How does Economic development in Eastern Europe affect Austria's regions? A multiregional general equilibrium framework

by

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ABSTRACT: This paper presents a framework for analysing the effects of economic development in Eastern Europe on Austria's regions. Therefore we concentrate on the effects of enhanced East-West trade, which results from the economic development in the transition countries. The analytical framework we use is a multiregional computable general equilibrium model for the Austrian economy. The model is based on an Arrow-Debreu-equilibrium. It contains the 9 Austrian Federal Provinces (NUTS-II) which are linked by trade flows with 4 of the Central and Eastern European countries and with the rest of the world. The simulation results of one trade scenario show how structural and welfare effects differ for the Austrian regions.

JEL classification: C68, F14, F15, F17, R13

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1. INTRODUCTION

The collapse of communism was the starting shot of a fundamental change in the economic and political structure of Europe which hopefully will end up with the transformation of the Central and Eastern European Countries (CEECs) to highly developed market economies well integrated into the world economy. Three processes are going on with differing speeds of progress in different countries:

- the transition to a market economy and the reform of the institutional framework,
- the catching-up of the CEECs which is expected to be the long term consequence of the reform, and
- the economic integration of these countries into the European and world economy.

These processes will lead to substantial changes of the volume and the composition of trade between the CEECs and the European Union. The fact that an increasing trade volume is beneficial for both sides has been confirmed by many studies (see Gasiorek et al. (1992), Haaland and Wooton (1992) Sheehy (1995), Baldwin et al. (1997), for example) and is rarely disputed. On the other hand it is often discussed that the increasing trade volume could cause substantial disruption in *some sectors* or in *some regions* of the European Union. This argument is true not only for the member countries of the EU, but also for the regions within member countries.

The argument usually put forward is that CEECs have a tremendous labour cost advantage over EU members. That means, once they have learnt to apply recent technologies and have accumulated or imported the required capital stock, they will push western producers away. This will be a problem for regions specialising on labour intensive sectors, and regions closer to the eastern border of today's EU will be affected more than those further away. While some regions might be compensated by attracting new demand from CEECs raising their incomes, others could suffer from a lack of competitiveness in the respective export industry.

One fault in this argument is that low wages are assumed to persist forever. Wages, however, are not exogenous, but will rise to the extent, that CEESs catch up with respect to their human and real capital stocks per unit of labour. A second fault in the argument is the neglect of general equilibrium repercussions. Even if we abstract from increased demand for western exports, a cheaper supply of goods from CEECs is not only a competitive threat, but at the same time it gives the western regions the opportunity of increasing their real incomes due to more favourable terms of trade. Rising real incomes induce additional demand, which could substitute markets lost to competitors in CEECs. Furthermore, cheaper inputs imported from CEECs could strengthen the competitive position of firms in EU regions.

The aim of this paper is to point to the importance of these general equilibrium feedbacks by simulating welfare effects of increasing trade flows from CEECs to the EU for the regions of Austria. We have chosen Austria because it is affected much stronger by the developments in the CEECs than any other member of the European Union. Austria has a common border with four of the CEECs, which applied for membership (Czech Republic, Slovakia, Hungary, and

Slovenia, called ``CEEC-4´´ in the following). We study a scenario which, at a first sight, seems to be extremely threatening to certain regions and sectors in Austria, namely an exogenous rightward shift of the supply curve of all goods, delivered from CEEC-4 to Austria. It turns out that, even though any effect from increasing demand from CEECs is neglected, the scenario would be beneficial for all Austrian regions, even though to a different degree. A computable general equilibrium model for the Austrian economy is developed in this paper. It is shown that the model is well capable of taking the relevant general equilibrium repercussions into account.

We start with a brief discussion of the macro-economic development of the CEEC-4 and CEEC-4/EU trade relations in chapter 2, in order to motivate the comparative static simulation exercise to be presented. In chapter 3 we will take a brief look at the methods used for measuring welfare effects of changing trade regimes. The model will be presented in chapter 4. After presenting the model, we will demonstrate the welfare and production effects our trade scenario has on Austria's regions (chapter 5). Finally, we will draw some conclusions from the simulation results and discuss the tractability and restrictions of our approach (chapter 6).

2. MACRO-ECONOMIC DEVELOPMENT AND TRADE OF THE CEEC-4

The Eastern Enlargement of the European Union

The CEEC-4 have already submitted their application for membership of the European Union. The last one was Slovenia in 1996. Three of them (Czech Republic, Hungary and Slovenia) belong to the group of six countries which the commission recommended in July 1997 that accession negotiations should begin with. Although the CEECs are no members of the EU today, trade relations between the EU the CEECs are almost liberalized today. They were first based on trade and economic cooperation agreements, unilateral trade concessions, and more recently on association agreements, known as 'Europe Agreements' (European Commission, 1997).

The macro-economic development in the CEEC-4

The system transformation of the CEEC-4 is now at a fairly advanced level. Havlik et al. (1997) summarised that the major framework conditions for a well-functioning market economy have been established in the neighbouring countries. The transformation crisis has been overcome, a relative strong economic growth has persisted, and the unemployment rates are decreasing. Monetary and fiscal stabilisation programs have been successful. The rate of inflation declined, the exchange rates are fairly stable, the currencies are convertible. There has been a strong decline of subsidies to private firms, prices are almost free from government control.

Nevertheless, some difficulties may persist and throwbacks are possible, mainly for the following reasons: dependence on cyclical ups and down of Western European economies, internal and external imbalances, structural deficits, balance of trade deficits (Havlik et al., 1997). The negative trade balance is a common problem of all transition countries. This is especially true for the Czech Republic. The Czech economy suffered from a severe fallback in

1997. The GDP growth fell since 1995, where it has reached its peak (5.9 %). Podkaminer et al. (1998) estimated a growth rate for 1997 of only 1.3 %. The main reason for that setback is that the Czech authorities tried to keep the nominal exchange rate constant since 1991. Rates of inflation higher than in Western Europe gradually undermined the competitiveness of Czech companies on foreign markets. So exports stagnated, while imports were booming. As a consequence of that, the current account deficit expanded dramatically (see Pöschl, 1998, p. 32). Besides other structural problems, the capital markets are still underdeveloped (see Brusis and Ochmann, 1996, pp. 18–23). Structural reforms in this area still have a long way to go.

Trade relations between the CEEC-4 and the European Union

One of the main characteristics of the CEEC-4 trade before 1989 was its 'dual' structure. The trade with other countries of the Council for Mutual Economic Assistance (CMEA) had the characteristics of advanced economies (i.e. selling and buying industrially advanced products to/from each other involving a considerable amount of intra-industry trade) while trade relations with the West had (and to a certain extent still have) more of the characteristics of the trade of developing countries (i.e. exporting relatively raw-material-intensive products and importing industrially more processed, higher value added products) (Landesmann and Székely, 1995, p. 43). So East-West trade followed the classical Heckscher-Ohlin pattern, where trade flows are determined by different factor intensities[1].

The development of trade between the CEECs and the EU after 1989 can be characterized by three main phases. From 1989 to 1992 (*'early restructuring phase'*) the economies of the CEEC-4 suffered from the transition recession. Output and incomes declined. Beyond trade creation, there has been a shift in the geographical pattern of trade away from their former trade partners to the EU[2] (trade redirection). The resulting East-West trade patterns were dominated by inter-industry trade. From 1992 to 1994/95 the CEEC-4 economies began to recover (*'recovery phase'*). The volume of East-West trade has grown very rapidly. Besides inter-industry trade, intra-industry trade began to rise. Regarding the sectoral structure, the transition period (1989-1994/95) was characterized by substantial changes in the import structure of the CEEC-4 and only modest variations in the composition of their exports (many studies obtained this result; see Halpern (1995), Havlik (1995), for example). The shift of the CEECs' import structure is characterized by a decrease of imports of intermediate and investment goods and an increase of consumption goods imports (Faini and Portes, 1995, p. 10). On the export side, there is a close relation between the commodity structure of the CEECs' exports and their industrial structure. So the modest changes of the export structure reflect a lack of industrial restructuring[3]. The

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1 This fact is not undisputed. See Aiginger et al. (1994) and Landesmann and Székely (1995) for the explanatory power of the Heckscher-Ohlin framework for explaining East/West trade.

2 Many studies confirmed this result. See Halpern (1995, p.61), for example.

3 Mitov (1996, p. 166) explains this development by the following factors. There is a *shortage of investment capital*, especially for technological development. *Inappropriate pricing structures* (low prices of some primary inputs and utilities) create disincentives to restructure or rationalize the resource allocation. While this may be beneficial in the short term, such a strategy is disastrous in the longer run. *Foreign investment* is still limited in

CEECs’ exports are strongly biased away from capital-, R&D- and skill-intensive branches and towards energy-intensive and labor-intensive branches. These specialization patterns have been strengthened since 1989, but there are a lot of exceptions and the development differs greatly between countries (Landesmann, 1995, p. 19).

During the *'catching-up phase'* (1994/95-2010/20) the import demand of the CEEC-4 gives Austrian firms the possibility to export investment goods, high-quality consumption goods and services (financial services, for example). On the other side, the expansion of the export capacities of the CEEC-4 will put a pressure on producers of resource-intensive commodities, labour-intensive commodities (leather and clothes) and partly even capital-intensive commodities (steel and coal) in Austria (Holzmann and Zukowska-Gagelmann, 1996, p. 194). As the CEEC may close their technological gap and become more and more similar to the Western European countries, the share of intra-industry trade will rise and the share of inter-industry trade will fall (Landesmann, 1995, p. 19).

We will now take a short look at the volume of future East-West trade. Most of the studies which try to project the volume of future East-West trade are based on the *'gravity approach to trade'*, where the volume of trade depends on the distance between the two trading countries as well as their incomes and their size. Gravity models are able to estimate the total volume and the geographical structure of East-West trade, but not their sectoral structure[4]. We have surveyed three studies which are based on the gravity approach (Baldwin (1994), Holzmann et al. (1993), Holzmann and Zukowska-Gagelmann (1996)). They all yield similar results. First, the trade volume between the Western and Eastern European countries should increase several-fold. The exports of the CEECs to Western Europe of the projection year are expected to be two to three times the exports of the base year. The imports of the CEECs from Western Europe are expected to be two to five times the imports of the base year. The different results depend on different reference and projection years, different country groups, and different assumptions underlying the scenarios. Second, trade with the CEECs should not lead to trade deficits for the Western European countries, i.e. the projections for Western European countries exports are typically higher than for their imports. So Western European countries should not suffer from trade imbalances.

A trade scenario

In our formal framework, the regional impacts of changing trade flows between Austria and its eastern neighbours is simulated by exogenous shifts in CEEC-4’s supply and demand curves for goods traded with Austria. General equilibrium effects are only taken into account for Austria, while the internal structure of CEEC-4 is not explicitly modelled.

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size and concentrated mostly in the traditional areas. There is a *general delay in the structural reforms* in all CEECs.

4 It is sometimes argued that the theoretical foundation of the gravity model is weak.

It is not possible, however, to catch all these processes by a single simulation scenario. Different shifts in different sectors have to be introduced in order to simulate the effects characterising different periods of transformation, catching up and integration. Limitation of space prevents us from any attempt to develop realistic scenarios for all phases of the process. Our main purpose in this paper is to demonstrate that taking general equilibrium feedbacks into account is important and tractable. It is important, because the overall results might dramatically differ from what one expects from simplistic partial equilibrium considerations.

The trade scenario simulated in this study is chosen such that this fact is made as clear as possible. The inflow of cheaper imports from CEECs in all sectors, where they have been strong already in the past, is usually regarded as most threatening for certain regions and sectors in Austria, and hence the most problematic process under a regional equity point of view. Therefore our scenario isolates this single component of the entire process. It is assumed that the CEEC-4 will increase their export capacities of all sectors to the three-fold level of 1994[5]. For simulating this scenario in our model, we have to shift the CEEC-4s' import supply functions for every industry to the right[6]. That means that the CEEC-4 are willing to supply a higher quantity of exports at a given price. In order to make such an increase possible, the CEEC-4 have to build up new production capacities. So this scenario reflects a successful restructuring of their industries.

3. MEASURING THE WELFARE IMPLICATIONS OF CHANGING TRADE REGIMES

The two major methods to evaluate the economic benefits of economic integration are *econometric evaluations* and *computable general equilibrium models*. Econometric evaluations estimate the parameters of usually simple theoretical models (or even from a single equation) by using econometric techniques. They usually focus on questions as the estimation of trade creation and trade diversion effects or growth effects of integration (Baldwin and Venables, 1995, p. 1626). The drawback of econometric evaluations is that they cannot capture the complicated interplay of effects which may be important for massive policy changes such as the integration of the CEECs into the European Union.

Computable general equilibrium models are the predominant framework for analyzing the economic benefits of economic integration. Baldwin and Venables (1995, p. 1628–1629) classified applied CGE models into three generations, which correspond to three types of welfare effects. The models of the *first* generation are static and assume perfect competition. Gains from trade in these models are due to improved efficiency from the reallocation of resources among sectors in different countries. The models of the *second* generation are also static, but allow for increasing returns to scale. Trade liberalization enables improved efficiency through scale

5 This magnitude is in line with the results of many studies which predicted the future volume of trade between the Eastern and Western European countries by a gravity model (see chapter 2). Although these studies predict only the total volume of trade in the long-run (with partial or total income catch-up of the Eastern European countries), they can serve as a guideline for the magnitude.

6 Remember that "import supply" is CEECs' supply of goods imported by Austria from these countries, according to our terminology.

economies and improved competition. *Third* generation models are dynamic and include accumulation effects. Savings will create additional investment and therefore increase the capital stock. Note while the welfare gains in the first two generations of models reflect increased efficiency for a given amount of inputs (static allocation effects), third generation models augment the capital stock and therefore increase the amount of available inputs (Cooper, 1996, p. 256). Although CGE models suffer from some weaknesses (see Gelauff and Graafland, 1994, for example), they are the most appropriated tool for analyzing benefits from economic integration.

4. THE MODEL

4.1 Summary

The model to be implemented is a static perfect competition computable equilibrium model with

- 11 regions, 9 domestic regions plus 2 foreign regions (CEEC-4 and ROW),
- 10 production sectors,
- 2 factors of production (labor and capital), and
- a household sector representing all types of domestic final demand, including investments.

There is no separate public sector, i.e. public services are contained in the production sectors and public incomes and expenditures are part of the representative household's incomes and expenditures. For the delineation of regions and sectors see the appendix. The model is identical to the one described by Bröcker (1998). The only modification is to introduce foreign trade relations. Bröcker's (1998) model is closed. For details the reader is referred to the cited paper. We follow its notation as close as possible.

The domestic economy is modeled as a general equilibrium, while the foreign regions are only partially represented by import supply and export demand[7] functions. Hence, for each domestic sector (firms and households) all returns and expenditures are covered by the model, while only a subset of flows into and out of foreign regions appears in the model.

A production sector in a domestic region is represented by a price taking profit maximizing firm, producing a single output by intermediate inputs and factor inputs under constant returns to scale. Therefore its output price equals minimum unit cost. Intermediate inputs are bought in the own region, in other domestic regions or abroad. As usual in multiregional computable equilibrium models, products of one sector from different regions of origin are regarded as distinct, and the degree of substitutability between them is limited. Outputs are sold for domestic intermediate or final use, or they are exported. Labor and capital are in fixed supply in each

[7] "Import supply" means a foreign region's supply of goods imported by domestic firms or households. Similarly, "export demand" means foreign demand for domestically produced goods.

domestic region. Regional factor returns flow to a regional representative household, maximizing homothetic utility by expending the income for goods, bought from domestic producers or imported. All preferences and technologies have a nested constant elasticity of substitution (NCES) form. The import supply and export demand functions are constant elasticity functions.

Thus far, the specification is standard. The usual procedure would be now to set up a complete social accounting matrix, to calibrate the free parameters of preferences and technologies and to simulate counterfactual scenarios. The necessary information, however, is usually not available. For a standard calibration we would need a full interregional input-output table reporting, for each sector in each region, all inputs by sector and region of origin. This is sometimes called an ”ideal” input-output table. As nobody ever had such a table, it is usually produced by a ”data generating” procedure based on ad hoc assumptions. Authors do not like to uncover the recipes of the witchcraft practiced in this stage. Standard ingredients are rules of proportionality, constant ratios, RAS-procedures and gravity equations.

In contrast to these mixtures, our philosophy in this context is simple and clear: don’t use ”data”, which you don’t have. Or putting it in a positive way: Only allow for free parameters which can be calibrated by existing information.

The information we do have is

- a national input-output table,
- information on the location of sectors (such as employment by sector and region),
- information on regional factor prices, and
- interregional transport cost.

What we don’t have, however, is

- input-output information on the regional level, and
- interregional trade data.

Thus we have to introduce assumptions into our theoretical model (not into the data generating process) making it possible to dispense with the latter type of information. Three assumptions lead to a solution:

- First, production technologies of firms and household preferences do not depend on location.
- Second, a pooling concept is applied, known as the Chenery-Moses approach in the input-output literature (Batten and Boyce, 1986). According to this approach, all outputs of a sector originating from different regions (domestic and foreign) and used in some region of destination are merged into a sectoral pool, from where customers take goods for intermediate or final use. The goods in the pool are called ”pool goods”. They are composite goods generated by a NCES aggregator (called the ”pool-aggregator”), using the goods from different origins as inputs. The regional composition is obtained from cost minimization. This pooling approach amounts to the same thing as to assume that all utility and production functions contain nests on the lowest level aggregating goods from different regions (one nest for each input sector), and that these nests do not differ between users. Such an

assumption is indispensable, because we have data for calibrating the position parameters for just one such nest per sector. The information comes from the regional distribution of the respective sector.

- The third assumption is that interregional trade is costly, with costs depending on interregional distance.

These assumptions imply that input-output coefficients in the benchmark equilibrium endogenously vary over regions in response to price variations, and that trade flows fulfill a gravity equation. Unfortunately, the calibration procedure becomes more complicated with these assumptions. Parameters can not directly be deduced from the ”data”, but have to be found by solving a fairly large system of non-linear equations. The reader is referred to our cited paper (Bröcker, 1998) for details. The model is calibrated with 1994 data. Hence, the benchmark equilibrium reproduces the statistical observations of 1994 used for parameter calibration.

After a successful calibration we are able to simulate counterfactual scenarios. Two types of equilibria will be studied, an equilibrium with complete market clearing and a fixed wage equilibrium. In the latter, goods markets and the capital markets clear, while unemployment arises due to a fixed lower bound for real wages.

4.2 Formal description

We begin with index notation.

- Subscripts $r, s = 1, \dots, N, N+1, \dots, R$ refer to regions.

  $\{1, \dots, N\}$ are domestic, $\{N+1, \dots, R\}$ are foreign regions.

- Superscripts $i, j = 1, \dots, I$ refer to sectors.

- Superscript $k = 1, \dots, K$ refers to factors.

Superscripts are always understood to run through their whole range, while ranges of regional subscripts are always explicitly given.

Let S_r^i and P_s^i denote supply and pool-good quantities, respectively, and let p_r^i and q_s^i denote their respective prices. For domestic regions S_r^i is just the sectoral output x_r^i, $S_r^i = x_r^i, r = 1, \dots, N$. For foreign regions S_r^i is import supply, which is assumed to be an increasing function of price,

$$S_r^i = \pi_r^i \left(p_r^i\right)^{\mu_r^i} .$$

π_r^i is a position parameter to be calibrated, and μ_r^i is an elasticity, which may vary over regions and sectors. In the limiting case $\mu_r^i \to \infty$ the price p_r^i is constant.

For domestic regions the quantity of pool goods is obtained from intermediate and final demand,

$$P_s^i = d_s^i + \sum_j a_s^{ij} x_s^j, \quad s = 1, \ldots N.$$

d_s^i is final demand resulting from utility maximization under the budget constraint

$$\sum_k f_s^k w_s^k = \sum_i d_s^i q_s^i, \quad s = 1, \ldots, N.$$

f_s^k is the factor stock and w_s^k is its price. All regional factor returns are expended completely in the same region. There is no saving (remember that d_s^i includes investment demand) and no interregional flow of funds.

For foreign regions P_s^i is export demand, which is decreasing in its price,

$$P_s^i = \tau_s^i \left(q_s^i\right)^{-\varepsilon_s^i}, \quad s = N + 1, \ldots R,$$

with position parameter τ_s^i and elasticity ε_s^i. We do not allow for the limiting case $\varepsilon_s^i \to \infty$, because it would imply that all prices are determined from abroad and that regions would specialise completely, which is unrealistic.

The condition of goods market clearing completes the description of the quantity system,

$$S_r^i = \sum_{s=1}^{R} t_{rs}^i P_s^i, \quad r = 1, \ldots, R.$$

t_{rs}^i is the trade coefficient, measuring the cost minimizing input of goods from r (including imports) per unit of pool good in s.

As to the price system, we need the equations for factor prices w_r^k, prices of pool-goods q_s^i, and output prices $p_r^i, \quad r = 1, \ldots, N$.

Concerning factor prices, different cases have to be considered. The factor price of capital is always obtained from the market clearing condition, while that for labor is obtained either as an exogenous lower bound for the wage rate or from market clearing. The former case applies in a fixed wage scenario, if there is a binding lower wage bound, the latter applies otherwise. These different possibilities can be summarized in a complementarity condition,

$$f_r^k \geq \sum_j c_r^{kj} x_r^j, \quad w_r^k \geq \overline{w}_r^k,$$

$$\left(f_r^k - \sum_j c_r^{kj} x_r^j \right) \cdot \left(w_r^k - \overline{w}_r^k \right) = 0, \quad r = 1, \ldots, N.$$

$\overline{w}_r^k$ is the lower bound. It may be set equal to zero if one does not want it to be binding. c_r^{kj} is the cost minimizing factor input per unit of sector *j* output in region *r*.

Output prices and prices of pool goods equal their unit cost,

$$p_r^i = \sum_j a_r^{ji} q_r^j + \sum_k c_r^{ki} w_r^k, \quad r = 1, \ldots, N,$$

$$q_s^i = \sum_{r=1}^{R} t_{rs}^i p_r^i, \quad s = 1, \ldots, R.$$

The system is complete, if we specify technologies and preferences, from which input coefficients, trade coefficients and final demand are derived. The specification of technologies and calibration of their parameters are treated in the next subsection. The derivation of trade coefficients, however, deserves a special treatment here.

As already mentioned, interregional trade is modeled by taking transport cost explicitly into account. The term ”transport cost” is a short cut for all kinds of distance dependent costs related to interregional trade. For the sake of simplicity we adopt Samuelson’s (1954) iceberg model. A good transported from *r* to the pool in *s* loses a certain share η^i of its quantity per unit of distance. Hence, if z_{rs} denotes distance from *r* to *s*, then the price per unit of good from *r* arriving in *s* (the ”c.i.f. price”) is

$$v_{rs}^i = p_r^i \exp\left(\eta^i z_{rs}\right).$$

Furthermore, let $ct^i\left(v_{1s}^i, \ldots, v_{Rs}^i\right)$ be the unit cost function derived from the pool aggregator. Arguments of the pool aggregator are quantities available in the region of destination, and arguments of the corresponding cost function are the respective c.i.f. prices. Note that ct^i has a sectoral index, but no regional index. The aggregator is the same for all destinations.[8] According to Hotelling’s lemma, the input per unit of pool good is the first derivative of the unit cost function. Therefore, the input of goods at the place of origin per unit of pool good in the place of destination is

$$t_{rs}^i = \frac{\partial ct^i}{\partial v_{rs}^i} \exp\left(\eta^i z_{rs}\right).$$

4.3 Technology and preferences

Households are assumed to have a one-level CES utility, which is identical for all regions. It is uniquely specified by the elasticity of substitution σ_H and an *I*-Vector of position parameters.[9]

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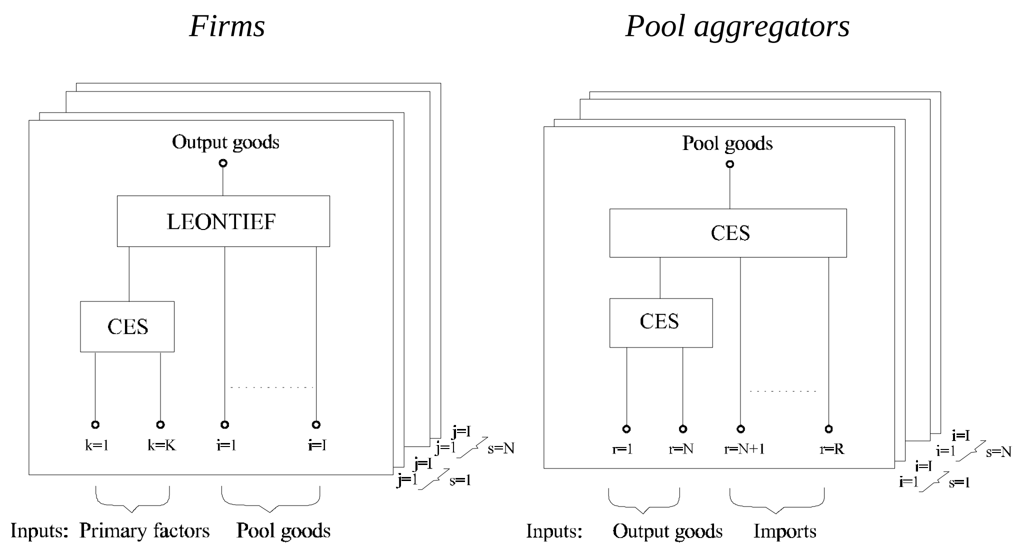
8 There is one exception: Inputs from foreign regions into foreign pools are restricted to zero.

9 The classical reference for parametrising NCES functions is Keller (1976). There the position parameters are called distribution parameters, and are normalized such that they add up to unity. We dispense with normalization in order to have a degree of freedom for freely choosing units of all goods (see Bröcker, 1998, appendix).

This vector is calibrated such that the final consumption vector in the national input-output table is exactly reproduced by the corresponding national aggregate in the benchmark equilibrium of the model. Similarly, technologies of firms are uniquely specified by the substitution structure (see figure 1) and an $(I + K)$-vector of position parameters, which is calibrated using national input-output data.

Figure 1: Representation of the technology of the firms and the pool aggregators



Source: The authors' own draft.

Finally, the pool aggregators have a 2-level substitution structure (see figure 1) and an *R*-vector of position parameters. Remember that the aggregators are the same for all regions of destination, except for the fact that foreign regions are not allowed to buy from foreign regions. Hence, the upper nest is missing for foreign regions of destination. The position parameter is calibrated such that, for each sector, the data on regional employment and on imports by foreign regions of origin are exactly reproduced by the benchmark equilibrium.

4.4 Elasticities and transport rates

Only position parameters are obtained from calibration. External information is required for fixing the remaining parameters. For elasticities we fix a base case (table 1) and vary the elasticities systematically in a sensitivity analysis. Though we have consulted an extensive body of econometric literature[10] a considerable degree of arbitrariness remains, because estimates vary

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[10] Sadoulet (1995), Ho and Jorgenson (1994), Brenton and Winters (1992), Harrison et al. (1991), Jones and Whalley (1988), Fullerton et al. (1983), Mansur and Whalley (1984), Burniaux et al. (1990), Mensbrugghe et al. (1990).

over wide ranges. Note that we apply the small economy assumption, as far as import supply from the rest of world is concerned[11].

Table 1: Elasticities and transport rates used in the model.

	Production	Transport	Import demand	Import supply		Export demand		Transport rates
Type of elasticity	Substitution	Substitution	Substitution	Price	Price	Price	Price	(per 1000 km)
	σ^i_P	σ^i_T	σ^i_M	μ^i_{CEEC}	μ^ι_{ROW}	ε^ι_{CEEC}	ε^ι_{ROW}	η^ι
AGRICUL	0.8	8	6	3	100	2.50	3.00	0.2
CLOTHES	1.1	8	6	3	100	2.50	3.00	0.1
METAL	0.9	5	5	0.5	100	2.00	2.75	0.1
TECH	0.9	5	5	0.5	100	2.00	2.75	0.2
MINSPEC	0.8	5	6	3	100	2.50	3.00	0.2
FOOD	0.9	8	5	3	100	2.00	2.75	0.2
CONSTR	0.9	6	4	1.5	100	1.50	2.50	0.5
TRADEACC	1.3	6	4	1.5	100	1.50	2.50	0.5
SERVICE1	2.0	6	4	1.5	100	1.50	2.50	0.5
SERVICE2	3.0	6	4	1.5	100	1.50	2.50	0.5

Source: The authors' own assumptions, based on a literature survey.

The transport rates shown in table 1 are crude guesses. Jointly with the parameters σ^i_T, these rates control the distance sensitivity of interregional trade. It can be shown that interregional trade in our model fulfills a gravity equation with distance function $\exp\left(-\lambda^i z_{rs}\right)$, with $\lambda^i = \left(\sigma^i_T - 1\right)\eta^i$. Bröcker (1984, p. 131) estimated λ-parameters around 1 per thousand. kilometers for international commodity trade. Hence, for σ^i_T in the range 5 to 8, η^i should be in the range of $1/7$ to $1/4$. Thus, at least the order of magnitude of the given rates for goods producing sectors seem plausible. Considerably higher rates have to be assumed for construction and services, as the respective output is less easily tradable.

5. SIMULATING THE EFFECTS OF SCENARIO 'CEEC EXPORT EXPANSION'

Driving forces within the model

Before we turn to the results of our scenario, we want to deal with the driving forces which work inside the model and determine the results. This gives us the opportunity to improve our understanding of the behavior of the model and to avoid the "black-box feeling", which is often associated with general equilibrium models.

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[11] The small country assumption states that a country faces fixed world market prices. They can be fixed either on both import and export sides (this case is also referred to as a "small open economy") or on the import side only ("'almost' small open economy"). We have fixed the import prices for imports from the ROW by choosing a very high value for the import supply elasticity (μ^ι_{ROW}).

The Austrian demand for imports of a specific sector depends on the relative price of the imports to domestically produced commodities. As long as this relative price remains constant, import demand remains constant. Since import supply of the CEEC-4 increases, a disequilibrium in form of excess supply occurs on the respective import market. So the price of the imports has to fall in order to clear the import market. The falling import price leads to a rise of Austrian import demand and to a fall of CEEC-4 import supply. This leads to a new equilibrium on the import market. The resulting market clearing amount of additional imports is smaller than the initial amount of additional import supply of the CEEC-4 and depends primarily on the price elasticity of the import supply of the CEEC-4 (m^{i}_{CEEC}) and the elasticity of substitution of the domestic pool aggregators between foreign and domestic products (s^{i}_{M}). The Austrian demand for imports from the Rest of the World decreases because of the falling prices for imports from the CEEC-4. So imports from the CEEC-4 are substituted for imports from the ROW and for domestically produced commodities.

Since the demand for domestically produced commodities of the sectors with the increasing import penetration declines, a part of the production factors becomes unemployed. So factor (and therefore commodity) prices have to fall in order to clear the markets. If we assume that the import penetration affects a labour-intensive sector, employment in this sector declines. So the wage rate has to fall to clear the labour market. This causes the firms in other sectors to increase employment. So factors are reallocated between sector due to changes of their relative prices.

The decline of the import prices improves the terms of trade[12] in Austria. It is a well-known statement in trade theory that a rise of the terms of trade increases a country's welfare (see Krugman and Obstfeld, 1994, p. 92, for example). Total demand for domestically produced commodities consists of two components, namely final demand of the households and export demand of the foreign countries. Final demand of the domestic households rises because an increase of an country's welfare (which is equivalent to an increase of real income) results in an increase of final demand. The commodity prices in Austria decline because of the fall of the factor prices and because of the fact that cheaper imports are used as intermediates in production. So demand of the foreign countries for Austrian exports increases because of the falling price level in Austria[13]. This damps the falling price level and helps to improve the terms of trade.

In the model specification with *fixed real wages* the causal chains are in principle the same. The main difference lies in the functioning of the labour markets. In contrast to the flexible wage specification, where only a reallocation of resources between sectors takes place, total aggregated output and employment rises because of the infinitely elastic labour supply (up to a predetermined limit). Welfare effects are higher in the model specification with fixed real wages than in the model specification with flexible wages. To understand this, we have to take a look at the initial state of the economy before we simulate any scenario (= benchmark equilibrium). In

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12 The terms of trade are defined as the ratio of a country's export prices to its import prices.

13 Notice that the balance of payment condition is automatically fulfilled for each Austrian region due to the budget restriction of the households. Therefore the balance of payment condition is fulfilled for Austria as a whole. This implies that the *value* of the additional exports equals the *value* of the additional imports.

an economy with flexible wages, the wage rate is obtained from the market clearing conditions. This means that total labour supply is always employed. So there is an efficient use of all resources. In an economy with fixed (real) wages unemployment can occur, if the lower bound for the wage rate is binding. In this case, the lower wage bound deters the firms to demand enough labour. As a consequence of this, unemployment occurs. So fixed wages lead to distortions within the economy. On the one hand, these distortions lead to a lower welfare level of the economy in the benchmark equilibrium (compared to a non-distorted economy, i.e. flexible wages). On the other hand, the reduction of this distortions (e.g. by foreign trade) will lead to higher welfare gains because there are more "efficiency reserves" within the economy[14].

Employment in Austria is rising due to the rising imports from the CEEC-4 (table 3). This result seems to be implausible, so we have to explain the forces which lead to this result. The common-sense argument is that additional imports will hurt the respective industry and will lead to employment losses. This is true in a partial equilibrium context, where additional imports of one sector lead to more competition in this sector. So employment in this sector will decline, since demand shifts from domestically produced commodities to imported commodities. In a general equilibrium context, this will happen too. But there are additional forces working which lead to an increase of employment. As we have pointed out above, the increase of the terms of trade due to the declining import prices leads to an increase of welfare in Austria, which is equivalent to an increase on real income. This is the same effect as in the case of flexible wages. The only difference is that labour markets react on excess demand by quantity rather than price adjustment. So either the wage rate (flexible wages) or employment (fixed wages) increases.

Simulation results

Table 2 presents the sectoral results for both the flexible and the fixed real wage model specification. What we can obtain from the results are the substitution effects on the import side (imports from CEEC-4 for imports from ROW and for domestic production) and the reallocation of production factors between sectors. In addition to these effects, intersectoral interdependencies and preferences of the households influence the results. With flexible wages, total output remains constant. With fixed real wages, total output rises by 0.6 %.

[14] In addition to the fixed real wage rate, we have to assume that there is enough unemployed labour force which can be demanded by the firms.

Table 2: Sectoral results of scenario 'CEEC Export Expansion': Imports, exports, production and final demand (per cent changes compared with the benchmark equilibrium)

Flexible wages

	Imports			Exports			Production	Final demand
	CEEC	ROW	Sum	CEEC	ROW	Sum		
AGRICUL	105.2%	-3.8%	4.1%	1.3%	1.5%	1.5%	-0.9%	0.3%
CLOTHES	104.0%	-5.3%	1.7%	1.6%	1.9%	1.9%	0.6%	0.6%
METAL	169.2%	-8.7%	10.5%	1.4%	1.9%	1.8%	-2.7%	1.4%
TECH	170.6%	-3.5%	1.4%	1.3%	1.8%	1.8%	0.7%	0.4%
MINSPEC	104.2%	-5.0%	5.2%	1.6%	1.9%	1.9%	-0.8%	0.5%
FOOD	96.8%	-2.4%	-0.2%	1.1%	1.5%	1.5%	0.4%	0.2%
CONSTR	121.0%	-2.1%	9.6%	0.9%	1.5%	1.4%	0.2%	0.2%
TRADEACC	121.2%	-1.7%	4.5%	0.7%	1.2%	1.1%	0.1%	0.1%
SERVICE1	121.4%	-1.5%	-1.4%	0.6%	1.1%	1.1%	0.3%	0.1%
SERVICE2	121.2%	-1.8%	4.5%	0.7%	1.2%	1.2%	0.1%	0.2%
Sum	142.4%	-4.3%	3.1%	1.3%	1.8%	1.7%	0.0%	0.3%

Fixed real wages

	Imports			Exports			Production	Final demand
	CEEC	ROW	Sum	CEEC	ROW	Sum		
AGRICUL	105.1%	-3.8%	4.0%	1.6%	2.0%	1.9%	-0.1%	0.9%
CLOTHES	104.3%	-4.9%	2.1%	2.0%	2.3%	2.3%	1.3%	1.1%
METAL	169.2%	-8.5%	10.7%	1.7%	2.3%	2.2%	-2.0%	1.9%
TECH	170.5%	-3.2%	1.7%	1.6%	2.2%	2.1%	1.4%	0.9%
MINSPEC	104.4%	-4.8%	5.4%	1.8%	2.2%	2.1%	-0.2%	1.0%
FOOD	96.9%	-2.3%	-0.1%	1.3%	1.8%	1.7%	1.0%	0.7%
CONSTR	121.0%	-2.2%	9.5%	1.2%	1.9%	1.9%	0.8%	0.9%
TRADEACC	121.3%	-1.7%	4.6%	0.9%	1.5%	1.5%	0.7%	0.7%
SERVICE1	121.4%	-1.5%	-1.3%	0.9%	1.5%	1.5%	0.9%	0.7%
SERVICE2	121.1%	-1.9%	4.3%	1.1%	1.8%	1.7%	0.8%	0.8%
Sum	142.4%	-4.1%	3.3%	1.6%	2.2%	2.1%	0.6%	0.9%

Source: The authors' own calculations.

Two factors primarily cause different results for the Austrian regions: the sectoral composition of the industrial structure of a region and the distance to the CEEC-4. The sectoral composition of a region influences regional results through the factor prices. In regions with a higher share of sectors which suffer from the import competition there is a greater pressure on the factor prices than in other regions. So there is an inverse relationship between structural adjustment needs and the rise of real income. Distance matters because the nearer an Austrian region lies to the CEEC-4, the higher is the CEEC-4s' share in the total volume of foreign trade of the region[15]. Due to interregional trade flows, supply as well as demand shocks ripple throughout the economy.

Three measures are used to present the impacts of this scenario on the different Austrian regions. The change of *regional real income* measures how the welfare of the regional households is affected. A *structural change indicator* (s^r) measures the magnitude of adjustment per region. Although structural change is costless in the neoclassical world, this structural change indicator can be interpreted as a measure for the burden structural change has on a region in reality. It is defined as the percentage change of the sum of the absolute values of the changes of sectoral output in a region $\left(x_i^r - \bar{x}_i^r\right)$, divided by total regional output (x_i^r denotes the output of sector i in region r in the counterfactual equilibrium, $\bar{x}_i^r$ is the corresponding output in the

15 This results from the gravity approach to trade.

benchmark equilibrium). The third measure is the increase of employment in the regions. Notice that employment rises in the fixed real wage specification only.

$$s^r = \frac{\sum_i \left| x_i^r - \bar{x}_i^r \right|}{\sum_i \bar{x}_i^r} * 100\%$$

Table 3: Regional results of scenario 'CEEC Export Expansion': real income, regional structural change and employment (per cent changes compared with the benchmark equilibrium)

	Flexible wages			Fixed real wages		
	Real income	Structural change	Employment	Real income	Structural change	Employment
Burgenland	0.28%	0.56%	-	0.91%	0.97%	1.01%
Carinthia	0.27%	0.47%	-	0.86%	0.93%	0.99%
Lower Austria	0.27%	0.63%	-	0.85%	0.96%	0.94%
Upper Austria	0.21%	0.64%	-	0.74%	0.91%	0.86%
Salzburg	0.23%	0.45%	-	0.79%	0.87%	0.94%
Styria	0.23%	0.62%	-	0.79%	0.89%	0.91%
Tirol	0.19%	0.50%	-	0.72%	0.83%	0.87%
Vorarlberg	0.17%	0.57%	-	0.66%	0.90%	0.80%
Vienna	0.35%	0.25%	-	1.05%	0.92%	1.22%
Sum	0.26%	0.49%		0.86%	0.91%	0.99%

Source: The authors' own calculations.

The welfare gains range from 0.17 % (Vorarlberg) to 0.35% (Vienna) for flexible wages and from 0.66 % (Vorarlberg) to 1.05 % (Vienna) for fixed real wages (see table 3). While total employment remains constant for flexible wages, an increase of employment will occur for fixed real wages. The additional employment ranges from 0.80 % (Vorarlberg) to 1.22 % (Vienna).

We can make two observations regarding the structural adjustment needs. Regional structural adjustment needs are lower (compared to the regional welfare gains) and more equally distributed in the fixed real wage specification than in the flexible wage specification. The reason for that is that in the latter model specification, the only way to ensure a new equilibrium in case of a disequilibrium is resource reallocation between sectors due to changes in relative prices. The less flexible the prices are, the less resource reallocation between sectors can take place. In the case of fixed real wages, only capital is reallocated between sectors, whereas adjustment on the labour markets is done by quantity rather than price adjustment. So less restructuring takes place.

Sensitivity analysis

Results from applied general equilibrium models are often presented as a single solution of a deterministic system. But there are several features of these models which give rise to uncertainty concerning the reliability of the solution. Mensbrugghe et al. (1990, p. 174) divided these uncertainties in three broad groups, namely uncertainty about the model specification, the macroclosure and the values of parameters such as elasticities, transport rates, etc. Though we have consulted an extensive body of econometric literature, a considerable degree of arbitrariness remains, because estimates vary over wide ranges. Especially the values for the sectoral transport rates are only crude guesses. So we will perform extensive sensitivity analysis for evaluating these uncertainties. In addition to this, another important aspect of sensitivity analysis is that it will improve our understanding of the behavior of the model.

The level of *national real income* crucially depends on the value of three elasticities: import supply elasticity (m_r^i), import demand elasticity, and export demand elasticity (e_s^i) (see figure 2[16]). If the import supply elasticity of the CEEC-4 is high, a small fall of the import price leads to a high fall of foreign import supply. What follows is that a small fall of the import prices is sufficient to clear the import markets. The less the import prices are falling, the smaller is the welfare effect. The same argumentation can be used to explain the sensitivity of the welfare gains to the domestic import demand elasticity. The higher the elasticity, the more substitution will occur between domestic commodities and imports and the sooner the import markets will be cleared. A higher value for the foreign export demand elasticity leads to higher welfare gains, because additional demand leads to increasing factor prices (compared to the foreign price level) and therefore to increasing real income. The fact that trade elasticities are the most crucial elasticities, is a well known result in applied general equilibrium analysis (see Mensbrugghe et al., 1990, p. 200, for example). The remaining elasticities (elasticity of substitution of the households (s_H), transport elasticity (s_T^i), elasticity of substitution of production (s_P^i),) have virtually no influence on national real income.

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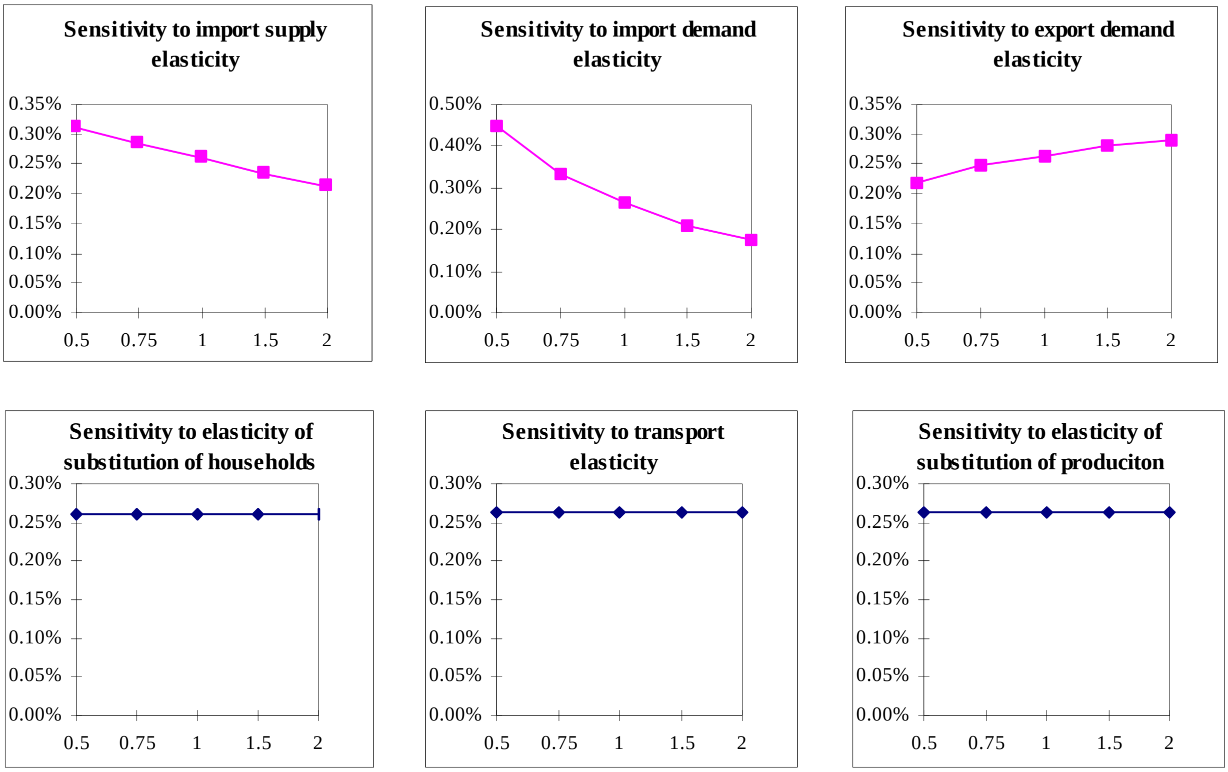
[16] We have performed sensitivity analysis for flexible wages only. The results for fixed real wages are very similar. The model results are calculated for five elasticity values, whereby - one by one for each elasticity - base values are multiplied with the following factors: 0.5, 0.75, 1, 1.5, and 2.

Figure 2: Sensitivity of real income in Austria to the variation of elasticities for the counterfactual equilibrium 'CEEC Export Expansion' (per cent changes compared with the benchmark equilibrium, variation of elasticities compared to the base run value)

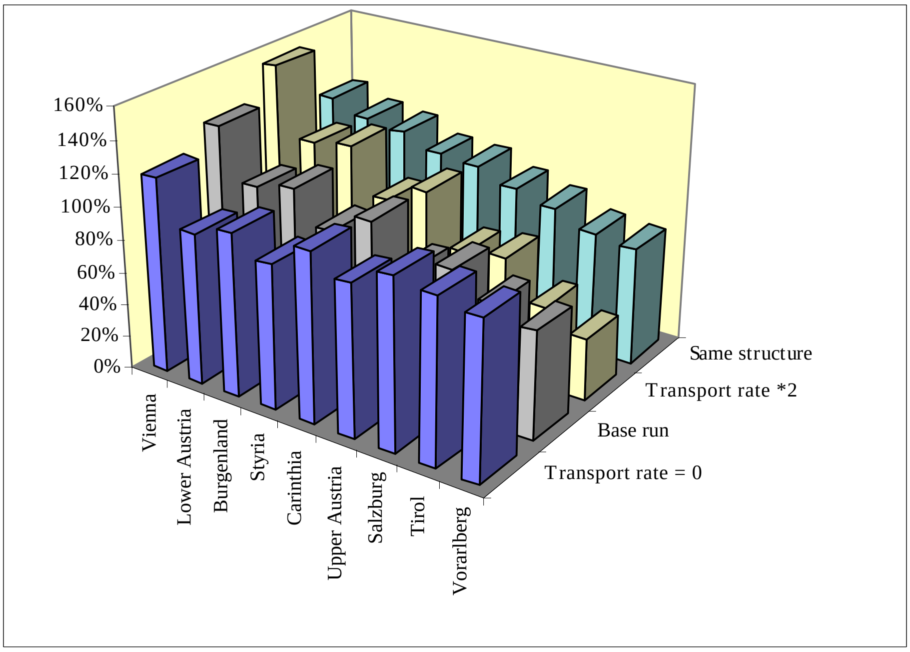


Source: The authors' own calculations.

In addition the variation of the elasticities stated above, we have investigated the influence of the *transport rates* on the regional distribution of the real income gains. Therefore we have ranked the Austrian regions according to their distance to the CEEC-4. The regional welfare results for the base run can be found in the second row in figure 3. What we can obtain is that the region with the lowest distance to the CEEC-4 (Vienna) has the highest welfare gains, the region with the highest distance (Vorarlberg) has the lowest welfare gains.

In order to separate the influences of sectoral composition and distance to CEEC-4 of Austria's regions on regional welfare, we first set the transport rate equal to zero. This isolates the influence of sectoral composition (first row in figure 3). What we see is a great similarity with the results of the base run. This suggests that the sectoral composition of the regions mainly determines the regional results. If we double the transport rate (third row in figure 3), we see the growing influence of the transport rate. By assuming that all regions have the same sectoral composition, we isolate the influence of distance (fourth row in figure 3). We see that Vienna's welfare gains are 118 % of the national gains, Vorarlberg's gains are 72 % of the national gains. What we can conclude now is that both distance and sectoral composition matters, but - with our parameter values - the latter seems to have a greater influence.

Figure 3: Regional welfare gains for the Austrian regions for the scenario 'CEEC Export Expansion' for different transport rates (percent of national values)



Legend:

'Transport rate = 0'	No transport costs for interregional and international transport
'Base run'	Base run of the model
'Transport rate*2'	Double transport costs
'Same sectoral structure'	The same sectoral structure is assumed for all Austrian regions; this shows the impact of distance to CEEC-4

Source: The authors' own calculations.

6. CONCLUSIONS

In this paper we have presented a framework to investigate the influence of economic development in Eastern Europe on regional production and welfare in Austria. We have concentrated on the effects future trade patterns between Austria and its 4 neighboring Central and Eastern European countries (CEEC-4) will have on welfare and production for Austria's regions. Our framework is a multiregional general equilibrium model for the Austrian economy. The 9 Austrian Federal Provinces (NUTS-II) are linked by trade flows with 4 of the Central and Eastern European countries and with the rest of the world.

We have seen that the development of trade between the CEEC-4 and Western Europe after 1989 can be characterized by three phases, namely the *'early restructuring phase'* (1989-1992), the *'recovery phase'* (1992-1994/95) and the *'catching-up phase'* (1994/95-2010/20). We have concentrated on one subset of possible trade developments during the 'catching-up phase' (1994/95-2010/20). Therefore we have constructed the scenario 'CEEC Export Expansion'. In this scenario we have assumed that the CEEC-4 will increase their supply of exports to Austria to the three-fold level of 1994 for all sectors. The represents a success of the CEEC-4 in building up new export capacities. We have examined welfare and production effects of this scenario on Austria's regions for two different model specifications (flexible and fixed real wages). Real income in Austria rises by 0.26% (flexible wages) and 0.86 % (fixed real wages). There is a pronounced regional pattern of the welfare gains. This result seems to be determined rather by the sectoral structure of the regions than by the geographical distance to the CEECs. The effects on sectoral output are determined by the reallocation of resources due to changes in relative prices. Two conclusions can be drawn from *sensitivity analysis*. The first is the well known property of single country models that the magnitude of the welfare gains crucially depends on the trade elasticities. The second is that both distance and sectoral composition matter, but - with our parameter values - the latter seems to have a greater influence. The type of the *model closure* (flexible wages or fixed real wages) influences the magnitude of production and welfare effects, but leaves their regional and sectoral distribution nearly unaffected.

Although we have refrained from any attempt to perform a comprehensive analysis of future East-West trade patterns (which would require the development of a couple of reasonable scenarios), the plausibility of the model results has shown the tractability of our approach.

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APPENDIX

A1 Sectors

The industrial classification is based on the official ”Wirtschaftsabteilungen” of the ”Betriebssystematik 68” (ÖSTAT, 1985) and on Palme (1988).

Table A.1: Industrial classification of the model

Industry		Abbreviation
1	Agricultural industries	AGRICUL
Labour-intensive manufacturing		
2	Manufacturing of clothes	CLOTHES
3	Manufacturing of metal and other raw materials	METAL
4	Manufacturing of technical products	TECH
Capital-intensive manufacturing		
5	Mining and other primary industries, special materials	MINSPEC
6	Manufacturing of food	FOOD
7	Construction	CONSTR
8	Trade, storage and accommodation	TRADEACC
9	Production services	SERVICE1
10	Other services	SERVICE2

Source: The authors’ own classification based on ÖSTAT (1985) and Palme (1988).

A2 Regions

Austrian regions are the ”Bundesländer”. The two foreign regions are the group of the four neighboring reform countries (CEEC-4: Czech Republic, Slovakia, Hungary, and Slovenia) and the rest of the world (ROW).

A3 Data

The data required for calibration (reference year: 1994) and the respective data sources are as follows:

- National input-output table (Projection of the official input-output table of the Austrian statistical office by Dr. Kurt Kratena from the Austrian Institute of Economic Research. Many thanks to him at this place),

- foreign trade by sector and foreign region (ISIS),
- employment by sector and region (ISIS),
- average wage rates by sector and region (ISIS),
- interregional distances (Euclidean distances between centers of gravity of the respective regions).