise or lower the general price level of the economy, which will determine sectoral export competitiveness. Since most manufactures are export-oriented, their output levels will respond to the evolution of exports.

To conclude, it is important to note that the results obtained are applicable for a short and medium run period, which is the timing associated to our model. However, in the real world, the positive effects of MNEs entry would usually appear before than the negative effects through profit repatriation. This would suggest that the host economy may benefit from the presence of MNEs for some time but, the sooner profits were repatriated, the sooner their negative effects would develop.

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Table 1. Definition of sectors and their relative weight in the Czech economy, 2001

	% on gross output	% on capital	% on imports	% on exports	% of sectoral gross output devoted to:					MNEs' % on gross output	MNEs' % on capital
					intermediates	investment	exports	private consumption	public consumption		
01/05 Agriculture, hunting and fishing	3.0	4.5	2.2	1.1	66.9	8.5	8.6	15.5	0.5	0.6	0.6
10/14 Mining and quarrying	1.0	3.1	4.7	0.9	76.4	2.7	19.2	1.8	0.0	18.7	27.3
15/16 Food, beverages and tobacco	7.6	8.3	3.0	2.9	34.6	0.0	9.8	55.5	0.0	31.5	50.9
17/19 Textiles, wearing apparel, leather, footwear	3.1	2.0	5.3	5.7	28.9	0.0	46.5	24.4	0.2	26.5	23.9
20 Wood and wood products, except furniture	1.9	1.8	1.7	4.0	40.2	5.1	50.2	4.5	0.0	23.8	22.0
21/22 Paper; printing, publishing and recorded media	2.4	2.5	3.0	2.8	54.0	7.9	28.5	9.5	0.0	45.3	52.5
23 Petroleum	1.0	0.1	1.4	0.4	74.9	0.0	9.5	15.5	0.0	1.0	1.0
24/25 Chemicals, rubber and plastics	4.4	3.7	12.8	8.7	38.3	3.4	49.2	6.3	2.8	42.6	49.1
26 Non-metallic mineral products	2.6	3.4	2.5	4.5	44.2	13.3	41.7	0.9	0.0	49.0	58.6
27/28 Basic and fabricated metal products	7.6	5.3	9.9	10.7	56.7	8.3	34.6	0.4	0.0	24.0	28.9
34 Motor vehicles	6.5	3.0	7.5	14.1	35.1	2.5	55.8	6.7	0.0	90.7	89.5
35 Other transport equipment	1.1	0.4	1.1	1.5	38.6	17.1	35.0	9.3	0.0	23.0	18.5
30/33 Electronics	2.7	2.0	9.4	6.6	30.7	2.8	62.6	3.6	0.3	63.0	58.8
29 Machinery and equipment n.e.c.	8.6	3.8	20.4	19.5	31.7	3.7	57.9	6.7	0.1	29.3	24.1
36/37 Furniture, manufacturing n.e.c.	1.3	1.1	1.1	1.5	40.6	7.5	30.1	21.9	0.0	29.9	34.3
40/45 Electricity, gas and water supply; construction	11.0	9.9	1.6	2.6	72.2	10.6	6.3	9.8	1.1	11.9	12.6
50/55 Trade, repair; hotels and restaurants	4.1	5.3	1.2	0.6	32.9	50.0	3.9	13.0	0.2	30.8	36.2
60/64 Transport, storage and communication	6.4	8.5	2.6	4.7	58.1	0.2	28.9	12.6	0.2	10.8	9.5
65/74 Finance, insurance, real estate, business activities	11.9	20.6	6.6	4.7	58.6	10.7	10.4	15.8	4.6	22.6	10.7
75-79 NACE Other services	11.7	10.7	1.9	2.5	17.3	11.9	5.7	16.6	48.5	1.0	1.0
01/99 Total	100.0	100.0	100.0	100.0	-	-	-	-	-	29.1	28.5

Note: Authors' own elaboration from Dimanaran and McDougall (2005), OECD (2005) and Czech National Bank (2004). The definitions of the sectors follow the ISIC Rev 3 Classification

Table 2. Simulation results: Effects on aggregate variables (percent change from benchmark)

	Wage		Rental rate of capital		GDP		Welfare		CPI		Imports		Exports	
	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep
Chemicals	0.23	0.17	-0.55	-0.64	0.30	-0.24	0.61	-0.39	0.08	-0.09	1.30	1.32	1.36	1.38
Motor vehicles	0.05	-0.06	-1.17	-1.30	0.11	-0.69	0.20	-1.28	-0.10	-0.35	0.59	0.62	0.61	0.65
Electronics	0.21	0.16	-0.34	-0.40	0.23	-0.12	0.40	-0.24	0.09	-0.02	0.93	0.95	0.97	0.98
Trade	0.09	0.02	-0.51	-0.61	0.27	-0.30	0.69	-0.38	-0.01	-0.20	0.18	0.20	0.19	0.21
Finance	0.20	0.10	-0.61	-0.71	0.35	-0.31	0.72	-0.52	-0.14	-0.35	0.50	0.52	0.52	0.54

Note: “MNE’s entry” stands for the simulation without profit repatriation, and “Profit Rep” stands for the simulation with profit repatriation.

Table 3. Simulation results: Effects on sectoral production (percent change from benchmark)

	Chemicals		Motor Vehicles		Electronics		Trade		Finance	
	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep
Agriculture, hunting and fishing	-0.01	-0.02	0.03	0.02	-0.04	-0.05	0.06	0.05	0.06	0.05
Mining and quarrying	-0.01	0.00	0.00	0.02	-0.01	-0.01	0.00	0.01	0.00	0.02
Food, beverages and tobacco	0.24	-0.16	0.10	-0.49	0.13	-0.12	0.33	-0.09	0.36	-0.13
Textiles, wearing apparel, leather, footwear	-0.05	0.14	0.08	0.37	-0.31	-0.19	0.13	0.34	0.26	0.51
Wood and wood products, except furniture	-0.24	0.07	0.07	0.54	-0.31	-0.11	-0.01	0.32	0.11	0.50
Paper, printing and publishing	-0.12	0.06	0.07	0.35	-0.20	-0.08	0.02	0.22	0.23	0.47
Petroleum	0.16	-0.12	0.04	-0.33	0.09	-0.10	0.21	-0.11	0.22	-0.16
Chemicals, rubber and plastics	13.97	14.30	0.08	0.39	-0.21	-0.07	-0.01	0.21	0.12	0.38
Non-metallic mineral products	-0.14	0.09	0.08	0.43	-0.18	-0.03	0.00	0.25	0.12	0.41
Basic and fabricated metal products	-0.41	0.01	0.08	0.73	-0.42	-0.14	-0.04	0.42	0.20	0.74
Motor vehicles	-0.11	0.03	16.89	17.13	-0.12	-0.02	0.03	0.18	0.17	0.35
Other transport equipment	-0.16	0.01	0.29	0.55	-0.08	0.04	0.19	0.37	0.35	0.56
Electronics	-0.20	0.13	0.07	0.56	17.95	18.20	-0.01	0.34	0.21	0.62
Machinery and equipment n.e.c.	-0.18	0.02	1.80	2.12	-0.16	-0.02	0.06	0.28	0.24	0.50
Furniture, manufacturing n.e.c.	-0.05	0.04	0.08	0.22	-0.21	-0.15	0.14	0.23	0.24	0.35
Electricity, gas and water supply; construction	0.05	-0.12	0.09	-0.15	0.03	-0.08	0.23	0.06	0.33	0.13
Trade, repair; hotels and restaurants	0.06	-0.22	0.18	-0.22	0.00	-0.17	5.65	5.39	0.59	0.25
Transport, storage and communication	-0.12	-0.08	0.11	0.17	-0.13	-0.10	0.12	0.17	0.18	0.23
Finance, insurance, real estate, business activities	-0.02	-0.08	0.05	-0.02	-0.05	-0.08	0.10	0.04	2.12	2.05
Other services	0.03	-0.09	0.05	-0.13	0.00	-0.08	0.12	-0.01	0.18	0.03

Note: see Table 2.

Table 4. Simulation results: Effects on sectoral exports (percent change from benchmark)

	Chemicals		Motor vehicles		Electronics		Trade		Finance	
	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep
Agriculture, hunting and fishing	-0.57	0.36	-0.03	1.36	-0.46	0.14	-0.46	0.54	-0.37	0.78
Mining and quarrying	-0.04	0.02	0.00	0.09	-0.03	0.01	-0.03	0.04	-0.03	0.05
Food, beverages and tobacco	-1.01	0.65	-0.02	2.49	-0.83	0.24	-0.73	1.05	-0.45	1.61
Textiles, wearing apparel, leather, footwear	-0.35	0.35	0.04	1.10	-0.57	-0.11	-0.14	0.62	0.06	0.93
Wood and wood products, except furniture	-0.28	0.09	0.05	0.62	-0.33	-0.08	-0.07	0.34	0.05	0.52
Paper; printing and publishing	-0.28	0.14	0.02	0.66	-0.32	-0.04	-0.14	0.31	0.07	0.60
Petroleum	-0.12	0.12	0.00	0.35	-0.13	0.03	-0.11	0.16	-0.05	0.27
Chemicals rubber and plastics	15.09	15.38	0.05	0.49	-0.25	-0.06	-0.08	0.23	0.05	0.41
Non-metallic mineral products	-0.15	0.05	0.04	0.34	-0.20	-0.07	-0.03	0.19	0.07	0.32
Basic and fabricated metal products	-0.34	0.01	0.06	0.59	-0.34	-0.11	-0.04	0.34	0.15	0.59
Motor vehicles	-0.20	0.05	21.26	21.71	-0.21	-0.04	-0.03	0.24	0.15	0.47
Other transport equipment	-0.30	0.11	0.24	0.86	-0.19	0.08	0.03	0.47	0.20	0.70
Electronics	-0.22	0.13	0.05	0.59	17.11	17.37	-0.05	0.33	0.16	0.60
Machinery and equipment n.e.c.	-0.24	0.07	1.70	2.17	-0.20	0.00	-0.01	0.32	0.18	0.56
Furniture, manufacturing n.e.c.	-0.44	0.29	0.04	1.14	-0.53	-0.05	-0.21	0.58	-0.03	0.88
Electricity, gas and water supply; construction	-0.68	0.24	0.00	1.38	-0.53	0.07	-0.35	0.64	-0.10	1.04
Trade, repair; hotels and restaurants	-0.80	0.20	0.12	1.64	-0.68	-0.02	11.22	12.40	0.18	1.43
Transport, storage and communication	-0.36	0.06	0.09	0.73	-0.32	-0.04	-0.07	0.39	0.03	0.56
Finance, insurance, real estate, business activities	-0.58	0.31	0.08	1.44	-0.47	0.12	-0.35	0.60	6.37	7.47
Other services	-0.75	0.09	0.09	1.37	-0.73	-0.18	-0.22	0.69	0.27	1.33

Note: see Table 2.

Table 5. Simulation results: Effects on sectoral imports (percent change from benchmark)

	Chemicals		Motor vehicles		Electronics		Trade		Finance	
	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep	MNEs' entry	Profit Rep
Agriculture, hunting and fishing	0.31	-0.23	0.05	-0.74	0.22	-0.13	0.31	-0.27	0.26	-0.40
Mining and quarrying	0.06	-0.05	0.01	-0.15	0.04	-0.03	0.07	-0.05	0.06	-0.07
Food, beverages and tobacco	0.83	-0.56	0.11	-1.94	0.61	-0.29	0.76	-0.72	0.62	-1.08
Textiles, wearing apparel, leather, footwear	0.30	-0.20	0.07	-0.67	0.13	-0.19	0.35	-0.19	0.34	-0.27
Wood and wood products, except furniture	-0.06	-0.03	0.04	0.09	-0.12	-0.10	0.06	0.10	0.11	0.15
Paper; printing and publishing	0.07	-0.07	0.06	-0.15	-0.01	-0.10	0.15	0.00	0.25	0.08
Petroleum	0.25	-0.21	0.05	-0.56	0.18	-0.12	0.29	-0.22	0.26	-0.34
Chemicals, rubber and plastics	10.24	10.26	0.07	0.03	-0.07	-0.09	0.08	0.05	0.16	0.13
Non-metallic mineral products	-0.06	0.09	0.08	0.30	-0.06	0.04	0.04	0.19	0.11	0.29
Basic and fabricated metal products	-0.30	-0.04	0.02	0.42	-0.32	-0.15	-0.05	0.23	0.10	0.43
Motor vehicles	0.06	-0.01	3.87	3.79	0.07	0.02	0.12	0.05	0.14	0.05
Other transport equipment	0.05	-0.09	0.17	-0.03	0.05	-0.04	0.23	0.08	0.29	0.12
Electronics	-0.07	0.06	0.08	0.28	10.55	10.66	0.07	0.21	0.21	0.38
Machinery and equipment n.e.c.	0.01	-0.07	0.79	0.69	-0.01	-0.06	0.13	0.05	0.19	0.10
Furniture, manufacturing n.e.c.	0.31	-0.22	0.07	-0.71	0.17	-0.17	0.35	-0.21	0.33	-0.32
Electricity, gas and water supply; construction	0.38	-0.30	0.06	-0.93	0.26	-0.18	0.39	-0.33	0.34	-0.49
Trade, repair; hotels and restaurants	0.46	-0.35	0.11	-1.08	0.32	-0.20	1.43	0.60	0.49	-0.49
Transport, storage and communication	0.15	-0.11	0.04	-0.35	0.11	-0.06	0.17	-0.11	0.15	-0.17
Finance, insurance, real estate, business activities	0.29	-0.20	0.10	-0.61	0.20	-0.12	0.32	-0.19	2.67	2.06
Other services	0.47	-0.15	0.02	-0.91	0.41	0.01	0.29	-0.38	0.09	-0.68

Note: see Table 2.

Appendix

A.1. Notation hints

1. We preserve *GTAP's notation* wherever possible.

2. *Indices*: i and j denote *sectors and commodities*, ($i, j = 1, \dots, n$); r and s denote *regions*, which may be either the rest of the world (ROW) or the economy hosting MNEs (H), i.e., $r, s = ROW, H$; and f denotes *factors of production*, which may be either labour (L) or capital (K), i.e., $f = L, K$. An o superscript stands for *origin* of production according to the three type of firms existing in the model. Firms may be national (N) or MNEs (F) in the country hosting MNEs, or domestic (D) in the region in which MNEs are absent, i.e., $\{o = N, F, D, \text{ where } o = N, F \text{ if } r = H \text{ and } o = D \text{ if } r = ROW\}$. For example, as in GTAP, dfm_{Ljr} is the total demand for labour in the j^{th} sector of region r ; whereas dfm_{LjH}^N , dfm_{LjH}^F , dfm_{LjRow}^D and dfm_{Ljr}^o are, respectively, the demand for labour by national firms in the host economy, the demand for labour by MNEs in the host economy, the demand for labour by domestic firms in ROW, or any of the three, in the j^{th} sector of region r . Note that $dfm_{LjRow}^D = dfm_{LjRow}$ and that $dfm_{LjH} = dfm_{LjH}^N + dfm_{LjH}^F$.

In contexts where two commodity subscripts are used (e.g., demand for intermediates among sectors), the first one refers to the producing industry of a commodity, and the second one to the consuming industry. For example, as in GTAP, $vd fm_{ijr}$ is the demand for good i to be used as an intermediate in the sector j of region r . In contexts where two regional subscripts are required (e.g., imports), the first one refers to the origin of a trade flow, and the second one to the destination. For example, $vxmd_{isr}$ is the amount of physical units of exports of the good i from region s to region r (or imports of good i in r coming from s).

3. Often the model uses both a variable and a parameter which is the initial value of that variable (i.e., its value in the benchmark). In that case, following GTAP, their notation is exactly the same, except for the first letter which will be d for variables (in most cases indicating demand) and v for parameters (indicating value, i.e., the initial value). For example, vfm_{Ljr} represents the benchmark labour demand in sector j of region r , while the above mentioned dfm_{Ljr} is the corresponding demand.

4. Equations with an asterisk reflect that they are either an addition, or have been modified with respect to the GTAP standard version.

A.2. Model equations

Production

$$cf_{jfr}^o = \left(\sum_f \theta_{jfr}^o (\bar{p}_{jfr}^{fo})^{(1-\sigma_j^{LK})} \right) \Big/ (1-\sigma_j^{LK}) \quad (1^*)$$

$$ci_{ijr}^o = \left[\left(\theta_{dijr}^o (\bar{p}_{ijr}^d)^{(1-\sigma_i^A)} \right) + \left((1-\theta_{dijr}^o) (\bar{p}_{ijr}^m)^{(1-\sigma_i^A)} \right) \right] \Big/ (1-\sigma_i^A) \quad (2^*)$$

$$c_{jfr}^{yo} = \left(\sum_i \theta_{ijr}^o ci_{ijr}^o \right) + \left(\theta_{jfr}^{fo} c_{jfr}^o \right) \quad (3^*)$$

$$c_{jfr}^{yo} = p_{jfr}^{Yo} (1-t_{jfr}^y) \quad (4^*)$$

$$ddfm_{ijr}^o = vdfm_{ijr}^o Y_{jfr}^o \left(ci_{ijr}^o / \bar{p}_{ijr}^d \right)^{\sigma_i^A} \quad (5^*)$$

$$difm_{ijr}^o = vifm_{ijr}^o Y_{jfr}^o \left(ci_{ijr}^o / \bar{p}_{ijr}^m \right)^{\sigma_i^A} \quad (6^*)$$

$$dfm_{jfr}^o = vfm_{jfr}^o Y_{jfr}^o \left(cf_{jfr}^o / \bar{p}_{jfr}^{fo} \right)^{\sigma_i^{LK}} \quad (7^*)$$

$$p_{iH}^Y = \left(\left(\theta_{iH}^{YF} (p_{iH}^{YF})^{(1-\sigma_{iH}^{FN})} \right) + \left((1-\theta_{iH}^{YF}) (p_{iH}^{YN})^{(1-\sigma_{iH}^{FN})} \right) \right) \Big/ (1+\sigma_{iH}^{FN}) \quad (8^*)$$

Remuneration of capital as a specific factor

$$p_{jH}^K = \left(\left(\theta_{vfmjF} (p_{jH}^{KF})^{(1+\eta)} \right) + \left((1-\theta_{vfmjF}) (p_{jH}^{KN})^{(1+\eta)} \right) \right) \Big/ (1+\eta) \quad (9^*)$$

$$p_r^K = \left(\sum_j \theta_{jfr}^K (p_{jfr}^K)^{(1+\eta)} \right) \Big/ (1+\eta) \quad (10)$$

Public consumption

$$p_{ir}^g = \left[\left(\theta_{ir}^{dg} (\bar{p}_{ir}^{dg})^{(1-\sigma_i^A)} \right) + \left((1-\theta_{ir}^{dg}) (\bar{p}_{ir}^{mg})^{(1-\sigma_i^A)} \right) \right] \Big/ (1-\sigma_i^A) \quad (11)$$

$$\sum_i (\theta_{ir}^g p_{ir}^g) = p_r^G \quad (12)$$

$$ddgm_{ir} = vdg_{ir} G_r \left(p_{ir}^g / \bar{p}_{ir}^{dg} \right)^{\sigma_i^A} \quad (13)$$

$$digm_{ir} = vigm_{ir} G_r \left(p_{ir}^g / \bar{p}_{ir}^{mg} \right)^{\sigma_i^A} \quad (14)$$

Private consumption

$$p_{ir}^c = \left[\left(\theta_{ir}^{dc} (\bar{p}_{ir}^{dc})^{(1-\sigma_i^A)} \right) + \left((1-\theta_{ir}^{dc}) (\bar{p}_{ir}^{mc})^{(1-\sigma_i^A)} \right) \right] \Big/ (1-\sigma_i^A) \quad (15)$$

$$\prod_i (p_{ir}^c)^{\theta_{ir}^p} = p_r^C \quad (16)$$

$$ddpm_{ir} = vdp_{ir} C_r \left(\frac{p_{ir}^c}{\bar{p}_{ir}^{dc}} \right)^{\sigma_i^A} \left(\frac{p^C}{p_{ir}^c} \right) \quad (17)$$

$$dipm_{ir} = vip_{ir} C_r \left(\frac{p_{ir}^c}{\bar{p}_{ir}^{mc}} \right)^{\sigma_i^A} \left(\frac{p^C}{p_{ir}^c} \right) \quad (18)$$

Imports

$$p_{ir}^M = \theta_{isr}^{ym} \cdot \bar{p}_{isr}^m + \sum_j \theta_{jisr}^t \bar{p}_{jisr}^m \quad (19)$$

$$dxmd_{isr} = vxmd_{isr} \times M_{ir} \quad (20)$$

$$dtwr_{jisr} = vtwr_{jisr} \times M_{ir} \quad (21)$$

Transport services

$$\prod_r (p_{ir}^Y)^{\theta_{ir}^t} = p_i^T \quad (22)$$

Income balance condition

$$\begin{aligned} raINC_r = & vb_r - \left(p_r^G \overline{vgm}_r \right) - \sum_i \left(p_{ir}^Y \bar{I}_{ir} \right) + \sum_f \left(p_r^f evom_{fr} \right) + \\ & + revt_r^y + revt_r^L + revt_r^K + revt_r^{fd} + revt_r^{fm} + revt_r^{pd} + revt_r^{pm} + \\ & + revt_r^{gd} + revt_r^{gm} + revt_r^{xs} + revt_r^{ms} \end{aligned} \quad (23)$$

In the case in which we consider the effects of profit repatriation, two new equations arise when modifying equation (23). These are equations (23*) and (23*bis) for ROW and the host region, respectively:

$$\begin{aligned} raINC_{ROW} = & vb_{ROW} - \left(p_{ROW}^G \overline{vgm}_{ROW} \right) - \sum_i \left(p_{iROW}^Y \bar{I}_{ir} \right) + \sum_f \left(p_{ROW}^f evom_{fROW} \right) + \\ & revt_{ROW}^y + revt_{ROW}^L + revt_{ROW}^K + revt_{ROW}^{fd} + revt_{ROW}^{fm} + revt_{ROW}^{pd} + revt_{ROW}^{pm} \\ & + revt_{ROW}^{gd} + revt_{ROW}^{gm} + revt_{ROW}^{xs} + revt_{ROW}^{ms} \\ & + \%Profit Rep_j \left(\left(FDI_{KjH} - 1 \right) p_H^K vfm_{KjH}^F \right) \end{aligned} \quad (23^*)$$

$$\begin{aligned} raINC_H = & vb_H - \left(p_H^G \overline{vgm}_H \right) - \sum_i \left(p_{iH}^Y \bar{I}_{iH} \right) + \sum_f \left(p_r^f evom_{fH} \right) + \\ & + revt_H^y + revt_H^L + revt_H^K + revt_H^{fd} + revt_H^{fm} + revt_H^{pd} + revt_H^{pm} + \\ & + revt_H^{gd} + revt_H^{gm} + revt_H^{xs} + revt_H^{ms} \\ & - \%Profit Rep_j \left(\left(FDI_{KjH} - 1 \right) p_H^K vfm_{KjH}^F \right) \end{aligned} \quad (23^* \text{ bis})$$

Market-clearing equations

$$raINC_r = C_r vpm_r p_r^C \quad (24)$$

$$G_r = 1 \quad (25)$$

$$Y_{ir} vom_{ir} = \sum_j dd_{fm_{ijr}} + ddpm_{ir} + ddgm_{ir} + dxmd_{irs} + dst_{ir} + \bar{I}_{ir} \quad (26)$$

$$M_{ir} \text{ vim}_{ir} = \sum_j \text{difm}_{ijr} + \text{dipm}_{ir} + \text{digm}_{ir} \quad (27)$$

$$YT_j \text{ vtw}_j = \sum_i \sum_s \sum_r \text{dtwr}_{jisr} \quad (28)$$

$$\text{evom}_{Lr} = \sum_i \text{dfm}_{Lir} \quad (29)$$

$$\text{NEWevom}_{Kr} = \text{evom}_{Kr} \text{ FT}_{Kr} \quad (30^*)$$

$$\text{vfm}_{Kjr}^o \text{ FDI}_{Kjr} \left(\frac{p_{jr}^{Ko}}{p_{jr}^K} \right)^\eta = \text{dfm}_{Kjr}^o \quad (31^*)$$

$$\text{vfm}_{Kjr} \text{ FDI}_{Kjr} \left(\frac{p_{jr}^K}{p_r^K} \right)^\eta = \text{dfm}_{Kjr} \quad (32^*)$$

A.3. Complete list of variables and parameters

Endogenous variables

Production

difm_{ijr}^o	Demand for imported intermediates from sector i to be used by o -type firms in sector j in region r
difm_{ijr}	Total demand for the imported intermediate i in sector j in region r
ddf_{ijr}^o	Demand for domestic purchases of intermediates from sector i to be used by o -type firms in sector j in region r
ddf_{ijr}	Total demand for domestic purchases of intermediate i in sector j in region r
dfm_{fir}^o	Demand for primary factor f by o -type firms in sector i in region r
dfm_{fir}	Total demand for primary factor f in sector i in region r
NEWevom_{Kr}	Value of the capital stock after MNEs' entry in region r
FT_{Kr}	One plus the percentage change in the capital stock in region r
$\bar{p}_{jr}^{fo}$	Tax-inclusive price of factor f used by o -type firms in sector j in region r
$\bar{p}_r^L$	Tax-inclusive wage in region r
$\bar{p}_{jr}^{Ko}$	Tax-inclusive price of capital in o -type firms in sector j in region r
$\bar{p}_{ijr}^d$	Tax-inclusive price of the domestically purchased intermediate i to be used in sector j in region r
$\bar{p}_{ijr}^m$	Tax-inclusive price of the imported intermediate i to be used in sector j in region r
p_{jr}^{Yo}	Price of good j produced by o -type firms, excluding taxes or subsidies, in region r
p_{jr}^K	Price of capital in sector j in region r
p_r^K	Price of capital in region r
p_{jr}^Y	Price of good j before taxes
Y_{jr}^o	One plus the percentage change in gross output of o -type firms in sector j in region r
Y_{jr}	One plus the percentage change in total gross output in sector j in region r

Public consumption

ddgm_{ir}	Demand for domestic purchases of good i for public consumption in region r
digm_{ir}	Demand for imports of good i for public consumption in region r

G_r	One plus the percentage change in national public consumption in region r
$\bar{p}_{ir}^{dg}$	Tax-inclusive price of public consumption of the i^{th} domestic good in region r
$\bar{p}_{ir}^{mg}$	Tax-inclusive price of public consumption of the i^{th} imported good in region r
p_{ir}^g	Tax-inclusive price of good i purchased for public consumption in region r
p_r^G	Price of public consumption in region r

Private consumption

$ddpm_{ir}$	Demand for domestic purchases of good i for private consumption in region r
$dipm_{ir}$	Demand for imports of good i for private consumption in region r
$raINC_r$	Budget available for private consumption of the representative household in region r
C_r	One plus the percentage change in national private consumption in region r
$\bar{p}_{ir}^{dc}$	Tax-inclusive price of private consumption of the i^{th} domestic good in region r
$\bar{p}_{ir}^{mc}$	Tax-inclusive price of private consumption of the i^{th} imported good in region r
p_{ir}^c	Tax-inclusive price of good i purchased for private consumption in region r
p_r^C	Price of private consumption in region r

Imports and transport services

$dxmd_{isr}$	Demand for physical units of imports of good i in region r coming from region s
dwt_{jisr}	Demand for the transport service j needed for transport of good i from region s to region r
dst_{ir}	Production of good i used as a transport service in region r
M_{ir}	One plus the percentage increase in imports of good i in region r
p_{ir}^M	Price of imports of good i , including transport services, in region r
$\bar{p}_{isr}^m$	Price of the volume of physical imports, including tariffs and subsidies, of good i in the route from s to r
$\bar{p}_{jisr}^m$	Price of the transport service j , including tariffs, of good i in the route from s to r
p_i^T	Price of the transportation service i
YT_j	One plus the percentage change in the world production of the j^{th} international transport service

Taxes and subsidies

$revt_r^y$	Total payments of subsidies on output in region r
$revt_r^f$	Total income from taxes on primary factors in region r
$revt_r^{fd}$	Total income from taxes on domestic intermediates in region r
$revt_r^{fm}$	Total income from taxes on imported intermediates in region r
$revt_r^{pd}$	Total income from taxes on private consumption of domestic goods in region r
$revt_r^{pm}$	Total income from taxes on private consumption of imported goods in region r
$revt_r^{gd}$	Total income from taxes on public consumption of domestic goods in region r
$revt_r^{gm}$	Total income from taxes on public consumption of imported goods in region r
$revt_r^{xs}$	Total payments of subsidies on exports in region r
$revt_r^{ms}$	Total income from tariffs on imports in region r

Exogenous variables and parameters

Production

$evom_{fr}$	Total endowment of factor f in region r
θ_{fjr}^o	Share of the factor f in value added in o -type firms in sector j in region r
θ_{dijr}^o	Share of the domestic intermediate input i in its total use in o -type firms in sector j in region r
θ_{ijr}^o	Share of the intermediate input i (domestic plus imported) in gross production of the o -type firms in sector j
θ_{jr}^{fo}	Share of value added in gross production of the o -type firms in sector j in region r
θ_{iH}^{YF}	Share of MNEs' production in gross production in the host economy
θ_{vmjF}	Share of MNEs' capital in total capital in sector j in the host economy
θ_{jr}^K	Share of capital employed in sector j in region r
$vd\bar{m}_{ijr}^o$	Benchmark value of the domestic purchases of intermediates from sector i to be used by o -type firms in sector j in region r
$vd\bar{m}_{ijr}$	Benchmark value of the total domestic purchases of intermediates from sector i in sector j in region r
$v\bar{m}_{fir}^o$	Benchmark value of the demand for the primary factor f by o -type firms in sector j in region r
$v\bar{m}_{fir}$	Benchmark value of the total demand for the primary factor f in sector j in region r
$v\bar{ifm}_{ijr}^o$	Benchmark value of the imported intermediates from sector i to be used by o -type firms in sector j in region r
$v\bar{ifm}_{ijr}$	Benchmark value of the total demand for the imported intermediate i in sector j in region r
vom_{ir}	Benchmark value of the sectoral gross production in region r

Demand

$\bar{I}_{ir}$	Fixed investment expenditure in sector i in region r
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Public consumption

θ_{ir}^{dg}	Share of the domestic good i in public consumption in region r
θ_{ir}^g	Share of the good i in total public consumption in region r
$vd\bar{g}m_{ir}$	Benchmark value of the domestic purchases of good i for public consumption in region r
$v\bar{ig}m_{ir}$	Benchmark value of the imports of good i for public consumption in region r
$\overline{v\bar{g}m}_r$	Benchmark value of total (imported plus domestic) national public consumption in region r

Private consumption

θ_{ir}^{dc}	Share of the domestic good i in private consumption in region r
θ_{ir}^p	Share of the good i in total private consumption in region r
$vd\bar{p}m_{ir}$	Benchmark value of the domestic purchases of good i for private consumption in region r
$v\bar{ip}m_{ir}$	Benchmark value of the imports of good i for private consumption in region r
$v\bar{p}m_r$	Benchmark value of total national private consumption in region r

Foreign sector

vb_r	Negative of the current account balance of region r in the benchmark
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vim_{ir} Benchmark physical volume of imports in sector i in region r

Transport services

θ_{isr}^{ym} Share of the amount of physical units of goods (excluding transport services in imports of region r)

θ_{jisr}^t Share of the amount of transport services in imports of region r

θ_{ir}^t Share of the part of production of good i devoted to transport services in region r in the part of world production of good i devoted to transport services

$vxmd_{isr}$ Benchmark amount of physical units of imports of the good i in region r coming from region s

$vtwr_{jisr}$ Benchmark amount of the transport service j needed for transport of good i from region s to region r

vst_{jr} Benchmark production of good j used as a transport service in region r

vtw_j Benchmark aggregate of international transport services in sector j in the world

Taxes

t_{ijr}^{fd} Tax rate of the domestic intermediates from sector i to be used in sector j in region r

t_{ijr}^{fm} Tax rate of the imported intermediates from sector i to be used in sector j in region r

t_{jr}^f Tax rate on the factor f used in sector j in region r

t_{jr}^y Output subsidy rate in sector j in region r

t_{ir}^{gd} Tax rate on the domestic public good i purchased domestically in region r

t_{ir}^{gm} Tax rate on the imported public good i in region r

t_{ir}^{pd} Tax rate on the domestic private good i purchased domestically in region r

t_{ir}^{pm} Tax rate on the imported private good i in region r

t_{isr}^{ms} Import tariff rate on the good i exported from s to r

t_{isr}^{xs} Export subsidy rate on the good i exported from s to r

Elasticities

σ_i^A Elasticity of substitution between imports and domestic production in sector i (Armington elasticity)

σ_i^{LK} Elasticity of substitution between labour and capital in sector i

σ_{iH}^{FN} Elasticity of substitution between domestic and foreign production in sector i in the host economy

η Elasticity of transformation of capital across sectors

Simulation parameters

$\%Profit Rep_j$ Percentage of extra capital in the foreign part of sector j , whose remuneration is repatriated

$FDIf_{Kjr}$ One plus the percentage increase in the stock of capital held by foreign MNEs in sector j in region r

FDI_{Kjr} One plus the percentage increase in the total stock of capital of sector j in region r

