SCHRIFTEN ZUR WIRTSCHAFTSTHEORIE UND WIRTSCHAFTSPOLITIK

Hubertus Hille

Enlarging the European Union

A Computable General Equilibrium Assessment of Different Integration Scenarios of Central and Eastern Europe

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Enlarging the European Union

European politics has provided clear signals: the next round in the process of EU enlargement with the accession of the Central and Eastern European countries (CEEC) will come. Since expectations concerning the costs and benefits of integration are varied, it is our aim to contribute to this discussion by undertaking an empirical assessment of integration. Firstly the extent of potential free labour mobility between the CEEC and the EU is assessed using an econometric model. On that basis, different integration scenarios, i.e. trade liberalisation, capital transfers and labour migration are simulated using a computable general equilibrium model. Our results suggest that migration flows will be moderate and that integration is likely to cause positive welfare effects in the CEEC and negligible effects in the EU.

Hubertus Hille was born in Amman, Jordan, in 1970. He grew up in Ecuador, Egypt, Peru and Germany. He studied economics at the University of Bonn and the University of Kent at Canterbury from where he obtained his MA in European Economic Integration in 1996. He subsequently began a PhD-programme at the Europa-Kolleg Hamburg, writing his thesis under the supvervision of Prof. Thomas Straubhaar at the Institute of Economic Policy Research of the University of the Federal Armed Forces Hamburg.

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To my family

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CONTENTS

ABBREVIATIONS

AIDS	Almost Ideal Demand System
CA	Current Account
CAP	Common Agricultural Policy
CEE	Central and Eastern Europe
CEEC	Central and Eastern European Countries
CES	Constant Elasticity of Substitution
CET	Constant Elasticity of Transformation
cif	cost insurance freight
cgd	Savings and Investment Good (equation subscript)
CGE	Computable General Equilibrium
CP	Complementarity Format
CRTS	Constant Returns to Scale
EBRD	European Bank for Reconstruction and Development
EC	European Community
ECU	European Currency Unit
EU	European Union
FDI	Foreign Direct Investment
fob	free-on-board
GDP	Gross Domestic Product
GDR	German Democratic Republic
GE	General Equilibrium
GTAP	Global Trade Analysis Project
i.e.	that is
IMF	International Monetary Fund
IRTS	Increasing Returns to Scale
ISCO	International Standard Classification of Occupations
MC	Mixed Complementarity
MPSGE	Mathematical Programming System for General Equilibrium Analysis
NTB	Non-Tariff-Barriers
OLS	Ordinary Least Square Estimation
p.a.	per annum
R&D	Research and Development
r.h.s.	right-hand side
RA	Representative Agent
ROW	Rest of the World
s.t.	subject to
SA	Sensitivity Analysis
SAM	Social Accounting Matrix
SEC	Southern European Countries
S&I	Savings and Investment

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1 INTRODUCTION

Any European state which respects the principles of liberty, democracy, respect for human rights and fundamental freedoms, and the rule of law may apply to become member of the European Union [Article 49 in combination with Article 6(1) of the Treaty on European Union, 2 October 1997][1].

Since the signing of the treaty of Rome in 1957 and the establishment of the European Community (EC), enlargement has always been a crucial step in the shaping of a reconciled, peaceful and democratic Europe. After the fall of the iron curtain the Central and Eastern European Countries (CEEC) were given a clear perspective for joining the European Union (EU). Since then, the EU as well as the CEEC have been continuously working towards the accomplishment of the unification of Europe.

1.1 HISTORICAL OVERVIEW

The **Association Agreements**[2], which came into power on 1 March 1992, contained extensive co-operation measures in fields such as trade, environment, crime, financial assistance and the political dialogue. They were signed between the EU and Bulgaria, Estonia, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia, the Czech Republic and Hungary. Their aim was the economic and political preparation for full future accession of the CEEC to the EU.

In Copenhagen the European Council officially defined the so-called "**Copenhagen criteria**" in June 1993 which applicants would have to meet in order to become members of the EU. These were:

- democracy, the rule of law, human rights and the protection of minorities;
- a functioning market economy, and an ability to cope with competitive pressures within the Single Market;
- ability to accept the obligations of membership, including the rules and laws known as the acquis, a body of law with some 20'000 pieces of legislation.

Between 1994-96 all ten CEEC handed in their actual application requests. In December 1997 the European Council officially opened the **enlargement process** towards central and eastern Europe (CEE). Although all talks have been undertaken individually, all applicants have been taking part in this process with the same prerequisites and rights. The motto of the proceeding has therefore been: *Differentiation without discrimination*.

The decision of the European Council in Luxembourg in December 1997 to put in place

[1] This treaty is better known as "Treaty of Amsterdam".

[2] They were also called "Europe Agreements".

a multilateral committee for political consultations, called the "**Europe Conference**" between the EU and all actual or potential applicants was aimed at further intensifying integration.

Current **accession negotiations** started in March 1998, at first only with Poland, Hungary, the Czech Republic, Estonia and Slovenia.[3] Up to now 23 of a total of 31 chapters have been dealt with. Depending on the country, preliminary agreements have been achieved in eight to eleven chapters. Due to requests for interim regulations, accord in the other chapters has been postponed.[4] Talks regarding the remaining eight chapters are expected to start in the first six months of 2000. The most difficult chapters on agriculture, labour mobility, environment, and regional policy have not been dealt with yet and are likely to be controversial.

In December 1999 the European Council in Helsinki decided that negotiations with all other CEEC should soon commence. On 15 February 2000 negotiations at ministerial level started with Bulgaria, Latvia, Lithuania, Romania and Slovakia (as well as Malta).

The EU has been strongly **supporting** the accession efforts of the CEEC. Within the context of the PHARE-programme between 1989-98 all in all 8.8 billion euros have been put at CEEC' disposal in order to build an effective administration and undertake investments for the implementation of the acquis. In March 1999 the European Council in Berlin implemented additional instruments in the areas agriculture and structural policy in order to lead the CEEC to EU standards. For the period 2000-06 financial resources of 21.84 billion euros (including PHARE) are ready to assist CEEC' accession endeavours.

The EU itself is forced to carry out **institutional reforms** before new members can actually be admitted. The agreement on the Agenda 2000 (the financial framework for the years 2000-06) at the European Council in Berlin in March 1999 has been an important step in that direction, although further budgetary reforms seem to be necessary.[5] Additionally a governmental conference was held on 14 February 2000 with the aim of defining all required institutional reforms. It is supposed to conclude in December 2000. The aim is to pass a new Treaty on European Union in order to enable eastern enlargement. Amongst other things, issues such as a different distribution of votes and an expansion of majority voting in the European Council, as well as a changed number of commissioners per country have to be tackled.

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3 The EU also started official accession negotiations with Cyprus.

4 CEEC' aspirations for temporary protective tariffs for agricultural goods and large production quotas have been reported to encounter strong resistance from the European Commission. See FAZ (2000).

5 The reduction of EU's budget and particularly the required reform of agricultural transfer payments turned out to be much more moderate than originally intended. Germany's foreign minister Fischer commented on this fact by saying that further reforms would be necessary before enlargement could take place (see Pawlovsky 1999).

1.2 Problem and Objective

The issue of the eastern enlargement of the EU is the subject of much heated debate in contemporary political discussions within Europe. Firstly, there is a debate between authorities from both, the EU and the CEEC in the context of official accession negotiations. The pace of integration, the fulfilment of the necessary prerequisites and the specification of interim regulations are the main topics of this discussion. Secondly, there are controversial debates within each of the two regions concerned. In the CEEC, on the one hand, there are fears about a lack of competitiveness of their products and the emigration of highly skilled workers to the detriment of the domestic economies. In the EU, on the other hand, worries are frequently articulated about excessive costs of enlargement and a large inflow of foreigners.[6] Hence, the mobility of workers from East to West is an issue which deeply concerns people on both sides of the borders. Sometimes even the whole issue of eastern enlargement of the EU is questioned; a debate which is pointless since it ignores both, the philosophy of the European Union (see Article 49) and the actual steps that have already been undertaken. Therefore, today's question no longer concerns whether or not the CEEC should join the EU, but rather when enlargement should take place and with what interim regulations.

The **problem** of the controversies in the enlargement discussion is that some of the arguments specifically make use of fears and emotions of the citizens without providing scientific proof for the "horror scenarios". The outlined size of migration flows between East and West as well as the consequences of CEEC' integration are then often depicted in exaggerated form. But apart from such polemics, it is difficult to objectively assess the effects of an eastern enlargement. Some theoretical studies can expound the general tendencies we ought to expect. Their disadvantage is that they cannot specifically *quantify* the potential effects. Thus, the empirical part is missing in such papers. Other analyses, although empirical, concentrate on one particular market or subject, assuming that all other markets remain unchanged. These evaluations do not allow for *interdependencies* and cross effects in an economy.
This paper considers these handicaps by combining an empirical study with a special consideration of the whole economy.

The **objective** of the present study is an assessment of the consequences resulting from deeper forms of economic integration between the CEEC and the EU using a computable general equilibrium (CGE) model. In doing so, we attach particular emphasis to the issue of labour mobility by specifically estimating important migration parameters. Thus, our aim is to contribute to the prevailing discussion by presenting numerical results derived from both econometric estimates as well as simulations from a CGE-model. Specifically, two questions shall be answered:

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6 Compare with Straubhaar (1998), p. 145.

1. What will be the potential extent of (net) migration between the CEEC and the EU once free mobility of labour is allowed?
2. Which macroeconomics effects will further integration of the CEEC to the EU have on both economies?

In the context of question 2 we will specifically study the consequences of (i) further trade integration, (ii) official capital transfers from the EU to the CEEC and, based on the results of question 1, (iii) labour migration from the CEEC to the EU.

Aggregating the CEEC, Wise or Pointless?

As mentioned, the EU deals with each applicant from CEE according to the motto *differentiation without discrimination*. Thus, officially an individualistic approach is being applied. In our study, in contrast, the CEEC are mostly treated in an aggregated manner. Economic arguments, however, tend to question such an approach. After all, the CEEC are anything but one big integrated, homogeneous economic area. Most of these countries have interacted with each other and with the EU in a way which encouraged Baldwin (1994) to compare it to a "hub and spokes" system implying a very low degree of integration among the CEEC (the spokes). Also their economic performance followed a rather divergent pattern.

Nevertheless, besides the argument of pure practicability for the quantitative analysis, there are also economic and political reasons why an aggregation might be sensible. Firstly, there are assimilation tendencies among the CEEC. Important steps towards greater economic and political integration have, for instance, been undertaken by the members of the *Visegrad Group*[7] which constitutes a large share of the CEEC. Also in terms of economic and political transition, the CEEC are already rather homogeneous or are clearly converging. EBRD's *Transition Indicators*[8] registered the greatest progress of reforms in south-eastern European countries like Bulgaria and Romania which formerly lagged behind.

Secondly, the articulation of the political attitude and goals of individual CEEC strongly resemble each other: each actual and potential applicant from CEE has emphasised its intention to become a full member of the EU as soon as possible.

Also from the viewpoint of the EU there has been a considerable change towards a more equal treatment of the CEE candidates since the Tampere summit in October 1999. It expressed its will to carry out accession negotiations with <u>all</u> CEEC rather than with the one privileged group of six. The Economist (1999) interpreted this change as a more political and strategic view of enlargement, departing from the track of solely focusing on economic criteria. Hence, an enlargement scenario including more than only six CEEC becomes more and more probable.

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7 The Czech and Slovak Republic, Hungary and Poland form the so-called "Visegrad Group" (founded in 1991) which is a policy co-ordinating institution. From it emerged the Central and Eastern European Free Trade Agreement (CEFTA) on 1 March 1993.

8 Compare with EBRD (1999), p. 23, 26.

1.3 CONTENTS, STRUCTURE AND METHODOLOGY

The remainder of this paper is organised as follows: the **second chapter** will introduce the concept of different approaches to general equilibrium modelling and explain the main assumptions contained in our approach. An introduction to the treatment of data and the procedure of calibration will be given. The **third chapter** will acquaint the reader with the computable general equilibrium model and the data which we use for our evaluations. A static as well as a recursive dynamic model assuming constant returns to scale and perfect competition is being applied for our simulations.

Due to the particular attention which we devote to the issue of labour mobility, the **fourth chapter** will specifically focus on the question of how much free migration would come about if the EU and the CEEC formed a common market. Using the example of the Southern enlargement of the EC towards Greece, Portugal and Spain in the 1980s, we derive a potential East-West migration pattern by undertaking both, a descriptive as well as a pooled time series, cross-sectional econometric analysis. In particular, the estimated migration coefficients will be used in the CGE-model with the aim of evaluating the consequences of integration at a later stage.

Chapter five then presents the different policy experiments, discusses expectations as well as simulation results. Initially the integration experiments will be simulated individually before being combined into a synthesising analysis. **Chapter six** will eventually summarise and conclude the main findings of this thesis.

2 APPROACHES TO GENERAL EQUILIBRIUM MODELLING

2.1 INTRODUCTION

Before starting to discuss the specific kind of model which shall be used for our purposes in the next chapter, the concept of *"General Equilibrium"* (GE) per se and the computable approach, the software and general data issues will be introduced. In the second section of this chapter we will therefore present the original idea of a general equilibrium by Léon Walras and discuss models, areas of application, as well as advantages and shortcomings of the general equilibrium concept. The third section will focus on the computation of general equilibrium models explaining equilibrium conditions, and different approaches to implementing them. The fourth section will discuss the general data requirements which need to be fulfilled and introduces the reader to the concept of calibration. The fifth section summarises.

2.2 THE GENERAL EQUILIBRIUM

2.2.1 CONCEPT AND EVOLUTION

The idea of general equilibrium is an economic concept which assumes that several interrelated markets are simultaneously in equilibrium, i.e. that demand equals supply. Strictly speaking, it is "... a matter of determining the equilibrium prices and quantities of all commodities, given the agents' endowments and preferences, assuming furthermore that prices fluctuate in such a way as to balance supply and demand for each good, in a context of perfect competition where prices are given for each agent. The term *general equilibrium*, as opposed to the analysis in terms of *partial equilibrium* developed by Marshall, refers to the fact that it is considered that supply and demand for each good depends, not only on this good's price, but on all the other prices."[9] Equilibrium on economic markets, just as much as price flexibility, are both concepts which arise from the neo-classical doctrine. Nowadays economists would argue that such conditions are typical phenomena of the long-run. Nevertheless, modern general equilibrium applications also allow for rather Keynesian assumptions, for example by introducing price rigidities.

The "inventor" of general equilibrium theory, *Léon Walras*, still illustrated his new concept in his pioneering work of 1874-77 called *"Eléments d'Economie politique pure ou Théorie de la Richesse sociale"* as a problem of pure exchange. Walras' theory is nowadays made accessible to most economists using the comfortable illustration and

[9] Beaud and Dostaler (1995), p. 70.

insight of a two-sector, two-agent economy by means of the famous *Edgeworth Box.*[10] There, it can easily be shown that competitive equilibria are economically efficient and pareto-optimal. This means that there are no other allocations of the resources which might lead to an overall increase in all agents' utility. With respect to the price adjustment mechanism which ensures equilibrium, Walras came up with a rather abstract invention: he imagined the so-called *auctioneer*, i.e. a virtual individual who collects orders of both sale and purchase from economic agents at some previously fixed price. If the demand for goods lies above the supply, the auctioneer increases the price in the next round of bidding; in the opposite case he decreases it. This gradual process goes on until relative prices finally reach a level where all goods markets are cleared (tâtonnement process). Only when the equilibrium price is achieved, does the auctioneer allow the trade.

In terms of a mathematical solution, Walras argued that an economic equilibrium should exist if there is an equal number of variables and equations. In fact, mathematical situations can be constructed where, despite having an equal number of variables and equations, no equilibrium at all exists. There were many developments in this area, but it was Arrow and Debreu (1954) who specified the exact economic terms which ensure the consistency of general equilibrium theory. They developed a proof for the existence of equilibria using fixed point theorems. Their findings were based on two versions of fixed point theorems which are particularly relevant for the issue at hand. The first, which is the earliest of such theorems in topology, was formulated and proved by Brouwer (1910). A generalisation of Brouwer's theorem was carried out by Kakutani (1941). Without going into further detail about these theorems, it should be mentioned that the disadvantage of fixed point theorems is their non-constructive nature which means that they cannot be used to actually find an equilibrium, they can only be used to prove if a certain situation is in equilibrium or not. According to Kehoe and Prescott (1995 :2) the first numerical applications of general equilibrium models took place in the early sixties by Harberger (1962) and Johansen (1960) although only ten years later "Work on applied GE models received a crucial stimulus from the research of H.E. Scarf [1973] on the computation of economic equilibria. Scarf developed an algorithm for calculating an equilibrium of a multisectoral GE model. Refinements of this algorithm are still used by some modellers."[11] Thus, eventually a constructive proof for actively finding a general equilibrium was developed. Two of Scarf's most famous students were Shoven and Whalley (1972) who elaborated on his work and created a calibrated, multisectoral, general equilibrium model at the beginning of the seventies to analyse the welfare implications of changes in the tax regime.

Significant innovation to the Shoven/Whalley type of models was given through the inclusion of increasing returns to scale and imperfect competition. Pioneer for these changes was Harris (1984). During the same time dynamic models were also developed. Lipton and Sachs (1983), for instance, created a model in which economic agents live as long as the model itself (a phenomenon called *Ramsey dynamics*). Summers (1981) as well as Auerbach and Kotlikoff (1987) introduced the Overlapping Generations approach. Also the Real Business Cycle models developed by Kydland and Prescott

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[10] For a more detailed introduction see Varian (1992), chapter 5.

[11] Kehoe and Prescott (1995), p. 3.

(1982, 1991) belong to the class of dynamic models.

2.2.2 Types of Models and Areas of Application

Computable General Equilibrium models can overcome two deficiencies common to most of the regular macroeconomic models, which makes them particularly attractive in these areas. Firstly, they can deal with structural changes as a result of institutional modifications. This is for example the case in the analysis of different tax regimes, the transformation to other trade regimes or questions such as EU enlargement. Secondly, they do not need long time-series data as many other empirical models do. Especially in the absence of longer data series, as is the case for the European transformation economies, CGE-models can produce interesting results by means of calibration and simulation. The most popular areas to use CGE-models are analyses of changes in environmental policies, open economy modelling, i.e. implications of tariffs and quotas, questions of market failure such as competition policies and externalities, dynamic applications with finite or infinite time horizons, such as intertemporal savings and investment, reforms of tax and social security systems as well as questions of economic growth and development, to mention just the most important.

Shoven and Whalley (1992) differentiate models according to size, purpose, area of application and form: "Some are large-scale multipurpose models; others, small-scale issue specific models. They vary in their country of application, use of functional forms, and treatment of such issues as time, foreign trade, the government sector, their use of data and parameter values."[12] Klepper et al. (1994 :515) distinguish Walrasian models of static, competitive equilibria with flexible prices and mobile factors, highlighting the dichotomy between the monetary and real part of the economy and models of imperfect competition and dynamic models. Finally, Brandner (1990 :571-575) classifies CGE-models into multisectoral growth models in the Johansen tradition, models in the Shoven-Whalley tradition, models in the Jorgenson (1984) tradition which instead of calibration use econometric estimates and models which are brought into the context of so-called *activity analysis* (e.g. Ginsburgh and Waelbroeck 1981).

The differentiation of static and dynamic models in particular requires more attention since it also plays a role in the model described below. For simplicity, we can think about the inputs into a standard CGE-model as: technology, preferences, endowments and policy instruments. Purely static models normally provide two equilibrium situations, the *benchmark* and the *counterfactual*, which can be compared with each other. In the course of static CGE-simulations it is typically the policy instruments or the endowments which change. Hence, in the static version technology and preferences are assumed to be constant over time. Genuinely dynamic models, in contrast, also consider the change of preferences and / or technology over time. In so-called *Forward Looking Models* the typical constant savings propensity, which static models tend to use, is then replaced by a rational and endogenous dynamic trade-off between

[12] Shoven and Whalley (1992), p.71.

consumption today and investment for tomorrow.[13] Technology remains constant. In addition, completely endogenous growth models allow for endogenous, dynamic adjustment of technology through a change of total factor productivity (à la Dixit and Stiglitz 1977) or through R&D boosts.

Between these two extremes of static and genuinely dynamic models, there exists a third type of CGE-model so-called *recursive dynamic models* which link several static models, allowing for a certain evolution over time. A more detailed description of the latter type can be found in sections 3.6 and 3.7.

2.2.3 Weaknesses and Advantages of General Equilibrium Approaches

General equilibrium models contain a number of **weaknesses** which have resulted in serious discussions. According to Brandner (1990 :570) criticisms can be divided into those of a fundamental nature and those concerning specific aspects of certain approaches. Fundamental criticisms question the CGE-approach in principle. "In particular, they [CGE-models] rely on abstractions and assumptions which have been questioned by many economists (Hahn, 1989). For example, it is generally supposed that markets are perfect and well organised, that prices and factors are never rigid, that the market process depends on price signals only and, automatically as well as instantaneously, assures market-clearance at positive prices."[14] With respect to specific criticisms, Shoven and Whalley (1992) argue: "First, there is model choice. It is clear to us that, in any analysis of economic policy making, the choice of model is crucial in determining results. Clear demonstrations in the modelling literature show that conclusions from numerical models change by changing key assumptions. Model choice precedes computation, and computation gives no clear guidance as to the appropriate choice of model. (...) Second, there are questions of parametric specification, including procedures used for calibration. Calibration procedures are now widely emphasised in applied equilibrium systems, in part because of the large dimensionalities involved. With enough freedom over the parameters and functional forms in an applied general equilibrium model, it is generally possible to build a model that will exactly replicate any chosen data set. There is no statistical test of the model specification. (...) Third, issues concerning elasticity values. These are perhaps the weakest of all the parameter values used in current CGE-models."[15]

This very last criticism concerning exogenous elasticities is particularly important. Since econometric estimates about many elasticities do not yet exist, economists are forced to derive the values from other economic studies, economic rationale or simply by hypotheses and assumptions. Obviously, this often causes scepticism or disagreement. Economists therefore use a procedure which is known as *sensitivity analysis*. It is a method with which the importance of certain exogenous parameter values are analysed. This is done by running the same model various times successively

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[13] For forward looking CGE-models see Gaitan and Pavel (2000), Piazolo (1998) and Keuschnigg and Kohler (1996, 1997, 1998).

[14] Stephan (1995), p. 230.

[15] Shoven and Whalley (1992), p. 280.

while altering the parameter in question ceteris paribus. If sensitivity results do not deviate too much from the original counterfactual outcome, it is obvious that the disputed parameter value is not of major importance. However, since a model is also based on many other "exogenous" assumptions which could be challenged (e.g. model structure, static vs. dynamic models etc.), a sensitivity analysis should not be mistaken with a critical assessment of the model itself. It only relates to selected elasticity values.

Breuss (1998) mentions further shortcomings even of advanced models: "The first is the [outdated] data. The second is [...] the assumption of permanent full employment. The third is the weak dynamic specification of the models [...]"[16].

Despite the mentioned weaknesses, CGE-models possess many **advantages**. Two examples were already mentioned in the paragraph describing the different types of models. These were the capability of modelling structural changes and the fact that no time series data is needed. Modern CGE-models can capture almost all aspects of up-to-date economic theory. Additionally, "the Walrasian general equilibrium model provides an ideal framework for appraising the effects of policy changes on resource allocation and for assessing who gains and who loses, policy impacts not well covered by empirical macro models."[17] According to Stephan (1995 :230), no other tool developed so far has the abilities: "(1) to be applicable for theoretical as well as empirical analyses, (2) to trace the consequences of policy change through the entire economy, (3) to provide a unified framework for analysing the trade-offs between efficiency and equity, and (4) to illustrate the operation of an economic system in which all decisions are price-guided and are made on a micro level." The question remains as to how efficient GE-models are in their policy analysis. There is not much literature on the degree to which preceding GE-predictions have actually taken place. Kehoe and Kehoe (1994 :13/14) "stress that these models predict how a given policy change would affect an economy if it were to experience no other policy changes or external shocks. To be fair to the purpose of the models when evaluating their performance after a policy change, we would have to rerun them, including any other significant policy changes or external shocks that had occurred." They implemented a check for a model which tried to forecast the effects of Spain's accession to the European Community (EC). It showed that the model's results were close to its predictions.[18]

2.3 Approaches to Computable General Equilibrium Models and Software

The modern CGE-approach can be understood as the product of three different approaches: the theory of General Equilibrium, (non)linear programming and input-output analysis as invented by Leontief (1966). Modern programming possibilities have been especially helpful in increasing the scope of applications considerably compared

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16 See Breuss (1998), p. 9.
17 Shoven and Whalley (1992), p.1.
18 Compare with Kehoe and Kehoe (1994), p. 14.

with the basic general equilibrium theory presented earlier. Nowadays, as models include several production sectors and factors and more than one region, a fairly basic CGE-model will already easily account for several hundred endogenous variables. Computational implementation has therefore become the main focus of mathematicians and economists alike and given the breathtaking development of computers in recent years, CGE-science and applications have also experienced a substantial increase.

Given this progress, it is not surprising, that there already exist several computer programmes which are suitable for modelling and solving CGE-models. The heart of every CGE-model is the *solution algorithm* which is responsible for finding an equilibrium solution. It can be compared to some sort of operating instruction for the computer. In some software packages the modeller has to program the solution algorithm himself. Obviously, very profound mathematical knowledge is needed to perform such a task. Other CGE-programs offer a variety of already programmed solution algorithms which are called *solvers*. Two software packages of this latter kind cited in the literature are *GAMS*[19] and *GEMPACK*[20]. Both packages have proven successful in recent years and can be regarded as reliable and stable tools for analysing general equilibrium policy issues.

This study was undertaken using GAMS because most models that served as guidance had been implemented on this software. At a later point we will present these models and their results. Within GAMS there are different kinds of solvers which are capable of finding a solution to a general equilibrium model. Each of them relies on a different algorithm and different mathematical solution approaches. In the following we will present the key ideas of the equilibrium approach which is implicitly contained in the solver we use.

2.3.1 Equilibrium Conditions in the Economy

The description of an economic system of a country or a region in terms of a general equilibrium problem necessitates a particular specification in which certain entities and relationships are illustrated. These can be summarised as: (i) the definition of economic agents such as firms, households, the government and other regions; (ii) the definition of important decision variables which characterise the agent's behaviour such as prices and elasticities; (iii) the description of the agent's behaviour which depends on the decision variables mentioned above. This behaviour is normally expressed through profit or utility maximising functions and constraints; (iv) the definition of equilibrium mechanisms and market structure. This is the kind of decision with which to define a system of, for instance, flexible or rigid prices and wages, rationing, etc.

Once all these entities have been specified so as to create a logical structure of the whole economy, the next task is to find an equilibrium. What is an economy-wide

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[19] GAMS stands for *General Algebraic Modelling System* and is described in Brooke, Kendrick and Meeraus (1996). More information about GAMS can be obtained at: http://www.gams.com

[20] GEMPACK stands for *General Equilibrium Modelling PACKage* and is a development of Monash University, Australia. More information about GEMPACK at: http://www.monash.edu.au/policy/gempack.htm

equilibrium in this context? We will start to give the answer to this question using the definition of a so-called *market equilibrium* in the competitive Arrow-Debreu economy. Under the assumption of non-satiation[21] for both producers and consumers, general equilibrium is defined by three non-negative vectors for the fundamental variables: *prices, activities* and *incomes* which must satisfy the following conditions:

1. *Zero-profit* condition: no sector earns a positive profit, i.e. perfect competitive environment.
2. There is *market clearance* (supply = demand) for every commodity.
3. The *budget constraint* within the economy is fulfilled, which means that the endowment income determines expenditure (you cannot consume more than you earn).

The solver which we use for our general equilibrium model makes use of these equilibrium conditions as we shall demonstrate in what follows.

2.3.2 The Mixed Complementarity Approach

In computing and programming methods, particularly in our software package GAMS, there are three approaches for solving such general equilibrium problems. Each approach is implemented in a different solver, i.e. solution algorithm: (a) The Optimisation Approach, (b) the Equation Based Approach or (c) the Mixed Complementarity (MC) based approach. Whereas in the first two approaches the equilibrium problem is normally defined as a non-linear mathematical program and a simultaneous system of non-linear equations respectively, the MC-approach formulates the standard Arrow-Debreu equilibrium as a non-linear system of (weak) inequalities corresponding to the three classes of equilibrium conditions which we presented in points 1-3. In fact Mathiesen (1985a,b) demonstrated that a general equilibrium model can be formulated and efficiently solved as a complementarity problem. His idea will be presented in the following. In doing so, we partly follow the presentation of Rutherford (1997) and partly that of Springer (1998).

Mathiesen argued that in equilibrium there are three sets of "central" decision variables which need to satisfy the Arrow-Debreu system of the three classes of equilibrium conditions (market clearing, zero-profit, budget constraint) in order to determine the complementarity format (CP):

$$\text{(CP)} \qquad \text{Find } z \in R^{N \times M \times H} \text{ that solves } F(z) \geq 0,\ z \geq 0 \text{ and } z^T F(z) = 0$$

where z is a vector containing the three sets of decision variables which are N for prices, M for activity levels, H for income levels, $F(z)$ is the corresponding equilibrium condition and the term $z^T F(z) = 0$ is the optimal solution, where the equilibrium conditions are fulfilled.

[21] This means that producers try to maximise profits at given market prices, and households try to maximise utility at given market prices and expenditure levels.

Vector z contains three vectors with central decision variables. These are:

- *p* = a non-negative vector of *N* commodity prices including all final goods, intermediate goods and primary factors of production;
- *a* = a non-negative vector of *M* activity levels for constant returns to scale production sectors in the economy. Activity levels include industrial production, *Y*, investment, *Inv*, the consumption sector, *C*, and the government sector, *G*. Consumption and government activity are regarded as being produced as will be explained later;
- *Inc* = a vector of *H* income levels, one for each economic agent. In our case we only have one representative agent who combines private households and the government.

An equilibrium would require that these three sets of central decision variables fulfil the Arrow-Debreu equilibrium conditions which we presented in the previous section. What is more, activity levels, *a*, would have to fulfil the zero-profit condition, prices, *p*, the market-clearance condition and income, *Inc*, the budget constraint. Hence, in equilibrium there exists some sort of complementarity requirement between different pairs of decision variables and equilibrium conditions. Mathiesen called this equilibrium requirement *"complementarity slackness"* which is fulfilled if $z^T F(z) = 0$ or, in other words, if there is zero profit, zero excess demand and the budget constraint is fulfilled (i.e. all three equilibrium conditions accomplished). The word "slackness" implies that in an optimal (equilibrium) solution, either the equilibrium conditions must hold or the decision variables must take a value of zero, or both. Mathiesen's MC-approach thus defines an equilibrium as a combination of weak inequalities and complementarity slackness conditions.

An advantage of the MC-approach is that the standard framework of perfect competition can also be extended to allow for market imperfections and restrictions such as rigid prices and quantities or endowment rationing and price wedges as created by taxation.

In what follows, we discuss each of the three equilibrium conditions in the context of the MC-approach in more detail.

1. Zero-Profit Condition:

The zero-profit condition is related to all activities, *a*, in the model such as industrial production, private consumption, public consumption and investment. This condition requires that no producer earn positive profits. Thus, the value of inputs must be equal or greater than the value of outputs. A unit profit function can be written as:

$$\Pi(p) = R(p) - C(p) \leq 0$$

where Π is unit profits, *R* is unit revenue and *C* are unit costs.

Definition of Costs:

In the context of industrial production unit costs can be defined as the following minimisation problem:

$$C(p) \equiv \min_{x} \left\{ \sum_{i} p_i x_i \right\}$$

subject to a given production function: $f(x) = \bar{y}$ with $\bar{y} = 1$ (unit output),

where index i stands for various input factors, x_i are input factor quantities and p_i are factor prices. The production function f(x) characterises feasible input, x, per unit of production activity. Hence, under the assumption that one unit of output is produced with a given production technology, f(x) = 1, the task is to find the corresponding cost function. This is done by making use of the principle of duality.

For example, we intend to calculate the cost function from the following production function and budget constraint:

$$C = p_K \cdot x_K + p_L \cdot x_L$$

$$\text{s.t.} \quad f(x) = x_K^{\alpha} \cdot x_L^{\beta} \qquad \alpha + \beta = 1; \quad \alpha, \beta \geq 0$$

Using duality, the resulting unit cost function would be:

$$C(p) = \left(\frac{p_K}{\alpha} \right)^{\alpha} \cdot \left(\frac{p_L}{\beta} \right)^{\beta}$$

Definition of Revenues:

Unit revenues can be defined as the following maximisation problem:

$$R(p) \equiv \max_{y} \left\{ \sum_{i} p_i y_i \right\}$$

subject to a given production function: $g(y) = \bar{y}$ with $\bar{y} = 1$ (unit output),

where index i stands for various output goods, y_i are output quantities and p_i are output prices. Production function, g(x), characterises feasible output per unit of activity. Hence, under the assumption that input quantities for one unit of activity are fixed, g(x) = 1, the task is to find the revenue function which maximises unit revenue.

For example, we intend to calculate the revenue function from the following production function and budget constraint:

$$R = p_1 y_1 + p_2 y_2$$

$$\text{s.t.} \quad g(y) = \max\{y_1, y_2\}$$

Using duality, the resulting *unit* revenue function would be:

$R(p) = p_1 + p_2$

In the present example, g(y) just expresses the idea that the aim of the production function is the maximisation of output of the two goods, y_1 and y_2.

"Profit" is normally something which economists mainly associate with revenues and costs of a firm or in other words with industrial production. However, we mentioned above that the zero-profit condition and hence also the revenue-cost-principle, hold for *all* activities including, industrial production and investment as well as private and public consumption. How can this revenue-cost-principle be understood in the context of the different activities?

In the context of **industrial production**, producers should be understood to choose a certain output level at which they try to maximise their profits. Their costs are defined as costs for primary and secondary factors of production. Under the assumption of perfect competition no producer earns positive profits (➔ zero profits). The **investment process** works in a similar way to the production process of industrial goods, with the difference being that the investment output is not traded and that the demand for investment goods is determined by the marginal propensity to save. Producers of investment goods, however, also try to maximise their profits from production and face the costs of intermediate inputs. Under perfect competition, no positive profits are possible.

In the context of **private and public consumption**, households' profits can be understood as the difference between utility and expenditure to attain utility: the cost function, C(p), can then be regarded as the expenditure function for a fixed level of utility. The revenue function, R(p), then stands for utility which results from "producing" the consumption of goods. It is obvious that households choose a consumption and expenditure level where their utility gained from consumption equals the utility lost from spending their money: in other words, where the zero-profit condition is fulfilled.

2. Market-Clearance:

The market-clearance condition is related to prices, p, and it ensures that all factor and goods markets are cleared, i.e. that the demand for a commodity is less or equal than the supply:

$$\sum_j y_j \frac{\partial \Pi_j(p)}{\partial p_i} + \sum_h \omega_{ih} \geq \sum_h d_{ih}(p, Inc_h) \ ,$$

where $\partial \Pi_j(p)/\partial p_i$ is the net supply of good i per unit of activity of the constant returns to scale industry sector j. It is derived by applying Hotelling's lemma. The first sum on the left-hand side then represents the net supply of good i for the whole economy. The second sum on the left-hand side represents the aggregate initial endowments of good *i* by household *h*. The term on the right-hand side of the equation represents aggregate final demand for good i by households h at given prices p and household budget or income Inc_h. In other words, d_{ih} is the Marshallian demand function for good i. It is derived from utility maximisation subject to the budget constraint:

$$d_{i,h}(p, Inc_h) = \max \mathrm{U_h(y_i)},$$
$$\text{subject to} \quad \sum_i p_i \cdot y_i \leq Inc_h \qquad \text{(budget constraint)},$$

where U_h is the utility function for household h.

3. Income-Balance:

The third equilibrium condition concerns the income, *Inc*, and expenditure of economic agents. Firstly, it says that the value of each agent's income must equal the value of factor endowments:

$$Inc_h = \sum_i p_i \cdot \omega_{i,h},$$

where index i stands for the production factors, capital and labour.

Secondly, expenditure of economic agents is characterised by utility functions which express the assumption of non-satiation. This implies that the value of the agent's expenditure exhausts (equals) that of the agent's income:

$$\sum_i p_i \cdot d_{i,h} = Inc_h = \sum_i p_i \cdot \omega_{i,h}$$

This equation satisfies *Walras' law* since for any set of prices, excess demand is equal to zero:

$$\sum_i E(p) \cdot p_i = 0,$$

where E is the expenditure function.

Complementarity Slackness:

Initially we expressed Mathiesen's idea that a vector z containing the three sets of decision variables (activities, prices, income) needs to fulfil the corresponding equilibrium conditions, F(z), which are zero-profit, market-clearance and income-balance. Thus, having gone through the three equilibrium conditions above, the overall CP-equilibrium condition, $z^T F(z) = 0$, can be written as:

$$[a \quad p \quad Inc] \cdot F\begin{bmatrix} a \\ p \\ Inc \end{bmatrix} \Leftrightarrow [a \quad p \quad Inc] \cdot \begin{bmatrix} \Pi(p) \\ y_j \dfrac{\partial \Pi_j(p)}{\partial p} - E(p) \\ \omega \cdot p - Inc \end{bmatrix} = 0,$$

where the first vector on the left-hand side is vector *z,* containing the decision variables, and the second vector is *F(z)*, containing the equilibrium conditions. When solving this system of vectors it becomes obvious that:

$$\left.\begin{aligned} & a \cdot \Pi(p) = 0 \\ & p \cdot \sum_j y_j \frac{\partial \Pi_j(p)}{\partial p} - E(p) = 0 \\ & Inc \cdot [d \cdot p - \omega \cdot p] = 0 \end{aligned}\right\} \text{ or in (CP) format } z^{T} F(z) = 0$$

This demonstrates the complementarity relationship between activities and zero-profit constraint, prices and market-clearance condition as well as income and a balanced budget.

2.3.3 MPSGE: The Model and Function Generator for MC Models

Programming and defining MC models equation by equation can be an extremely tedious and error prone undertaking, especially for the market-clearance part, where partial derivatives have to be used to calculate the compensated demand functions, as we saw above. This is particularly true for cases where we assume production functions with several nests. A comfortable way to get around this problem is to use the GAMS-subsystem called *Mathematical Programming System for General Equilibrium Analysis* (MPSGE). It is a non-algebraic model and function generator in the sense that the user defines the model in a non-algebraic way, and the program automatically creates the required MC equations and solves the model. The intention of MPSGE according to its inventor Rutherford is "to provide a transparent and relatively painless way to write down and analyse complicated systems of non-linear inequalities. The language is based on nested constant elasticity of substitution (CES) utility- and production functions. The data requirements for a model include share- and elasticity parameters for all the consumers and production sectors included in the model. These may or may not be calibrated from a consistent benchmark equilibrium dataset. [...] In addition, the system includes two large-scale solvers, MILES and PATH, which may be used interchangeably. The availability of two algorithms greatly enhances robustness and reliability."[22] According to Rutherford (1993 :1) and the GAMS-solver's manual[23], "MILES executes a generalised Newton algorithm with a backtracking line search. This method is based on an algorithm investigated by Mathiesen (1985a) who proposed a modelling format and sequential method for solving economic equilibrium models."

[22] Rutherford (1997), p 1.

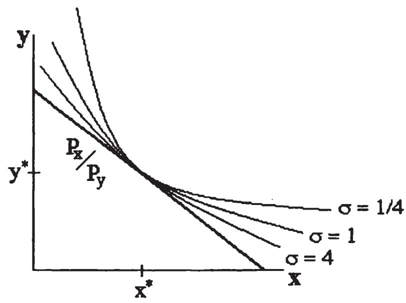
[23] Manual may be obtained at http://www1.gams.com/solvers/solvers.htm

The algorithm executed by PATH is a global Newton method in which the backtracking line search is replaced by a path search. The algorithms share the same quadratic rate of convergence near a solution, but they may follow different trajectories away from the equilibrium. Because convergence cannot always be guaranteed with either algorithm, it is helpful to have both algorithms available when solving large or difficult problems.

Modelling Consumer Demand or Production, an Example of MPSGE:

When working with a non-algebraic device such as MPSGE it becomes all the more important to be aware of the economic meaning behind the model specification. In the following simple example we shall demonstrate the working of MPSGE using the illustration of a CES-utility function.[24] As is known from microeconomic theory, agents optimise utility subject to certain constraints. The question which a modeller would pose in this context is how to represent preferences and constraints. In the example illustrated in FIGURE 1 we have important information which is required to answer those questions and to represent a utility function: firstly, there is observable information about demanded benchmark quantities of both goods, x^* and y^*. Secondly, there is visible information about prices of both goods since the slope of the budget line is determined by calculating the relative prices P_x/P_y. Thirdly, it is possible to derive information about the marginal rate of substitution at the benchmark point, where the budget line is tangential to the indifference curves. However, we still need information about the shape (or curvature) of the indifference curve to completely define the required

FIGURE 1: DETERMINING A UTILITY FUNCTION



Source: Own graph after Rutherford (1998a), figure 7.

benchmark utility function. This shape is determined by the elasticity of substitution at the benchmark point. As can be seen in the figure, all three indifference curves share the same benchmark quantities and benchmark prices, but it is only the elasticity of substitution (σ) which determines how flat or curved the agent's indifference curves (i.e.

[24] The example has been taken from Rutherford (1998a), p. 6.

preferences) are. A value of σ = 0 would imply perfect complements, a value of σ = 1 would imply Cobb-Douglas preferences and a value of σ = ∞ would mean perfect substitutes.

This example demonstrates how MPSGE works. All the information we need to give to MPSGE is data on benchmark quantities, prices and substitution-elasticities and MPSGE will generate the corresponding utility function by itself. The corresponding algebraic way to write the CES-function would be:

EQ. 1
$$U=\left[\delta\cdot X^{\frac{(\sigma-1)}{\sigma}}+(1-\delta)\cdot Y^{\frac{(\sigma-1)}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}},$$

where U is utility, δ is the share parameter which can be derived through calibration (calibration is dealt with in section 2.4.2) and σ is the exogenously assumed elasticity of substitution. The specification of a production function would work in exactly the same manner, except that information on goods would be replaced by information on factors of production.

How would the specification of the above utility function look in terms of the MPSGE programming code? We illustrate this briefly to show the intuition behind the software. TABLE 1 illustrates an extraction of a possible model. Here, the demand of some consumer, *Cons* (see first line of TABLE 1) is determined by:

1. The agent's budget which is assumed to stem from his provision of labour. All this is represented by the second line of TABLE 1. E: W stands for the endowment of labour providing the quantity Q: Lab.
2. The demand D for good X (endogenous) at price P_x = 1 (endogenous) with the benchmark quantity of X*.
3. The demand D for good Y (endogenous) at price P_y = 1 (endogenous) with the benchmark quantity of Y*.
4. The elasticity of substitution which is assumed to be one S: 1 (Cobb-Douglas).

The benchmark ratio of the P: fields (i.e. the relative prices of X to Y) specifies the marginal rate of substitution (MRS) between both goods. Here, the MRS = 1/1.

TABLE 1: SPECIFICATION OF A UTILITY FUNCTION IN MPSGE

$DEMAND: Cons	S: 1	
E : W	Q: Lab	
D : P_x	Q: X*	P:1
D : P_y	Q: Y*	P:1

Hence, these four lines contain all the necessary information to determine a benchmark utility function as illustrated in FIGURE 1. Even for more complicated utility or production functions (i.e. with additional nests) no additional information is needed as Rutherford (1997 :13) explains: "The elasticities together with the reference quantities and reference prices of inputs and outputs completely characterise the underlying nested CES [production] functions." In most other software packages a much more algebraic specification would be required. Also, the change of assumptions is very simple with MPSGE. If, for instance, we would want to assume another elasticity of substitution, it would be a simple task to change the s:1 in TABLE 1 to another value and resolve the model.

2.4 DATA AND CALIBRATION

Different policy simulations which are calculated by means of a given CGE-model always start from a so-called *benchmark equilibrium*. This is the "starting-point" of the model which, as the terminology suggests, needs to be in equilibrium before any simulations are actually undertaken, i.e. before the *counterfactuals* are calculated. The existence of a benchmark is important since it serves as a point of reference or comparison for all counterfactual equilibria which are later obtained in the course of policy simulations. Its construction is performed with the help of (i) a consistent dataset which is a collection of specifically prepared data from one particular year, (ii) some exogenously supplied behavioural elasticities and (iii) a process called calibration which is needed to identify all other missing parameter values.

Let us clarify for a moment the order in which we would have to proceed so as to get a CGE-model running: firstly, it would be necessary to have the theoretical model. The second step would be to find the corresponding data and to make sure that it is consistent (the exact meaning of this is explained in the paragraph below).[25] Thirdly, it would be necessary to determine values for those elasticities which have to be assumed and which are supplied exogenously. Fourthly, we would have to calibrate the model to identify all missing parameter values. Fifthly, we would have to make sure of attaining the benchmark equilibrium, which is basically a replication of the consistent dataset. Sixthly and lastly, we would run different simulations and compare the results with the benchmark values.

2.4.1 THE CONCEPT OF SOCIAL ACCOUNTING MATRICES

When we speak of a *consistent dataset* in the context of a CGE-model we do not only mean that all sorts of data which are required by the exogenous and endogenous variables of the model should initially be provided. The term "consistent" also expresses the imperative prerequisite that the dataset needs to meet the equilibrium conditions for the general equilibrium model under study. Thus, within the dataset the equilibrium conditions of demand equal supply, zero profit, fulfilment of the budget constraint and, in the case of an open economy model, the external sector balance should already be reflected.

[25] These first two steps could also be reversed: a model could also be tailored from a balanced dataset.

Such a consistent dataset as required by CGE-models is typically taken from a so-called *Social Accounting Matrix* (SAM)[26] of the economy. "A SAM can be defined as a numerical representation of the economic cycle with emphasis on distributive aspects. As in the complete System of National Accounts (United Nations) and in the I-O [input-output] framework, transactions in a particular year appear in a matrix format, showing receipts on the rows and outlays in the columns (...). Briefly, a SAM shows how sectoral value-added accrues to production factors and their institutional owners; how these incomes corrected for net current transfers are spent; and how expenditures on commodities lead to sectoral production and value-added. The "leakages" from this cycle, for example in the form of payments abroad or savings, are also shown. (...) A SAM in our view serves as an alternative for traditional Input-Output tables, but as a supplement to traditional national accounts statistics (...)."[27]

In other words, SAMs give a static image (snapshot) of the economic and social structure of a region or country in a particular year. The clue of this technique, analogous to the principle of double entry bookkeeping is that incomings and outgoings must balance. Thus, the sum of a row must be identical to the sum of the corresponding column. This last characteristic is particularly important for CGE-applications since the balancing information contained in a SAM exactly reflects the equilibrium conditions which we assume in our initial model. This implies that the model equations must describe every entry in the SAM. Thus, when constructing a SAM the CGE-user should already be fully aware of which structure his model should have.

Statistical data as collected by the statistical offices of a country are normally not balanced in the sense that, for example, income of all economic agents equals expenditure. Thus, the necessary prerequisites with respect to data as required by general equilibrium analysis do not exist. Constructing a SAM therefore implies collection of data, on the one hand, and correct preparation of this data to achieve a balanced SAM on the other.

There are two ways to display a SAM. Both forms contain the same information but are structured in different ways. On one side there is the so-called *rectangular* SAM[28], but more common and more intuitive with respect to economic flows is the so-called *square* SAM which shows an exact correspondence between rows and columns.

In TABLE 2 we present a schematic square SAM to better illustrate the concept. In a way it is a schematic and simplified version of the data on which our model is based. As mentioned, the SAM illustrates any flow of money within the economy as an expenditure by some actor (column) to another actor (row) so that one sector's purchase (expenditure) is another sector's sale (receipt). Looking at the *Activities* row, for instance, demonstrates that total income from production must come from domestic sales and exports. The *Activities* column shows that all production expenditures accrue for production inputs, i.e. intermediate inputs, value-added and indirect taxes. The *Commodities* row shows that the supply of commodities is demanded by domestic

[26] For a good introduction see King (1985).
[27] Keuning and de Ruijter (1988), p. 72, 73.
[28] See, for instance, Rutherford (1997), section 3.1.

purchasers. Demand occurs for intermediate inputs, household and government consumption and investment. The *Commodities* column demonstrates the purchase of or demand for goods with money flowing either to domestic producers or to importers from the rest of the world (ROW) and to the domestic government which charges tariffs. The *Factors* column illustrates that the value-added received by factors of production is allocated to households. The *Government* row reveals that government receives income through taxes and tariffs and spends the money (*Government* column) on government consumption, transfers (subsidies) and savings. The capital account reflects the equality between savings (private, government and foreign savings) in the row and investment in the column. The *Rest of the World* account indicates the equality between foreign exchange expenditures (imports) and foreign exchange earnings (exports) plus the current account surplus or deficit (foreign savings).

TABLE 2: THE SOCIAL ACCOUNTING MATRIX (SQUARE FORMAT)

		Expenditures						
		Activities	**Commodities**	**Factors**	**Households**	**Governm.**	**Capital**	**Rest of World**
Receipts	**Activities**		Domestic sales					Exports
	Commodities	Intermediate inputs			Private consumption	Governm. consumption	Investment	
	Factors	Value added						
	Households			Allocation matrix		Governm. transfers		
	Government	Indirect taxes	Import tariffs		Income taxes			
	Capital				Private savings	Governm. savings		Foreign savings
	Rest of World		Imports					

Source: Devarajan et al. (1991), p.4

The SAM contains all the equilibrium conditions pointed out above. The activity, commodity and factor accounts fulfil the zero-profit and market-clearing conditions. The household and government accounts embody the private household and public sector income-balance condition. And the capital and rest of world accounts contain the macroeconomic internal (savings equal investment) and external (imports equal exports plus current account surplus or deficit) income-balance condition.

2.4.2 Calibration

As we explained above, the successful calculation of the benchmark equilibrium requires three kinds of data: (i) SAM-data (i.e. a consistent dataset), (ii) exogenously supplied behavioural elasticities and (iii) calibrated data with which we identify all other missing parameter values like intercept, shift or share parameters of production and utility functions. The questions arises as to why, even with a consistent dataset, we need to undergo the additional process of calibration. Apart from the fact that such detailed information about share parameters, etc. does not exist in the literature, calibration is absolutely necessary to calculate the residual parameter values which are required to achieve the benchmark equilibrium. How is this done?

"In effect, the model is solved from equilibrium data for its parameter values, rather than vice versa (...). The first task in applying general equilibrium analysis is not to solve for an equilibrium, but rather use the observed equilibrium [in the SAM] to solve for model parameters consistent with that observation."[29] Overall, calibration is a rather straightforward task of calculus where a system of several equations and several unknown variables (i.e. the missing parameters) is solved.

Both, the exogenously assumed elasticities as well as the calibrated parameters can play an important role for a model's results. Whereas the calibrated values can not be changed by the user because they ensure the reaching of the benchmark equilibrium, exogenously assumed elasticity values should always be justified through econometric determination and/or tested in so-called sensitivity analyses.

2.5 Summary

The aim of this chapter has been to familiarise the reader with the concept, approaches and some of the technical details of applied CGE-analysis. Initially, we gave a short overview concerning the concept and evolution of GE-theory and models. Invented by Léon Walras, GE-modelling has been the core component of standard classical and neoclassical theory. Elaborated and refined by generations of economists, GE-theory has become particularly interesting since practical, i.e. computable, applications became possible in the 1970s. Nowadays, CGE-models are applied in a number of different areas and are mainly used for policy simulations. Their main advantages, particularly with respect to the analysis of the CEEC are the possibility of analysing structural changes without requiring time series data and their ability to trace policy consequences through the entire economy.

There are several approaches to the practical implementation of CGE-models. The MC-approach which is used in this study assumes complementarity slackness between three equilibrium conditions in the economy and three sets of central variables which ensure their existence. These are the zero-profit, the market-clearance and the income-balance condition. The respective variables are activity levels, prices and income.

MC-models can be programmed using MPSGE, a model and function generator

[29] Shoven and Whalley (1992), p. 103.

particularly designed for general equilibrium problems. It offers a transparent and non-mathematical way of writing down and analysing complicated systems of non-linear inequalities. The language is based on nested constant elasticity of substitution utility and production functions.

In order to be able to practically work with a CGE-model, it is necessary to have a consistent, i.e. equilibrated dataset of one particular benchmark year. The data, which is best prepared using a SAM, displays the numerical representation of the economic cycle with emphasis on distributive aspects and mirrors all three equilibrium conditions. Whereas the behavioural elasticities (e.g. substitution elasticities) have to be assumed and provided exogenously, intercept, shift or share parameters are calibrated endogenously by the model prior to policy simulation.

3 THE COMPUTABLE GENERAL EQUILIBRIUM MODEL

3.1 INTRODUCTION

This section provides a detailed description of the CGE-model which has been used in this study. We will firstly present a general overview and will later describe important details and assumptions of the model.

Our model is based on the so-called *GTAP-in-GAMS* model which was designed and programmed by Thomas Rutherford, University of Colorado.[30] It is also very similar in its structure to the *Uruguay model* which was successfully used in a number of studies concerning the impacts of the Uruguay Round[31], to the *GTAP model*[32] and the *DART model*.[33]

We apply a static and a recursive dynamic version of the model to simulate the eastern enlargement of the EU. This incorporates: (i) EU-CEEC trade integration consisting of the complete elimination of tariffs and non-tariff-barriers between both regions, (ii) capital transfers in the context of EU's regional policy flowing from the EU into the CEEC, (iii) mobility of the production factor labour (i.e. migration) on the basis of the parameter values calculated in chapter 4 and (iv) intertemporal investment resulting in capital accumulation within each region.

In successive sections we will present and discuss general issues of the model as well as the assumptions concerning production, demand, international trade, investment and capital, labour migration, the model closure, the data and critical remarks concerning the model's predictive value. Finally, the last section will summarise.[34]

3.2 GENERAL ISSUES

3.2.1 THE THEORETICAL STRUCTURE OF THE MODEL: AN OVERVIEW

The structure of the underlying CGE model is a comparative, recursive dynamic[35], open economy model with several sectors of production specifying the economic structure of three different, international regions: the European Union (EU), the central and eastern European Countries (CEEC) and the Rest of the World (ROW). For each region the production of nine sectors, private and public demand (consumption) and investment are fully defined. Hence, basically all transactions within an economy are modelled:

30 See Rutherford (1998b) for details.
31 See Harrison et al. (1995, 1996b, 1997) for applications of the "Uruguay Model".
32 See Hertel (1997) for a description of the original GTAP-model.
33 The DART model is described in Springer (1998).
34 An algebraic description of the our base model is provided in the Appendix.
35 The term "recursive dynamic" is explained more in detail in section 3.2.3

income flows from producers to consumers, to the state-institution or to investors and from there back to the demand for goods. FIGURE 5 on p. 73 gives a graphical overview of the assumed transactions within the economy. The continuous arrows show the movements of factors and goods. The broken arrows illustrate all financial transactions. The broken lines, for instance, indicate tax and tariff flows which symbolise an indirect income to the *Representative Agent* (RA). The dotted lines express all direct income and expenditure of the RA. Goods and factor prices and quantities are assumed to be completely flexible to ensure an equilibrium on each market. All goods are traded between regions, except for the investment good. Producers are assumed to be in perfect competition with each other by assuming constant returns to scale (CRTS). The model contains a predominant static and a smaller dynamic component. Two types of dynamic effects have been included into our CGE-analysis: The first one focuses on the periodical and transregional mobility of the production factor *capital* from West to East, (section 3.6.2) and *labour* from East to West (section 3.7). The second effect concentrates on intertemporal, recursive dynamic capital formation within each region (section 3.6.3).

Our model deviates from the standard GTAP-in-GAMS model in that we incorporate a constant government share in total output, a constant marginal propensity to save, non-substitutability between skilled and unskilled labour and the recursive dynamic approach. The model was programmed on GAMS/MPSGE.

3.2.2 THE ECONOMIC ACTORS AND PRICES

The Economic Actors:

Within each region we have one type of representative economic actor. He is responsible for earning income from different sources and spending it according to his utility maximising preferences. The amount of his wealth is a proxy for the economic welfare of a country. He is called *Representative Agent* and is a combination of private and public economic intermediaries (i.e. households and government). His income is therefore composed of earnings from several sources: firstly, from the provision of production factors, i.e. the supply of labour (households), the supply of capital (firms) and the supply of land. Secondly, it is the RA who is the beneficiary of all tax incomes which are collected within the model by the government, i.e. output, intermediate input, factor and export taxes as well as tariff revenues and taxes on government and private demand. Thirdly, the RA's budget is also determined by foreign borrowing or lending according to the current account balance. The expenditures of the RA consist of the combined value of household and government purchases as well as investment spending. All in all, the RA basically portrays a figure who represents the income and expenditure structure of the whole population of the economy.

Prices:

In equilibrium, the model follows one of the main assumptions of Walras' GE-concept by only determining relative prices. The absolute price level is not important, thus money illusion does not exist. This means that demand functions are assumed to be homogeneous of degree zero in prices: a doubling of all prices doubles income so that physical quantities demanded remain unchanged. Theoretically, the normalisation of prices in the benchmark scenario would therefore be arbitrary. MPSGE, however, has been programmed in such a way that prices will initially be normalised to 1. When running the counterfactual scenario at a later stage, relative prices may then deviate from the initial value.

A further key assumption of the model is that it satisfies *Walras' law*, i.e. market demand equals market supply on all markets. A general equilibrium in this system arises when market prices adjust in such a way as to ensure Walras' law.

All goods and factor prices are assumed to be completely flexible. This will probably be particularly criticised in terms of labour prices (i.e. wages) since short-run wage rigidity is a stylised fact. If we abandoned the assumption of complete wage flexibility, the alternative equilibrating variable would be the unemployment rate. It is possible that in this case results would deviate slightly since firms would face a different costs structure.

3.2.3 Static and Dynamic Effects

The greater part of the model that will be described in this chapter is of a purely static nature. This means that the model provides two equilibrium situations: initially one *benchmark* and later another *counterfactual* equilibrium. Policy analysis in this context is possible as comparative static analysis between two different states of equilibria. What the static version of the model leaves completely alone are simulations over various time periods and intertemporal endowment effects. It is precisely these components that characterise the *Recursive Dynamic Approach* which will be applied in some of our simulations. It is necessary to stress that a recursive dynamic model is not the same thing as a fully dynamic model (recall section 2.2.2). The latter is characterised by endogenous intertemporal decision making processes and a higher degree of endogenation of variables.

The Recursive Dynamic Approach:

The aim of this study is to analyse CEEC integration into the EU. This integration does not only consist of lower trade barriers but also of reduced impediments to factor mobility. Increased labour migration will be subjected to special examination in this context. Since migration is not a phenomenon which happens once and for all but a gradual and intertemporal occurrence, it seems useful to adopt a model which is capable of incorporating several successive time periods. At the same time it is possible to model repeated investment which will lead to a time-dependent increase in the capital stock of each region. This is done using the recursive dynamic approach, i.e. dynamic sequencing of static equilibria. The approach cannot deal with optimal intertemporal decision making which implies that agents are assumed to have myopic or adaptive expectations. The savings/investment decision, for instance, occurs according to the calibrated marginal propensity to save.

How does a recursive dynamic model work? It is a technique which enables the modeller to run a static model as many times in succession as he wants. In the programming language each successive run is called a *loop*. Each loop represents an additional time period after which a new and different state of general equilibrium is reached. Before each new loop, it is necessary to implement the changes which the modeller wants to examine. For instance, we could model a reduction of trade barriers and a change in the endowment of the production factors (i.e. capital transfers and migration) before the very first counterfactual loop. Before the second and each successive loop we would adjust both, the endowment of capital according to our assumptions about investment and capital transfers and the endowment of labour according to assumptions about migration. Additional trade barrier changes to the ones undertaken before the first loop would not be necessary because we believe that a complete integration into the EU suggests that trade barriers are reduced all at once.[36] In other words, the distinctive feature of the recursive dynamic model is that the exogenous endowments of the primary factors are assumed to evolve over time according to an adopted behaviour. How we model labour and capital to develop over time will be explained later.

Eventually, the model presents results for all variables and for each loop. In this way it is possible to illustrate the step-by-step development of the economy. In the progress of the recursive dynamic model, however, preferences and technology are assumed to remain constant. Thus, potential dynamic changes of consumer or producer behaviour (i.e. income effects) due to economic growth are ignored.

3.3 PRODUCTION

Firms produce output according to an assumed production function. Its functional form represents the underlying production technology which is assumed to be the same for all sectors and regions. So far, this implies the typical neoclassical technological assumption. Nevertheless, due to differing shares and quantities of inputs in the production process, as provided by the benchmark dataset, each sectoral industry's production structure is slightly different. Hence, shift and share parameters in the production function deviate from sector to sector and from region to region.[37] Producers are assumed to maximise profits by choosing the most cost-saving combination of intermediate production inputs and primary production factors. As primary production factors there are (i) unskilled labour, (ii) skilled labour, (iii) capital and (iv) land and natural resources. Capital includes physical capital such as machines, tools and buildings. Financial capital is not considered. Industries are believed to produce at constant returns to scale.

[36] Thus, we assume that no transition periods for sensitive sectors take place.

[37] It is precisely these shift and share parameters which need to be calibrated before starting with simulations.

3.3.1 THE PRODUCTION FUNCTION

Production is modelled according to a nested CES-production function. "Nested" in this context suggests a functional form which includes various production levels or branches as described in EQ. 2 - EQ. 7 and illustrated in FIGURE 2.

EQ. 2 $$Y_{ir} = \min\left\{FD_{ir}, AD_{ir}\right\} \quad \text{where}$$

EQ. 3 $$\Lsh\ FD_{ir} = \psi_{ir}\left(LND_{ir}^{\theta_{ir}^{LND}} K_{ir}^{\theta_{ir}^{K}} L_{ir}^{\theta_{ir}^{L}}\right).$$

EQ. 4 $$\Lsh\ L_{ir} = \left[\delta_{ir}^{lc} SKL_{ir}^{1-\sigma_{lc}} + \left(1-\delta_{ir}^{lc}\right) LAB_{ir}^{1-\sigma_{lc}}\right]^{1/(1-\sigma_{lc})}$$

EQ. 5 $$\Lsh\ AD_{ir} = \min\left\{ID_{ir},\ldots,ID_{jr}\right\}$$

EQ. 6 $$\Lsh\ ID_{ir} = \left[\alpha_{ir}^{ID} DI_{ir}^{\sigma_{DM}} + \beta_{ir}^{ID} MI_{ir}^{\sigma_{DM}}\right]^{1/\sigma_{DM}}$$

EQ. 7 $$\Lsh\ MI_{ir} = \left[\sum_{s} \alpha_{isr}^{M} M_{isr}^{\sigma_{MM}}\right]^{1/\sigma_{MM}}$$

where Y_{ir} is output of good i in region r, FD is value-added (factor demand), AD are aggregate intermediate inputs, LND is land, K is capital, L is labour, θ are calibrated Cobb-Douglas share elasticities, ψ is the calibrated shift parameter. Labour is defined as a CES-function where δ^{lc} is the calibrated CES-share elasticity of labour category lc. SKL is skilled and LAB is unskilled labour. σ_{lc} is the calibrated CES-substitution elasticity. Initially, we assume $\sigma_{lc} = 0$ which implies Leontief technology for labour. ID are intermediate demand of sector i and j (Armington intermediates) which is a CES composition of DI, the domestic composite and MI, the import composite. α and β are the calibrated distribution parameters of intermediates ID, and σ_{DM} is the calibrated Armington CES-substitution elasticity between domestic and imported goods. The import composite is a CES aggregation across imports M from different regions s with σ_{MM} being the calibrated import CES-substitution elasticity.[38]

At the top level of production we have two kinds of inputs which are *Value-Added* and aggregate *Intermediate Inputs*. Both inputs are used in fixed ratios to produce gross output which implies Leontief technologies (EQ. 2) as can be seen in the top-centre part of the graph. However, each of these top-level inputs has its own individual structure:

On the one side there is *Value-Added*, which uses the factor-inputs *Labour*, *Capital* and *Land* according to a Cobb-Douglas technology (EQ. 3). Labour is further divided into different skill categories defined as *Skilled* and *Unskilled* labour. We assume that both skill categories are used in fixed ratios (EQ. 4) implying no substitutability[39] between the two types. A graphical illustration of value-added can be seen in the left-hand corner

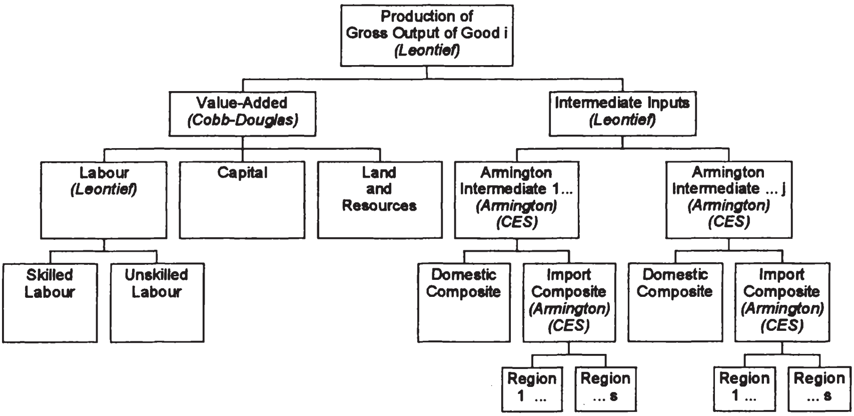
[38] All subscripts, superscripts,variables, and parameters are also summarised in tables A1-A3 in the Appendix. We closely follow the notation of Rutherford (1998b), p 3-8.

[39] In some of the sensitivity analyses in chapter 6 we test the model assuming other degrees of substitutability between skilled and unskilled labour.

of FIGURE 2.

On the other side there are aggregate *Intermediate Inputs* (EQ. 5) which are the composition of several *Armington Intermediate* Inputs. The amount of *Armington Intermediates* to produce one aggregate *Intermediate Input* is fixed. In economics language we call this assumption "fixed input-output coefficients"[40] which is another way of describing a Leontief technology. Each *Armington Intermediate* is a good which is composed of a domestically produced (*Domestic Composite)* and an imported unit *(Import Composite*) and which is described by a CES-function as can be seen in EQ. 6. The substitutability of the domestic against the foreign component of the composite intermediate good is defined by an exogenously given elasticity of substitution, σ_{DM}. Its value is normally chosen to be fairly high, which implies that both parts can be exchanged relatively well against each other.

FIGURE 2: MODEL STRUCTURE - PRODUCTION



Source: Own graph after Weyerbrock (1994), figure II.1.

A further differentiation among the *Import Composites* is undertaken on an even lower nest. Each *Import Composite* is put together by the same good from different regions of origin, s. Once again a CES-function (EQ. 7) is applied to determine the relationship of the different regions towards each other with an even higher elasticity of substitution, σ_{MM}, than in EQ. 6. These imperfect yet high substitutabilities modelled in EQ. 6 and EQ. 7 express the so-called *Armington assumption* which will be explained in greater depth in section 3.5.1.

With respect to domestic production, output can either be sold on the domestic market or exported abroad. All export markets are also regarded as imperfect substitutes from the viewpoint of a producer. This assumption is covered by an approach which is

[40] So-called *Input-Output tables* illustrate the demand of intermediate products in the production process. Data on fixed input-output coefficients is derived from these tables.

equivalent to the Armington assumption and which will be described and explained in section 3.5.2.

In section 2.3.2 we presented the equilibrium conditions which would have to be met in the context of an MC approach. For all activities, we argued, the zero-profit condition would have to be fulfilled. The zero-profit condition for production activities implies that the value of sales on the domestic and the export market net of tax must equal total costs of production:

EQ. 8 $$\left(p_{ir}^{D}, a_{ir}^{D} + p_{ir}^{X}, a_{ir}^{X}\right)\left(1 - t_{ir}^{Y}\right) = \sum_{f} a_{fir}^{F} p_{fr}^{F}\left(1 + t_{fir}^{F}\right) + \sum_{j} a_{jir} p_{jr}^{ID}\left(1 + t_{jir}^{ID}\right),$$

where p are output prices on the domestic *(D)* and export market *(X)* of sector i in region r, a are the respective unit demand functions on each market, t are output taxes. The left hand side determines producers' revenue. On the right hand side we find the costs of production with the unit demand functions a, prices p for primary production factors f, and intermediate demand, *ID*.

3.3.2 Constant Returns to Scale

This model assumes constant returns to scale. The standard theory of perfect competition implies that firms choose the output level where marginal costs equal the market price. Thus, no firm makes any positive profit and all firms are price takers. Models with imperfect competition and increasing returns to scale (IRTS) also exist. They imply that on the supply side, firms "[...] produce with constant marginal costs and a given fixed cost. If the same industry output is produced with fewer firms, there is a rationalisation gain as firms slide down their average cost curve, producing more output with the same fixed costs"[41]. Working with IRTS, however, requires estimates of the extent of unrealised economies of scale. Estimates of so-called *cost disadvantage ratios* by Pratten (1987) and Neven (1990) exist, although values for the CEEC are not yet available.

We know that particularly for the transition economies working with the assumption of perfect competition may be regarded as a daring assumption since the former socialist economic system was based on very large state enterprises. Competition was unknown. Since the start of transition in 1990, however, the CEEC have made tremendous achievements in reforming their economies. Not only has there been ongoing privatisation combined with a breaking up of larger enterprises, there has also been the opening of formerly protected markets to producers from abroad and strong foreign direct investment (FDI) creating additional firms. Perfect competition can then also justify the assumption of CRTS. Besides, the use of IRTS is even more unrealistic for the CEEC. After all, IRTS imply firm rents originating from rationalised production on a large scale. Although the former state owned CEEC enterprises were big, they were anything else but rationalised firms.

[41] Harrison, Rutherford and Tarr (1997), p. 1419.

3.3.3 TAXES IN THE PRODUCTION PROCESS

Output which is being sold on the domestic market as well as output which is being exported to other countries can be taxed with an *output* and an *export tax* respectively. Value-added inputs are taxed with a *factor tax* and intermediate inputs with an *intermediate input tax*. All tax revenues fall to the RA, since he also involves the public agent, i.e. the government which normally executes this "duty".

3.4 DEMAND

There are three categories of domestic demand in our model. Firstly, there is demand for intermediate production inputs by producers. We have already discussed this kind of demand in the context of the production process and will not consider it in this section again. Secondly, there is private demand for consumption goods by households. And thirdly, there is demand for goods by the public households, i.e. the government. The demand within the household and the government category works in very much the same way as in the case of production inputs. The most important differences between the demand for goods for consumption/government purposes and demand for intermediate goods for production purposes is that it is now determined through utility functions and indifference curves rather than production functions and isoquants.

3.4.1 THE UTILITY FUNCTION OF PRIVATE AND PUBLIC CONSUMERS

In each region, private and public demand is determined through the utility function of the RA. His total income is allocated to investment, public and private (consumer) demand according to a utility maximising Cobb-Douglas utility function:

EQ. 9 $$U_r = \theta_r^I \log(I_r) \cdot \sum_i \theta_{ir}^C \log(CD_{ir}) \cdot \sum_i \theta_{ir}^G \log(GD_{ir}) \qquad \text{where}$$

EQ. 10 $$\hookrightarrow CD_{ir} = \left[\alpha_{ir}^C DC_{ir}^{\sigma_{DM}} + \beta_{ir}^C MC_{ir}^{\sigma_{DM}}\right]^{1/\sigma_{DM}},\ GD_{ir} = \left[\alpha_{ir}^G DG_{ir}^{\sigma_{DM}} + \beta_{ir}^G MG_{ir}^{\sigma_{DM}}\right]^{1/\sigma_{DM}}$$

EQ. 11 $$\hookrightarrow MC_{ir} + MG_{ir} = \left[\sum_s \alpha_{isr}^M M_{isr}^{\sigma_{MM}}\right]^{1/\sigma_{MM}},$$

where U is utility, I is investment, CD is Armington consumer demand, GD is Armington government demand, θ are the calibrated share parameters of consumers C, and government G respectively. DC and MC are consumer demand for domestic and imported goods, DG and MG are government demand for domestic and imported goods and all other variables are defined are before.

Private and public households are assumed to be agents who maximise utility subject to a budget constraint. What is more, consumption of private and public households is modelled as a "production process" in which the zero-profit condition is applied and fulfilled. In this context, private and government consumers are assumed to minimise

expenditure in order to achieve a given utility level. Hence, in equilibrium, utility from the consumption of goods and agents' expenditure for the purchase of these goods must balance so that the following zero-profit conditions are realised.
For private households, the zero-profit function is:

EQ. 12 $$p_{ir}^{C} = \left(\alpha_{ir}^{C} p_{ir}^{D\,1-\sigma_{DM}} + \beta_{ir}^{C} p_{ir}^{M\,1-\sigma_{DM}}\right)^{1/1-\sigma_{DM}},$$

where all variables are defined as before. The left hand side of the equation displays the unit expenditure of private demand and the right hand side illustrates the unit cost function defined by the aggregate of domestic *D*, and imported goods *M*.

Accordingly the zero-profit function for the government (public household) would appear as follows:

EQ. 13 $$p_{ir}^{G} = \left(\alpha_{ir}^{G} p_{ir}^{D\,1-\sigma_{DM}} + \beta_{ir}^{G} p_{ir}^{M\,1-\sigma_{DM}}\right)^{1/1-\sigma_{DM}}.$$

3.4.2 THE BUDGET CONSTRAINT FOR GOVERNMENT DEMAND

As we mentioned above, the government is assumed to be an implicit agent who maximises utility subject to a budget constraint. The modelling and definition of the government's budget allow two possible alternatives. In the first form, the government's share in total output is assumed to be constant. Thus, if the RA's overall income rises, government's budget will rise proportionally and vice versa. The second form assumes that the government budget is fixed irrespective of the overall wealth. This implies that government's benchmark budget is believed to be optimal over time. The fact that government demand is included in the Cobb-Douglas utility function in EQ. 9 demonstrates that we apply the first form thereby assuming a constant government share in total output.[42]

3.4.3 CONSUMPTION TAXES

All consumption of private and government demand is taxed with an individual tax rate. The beneficiary of all tax revenues is again the RA. Thus, in a way the RA charges taxes for consumption from himself. This form of "redistribution" is accompanied by a dead-weight loss, characteristic to any form of taxation.

3.5 INTERNATIONAL TRADE

In the sections describing the supply and demand characteristics it has already become obvious that the different kinds of demand are met by goods which constitute a composition of domestically produced and imported components. Hence, the

[42] A sensitivity analysis in chapter 6 will illustrate the welfare implications of both modellings.

assumption of international trade of goods has already been implicitly followed. In our model, trade in goods and services constitutes the most important link between different international regions in this model.

3.5.1 Imports: The Armington Assumption

Each commodity demanded is an aggregate consisting of a mixture of several composite goods as mentioned earlier. These composite goods are a combination of both domestic and foreign products, where the latter can have various sources of origin.

Figure 3 illustrates this particular demand structure. As shown, demand is derived from a system of nested Cobb-Douglas and CES utility or production functions[43] where the *Armington assumption* is employed. This idea, first developed by Armington (1969), postulates that consumers distinguish goods by their origin and exporters distinguish by region of destination (product heterogeneity).[44] Hence, comparable goods are regarded as being imperfect substitutes. In contrast to the "traditional trade theories" which explain trade by either, differences of efficiency in the production of goods à la David Ricardo or by differences in the factor endowments of countries à la Heckscher/Ohlin/Samuelson[45] (*inter-industry trade)*, the Armington assumption also explains trade in similar products, a phenomenon called *intra-industry trade*. Although Grubel and Lloyd (1975) confirmed that most European trade occurred in goods within the same industry justifying the use of the Armington assumption, peculiarities of the EU-CEEC trade structure may question it. How far has East-West trade reached normal standards? After all, the CEEC used to form a very closed trading block with the other countries of the Eastern Bloç (i.e. the *Council of Mutual Economic Assistance*). EBRD (1999: 90) argues that most trade reorientation between the CEEC and the EU had already taken place by 1994, an observation which has also been confirmed by Piazolo (1996) who used a gravity model to estimate the "normal" trade patterns. Thus, our data reflecting the economic situation of 1995 should largely echo regular trade relationships between the CEEC and the EU.

In the model, agents (firms, household, government) decide first on the origin of their imports and based on the resulting composite import price, they then determine the optimal mix of imported and domestic goods. These two decisions are illustrated in Figure 3 in the boxes called *Import Composite* and *Armington Composite 1....* The demand for *Import Composites* as well as for *Armington Composites* is characterised by CES-utility/production functions as described in Eq. 6 and Eq. 7 or Eq. 10 and Eq. 11 respectively. The values of the elasticity of substitution are greater than one but are far from being infinite. Hence, a certain tendency towards substitutability of goods is observable without coming close to the assumption of perfect substitutes (because that would contradict the Armington assumption). In fact, the substitution elasticity for import composites has been chosen to be higher than the one for Armington composites.

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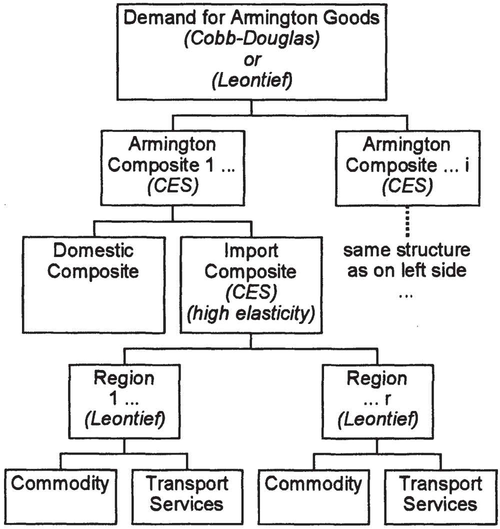
43 Cobb-Douglas functions are a special case of a general CES-function, where the elasticity is equal to 1. For a good introduction to CES-functions see Chiang (1984), pp. 425-30.

44 See also Shoven and Whalley (1992), p. 230, 231.

45 See Samuelson (1948).

Harrison et al. (1997) assume elasticities for the CES-function of import composites of $\sigma_{MM} = 8$ and for the Armington function of $\sigma_{DM} = 4$.[46] The significance of these values for simulation outcomes will later be tested in detailed sensitivity analyses.

FIGURE 3: PRODUCT DIFFERENTIATION WITHIN AN ARMINGTON STRUCTURE



Source: Own graph

Let us turn back to the demand structure: demand at the very top level in FIGURE 3, the demand for different Armington goods, is Cobb-Douglas (EQ. 9) in case of the RA or Leontief (EQ. 5) in the case of producer demand for intermediate inputs.

In previous sections we presented the different activities which characterise our model. These were (i) industrial production (ii) private consumption and (iii) public consumption. Each of these activities includes one *Armington activity*, each of which consists of import and transport activities. Thus, there are three different Armington good markets (one for production, one for private and one for public demand) in each region with three different import value shares. For each Armington activity the zero-profit condition must hold since import demand is characterised by cost minimising producers or expenditure minimising households and governments. Hence, the zero-profit condition for the "production" of one Armington good in general is:

46 See Harrison et al. (1997), p. 1408.

EQ. 14 $$p_{ir} = \left(\alpha_{ir} p_{ir}^{D\,1-\sigma_{DM}} + \beta_{ir} p_{ir}^{M\,1-\sigma_{DM}}\right)^{1/1-\sigma_{DM}},$$

where all variables are defines as before. Note that this equation is a generalised form of EQ. 12 and EQ. 13.

The import activity which is included in the Armington activity in EQ. 14 requires an individual nest since its components originate from various regions. This *Import Composite* also describes a zero-profit condition which consists of various substitution elements (each representing a different international region) and which includes transportation costs. The value of imports at the domestic *cif* price equals the *fob* price gross of export tax plus transport margin and tariffs. The zero-profit equation therefore is:

EQ. 15 $$p_{ir}^{M} = \sum_{s} a_{irs}^{M} \left[p_{is}^{X}\left(1 + t_{isr}^{X}\right) + \tau_{irs} p^{T}\right]\left(1 + t_{isr}^{M}\right),$$

where the variables are defined as before, superscript M denotes imports, X stands for exports, T means transport services of all trade between regions s and r. τ is the calibrated share parameter of unit transport costs. Note that unit demand for imports in region r, a_{irs}^{M}, must be multiplied with the good's export price of region s.

Drawbacks of the Armington Assumption:

The Armington assumption applied in this model is unfortunately not beyond criticism. In contrast to Armington's theory, other analytic trade models strictly divide goods into tradables and non-tradables. Within the category of tradables, domestic goods and imports are regarded as being perfectly substitutable. Both these assumptions of extreme dichotomy as well as perfect substitutability are, nevertheless, rather unrealistic for trade models so that we tended to follow Armington's hypothesis. Still, the CES (Armington) functional forms also have certain disadvantages. Income effects which should probably have an impact on consumption ratios (between similar imported and domestic goods) are, for instance, neglected completely. It is only the ratio of import and domestic prices (relative prices) which determines our demand ratios. Hence, the demand shares of different sectors remain fixed when increasing income.[47] Weyerbrock (1994)[48] reports additional problems. The assumption of product differentiation in connection with CES import-aggregation functions seems to cause unrealistically strong terms-of-trade effects, as empirical estimations have shown.[49]

One way to avoid such strong assumptions is by applying the *Almost Ideal Demand System* (AIDS) which defines import demand in a more flexible functional form. It allows for income elasticities of demand which are different from one. However, the AIDS specification becomes difficult in our case since additional elasticities are needed

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47 See Chiang (1984), pp. 421-22.
48 See Weyerbrock (1994), chapter II.
49 Shoven and Whalley (1984) showed these effects.

which are not available for the CEEC. Also, the policy simulations which we have in mind do not cause strong growth or income effects so that the mentioned drawback of using a CES-function will not be very distinctive. Weyerbrock (1994, 1995) eventually also abstains from using the AIDS import demand form because of the difficulties mentioned of finding the required data. As a matter of fact a CGE-study by Breuss and Tesche (1996) which actually uses the AIDS specification for analysing a very similar formulation finds that the "[...] results mostly support those of Weyerbrock (1995)"[50]. Thus the functional form of the import demand function is only of minor relevance.

3.5.2 Exports, Transport Services and Trade Barriers

Exports:

The export of goods and services is modelled in a corresponding manner to the import. All goods produced in one country can either be sold on the domestic market or exported abroad. This happens according to a *Constant Elasticity of Transformation* (CET) function. CET functions are basically the counterpart of the CES functions that we have already encountered, with the difference being that they deal with the supply rather than the demand side:

EQ. 16 $$Y_{ir} = \left[\alpha_{ir}^{Y} D_{ir}^{1+1/\eta} + \beta_{ir}^{Y} X_{ir}^{1+1/\eta}\right]^{1/(1+1/\eta)},$$

where Y_{ir} is domestic output of good i in region r which is either sold on the domestic market D_i, or exported abroad X_i. α and β are again the distribution parameters which expresses how much of domestic output is used at home or abroad. η is the exogenously given elasticity of transformation which decides how strongly the use of domestic output reacts to changes in relative prices. Similar to the substitution of elasticity values, the assumed values for the transformation elasticities are also normally larger than one, implying that different markets (domestic and foreign) are fairly close substitutes to domestically produced goods.

International Transport Services:

All trade in the model is accompanied by additional costs from international transport services, which importers have to bear. These costs have a Leontief type of relationship to actual trade flows, i.e. they are proportional to the trade of each good. This is illustrated at the bottom of FIGURE 3. Thus, real transport costs are:

EQ. 17 $$T_{irs} = \tau_{irs} M_{irs},$$

[50] Breuss and Tesche (1996), p. 22.

Trade Barriers:
The model also incorporates international tariffs as well as estimations of non-tariff-barriers (NTB) for goods and services which are imported into a region (see section 3.9.3). NTB are interpreted as a supplement to officially charged tariffs with the effect that the resulting tariff rate includes information on both official tariffs as well as NTB.

The tariff collector and beneficiary is, as always, the Representative Agent. In the course of different integration scenarios between the EU and the CEEC we adapt tariff rates to the intra-EU levels.

3.5.3 Trade and Factor Movements: Substitutes or Complements?

The question may arise as to whether trade and factor movements are substitutes or complements in our model or, putting it differently, if we are in a Heckscher-Ohlin (H-O) or a Ricardian type of world. In fact, the model does not allow such a strict distinction. There are basically two reasons why trade takes place: firstly, there are internationally differing production technologies. Although the nested production function which we displayed in Figure 2 is identical in all regions, different shift and share parameters (originating from the calibration process) account for the distinctiveness of technologies. Secondly, regions have dissimilar factor endowments resulting in divergent relative factor prices. Thus, just as in reality, trade is the consequence of a mixture of both approaches and is additionally complemented by transport costs and the Armington assumption. Which of the two effects (Heckscher-Ohlin or Ricardo) eventually dominates depends on the data. In our model and data the H-O type of effect seems to prevail since the results mostly correspond to the Rybczynski (1955) theorem which, strictly speaking, can only be proved for the 2-commodity, 2-factor, 2-region H-O case.[51] Therefore trade and factor movements are likely to be predominantly substitutive.

3.6 Investment and Capital

There are two concepts which involve the term *"capital"* and which should not be confused. On the one hand side there is *capital* which is used as a primary factor of production next to labour and land. In a static, one time run of the model this sort of capital is not affected by investment decisions in the sense that its amount does not change. In other words, the initial (benchmark) stock of capital as a production input is given exogenously by the SAM and is assumed to remain unchanged during the whole static run of the model. On the other hand, there exists a separate capital good (cgd) which we will synonymously call *Savings and Investment (S&I) Good* to prevent any confusion. It reflects the savings and investment decision of economic agents in each period. In the recursive dynamic approach this period's investment accumulates the next period's capital endowments.

[51] We will discuss this in greater depth in the next chapter.

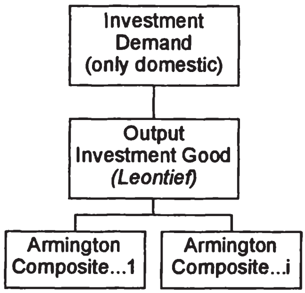
3.6.1 APPROACHES TO MODELLING INVESTMENT

Under investment we understand real capital formation so that no financial investment is being considered. Investment activity is described as a production process of the composite Savings and Investment Good as illustrated by FIGURE 4. It is a Leontief aggregation of Armington (intermediate) composites. Primary factors of production (labour, capital and land) are not used in the production process. The investment activity is non-sector specific which means that one investment good is produced for the whole economy. Additionally, the S&I-good is internationally immobile.

Investment behaviour can be modelled in several ways. We will present two possibilities which are relevant for our static and recursive dynamic model.

The benchmark equilibrium is by definition supposed to reflect an optimal state of the economy. According to the first way of modelling investment, an optimal state of the economy must also imply that the amount of investment (as provided by the SAM) is optimal too. The produced quantity of the Savings and Investment Good therefore does not alter between benchmark and counterfactual equilibrium. Merely the price of the S&I-good (i.e. the rental rate of return to capital) alters in order to ensure that the zero-profit condition is fulfilled. We call this form of modelling investment the *Fixed Investment Approach*. The simple version of the GTAP-in-GAMS model defines investment in this way. Its disadvantage is that in a neoclassical world, investment is unresponsive to the marginal productivity of capital. Thus, in a dynamic scenario net investment keeps accumulating over time and does not reach a steady state.

FIGURE 4: PRODUCTION STRUCTURE OF THE SAVINGS AND INVESTMENT GOOD



Source: Own graph after Springer (1998), p.52.

The other possibility of modelling investment behaviour works in the opposite way. The quantity of the investment good being produced within a country is not fixed but rather endogenously determined. Logically, we call it the *Endogenous Investment Approach*. This technique following Solow's (1956) neoclassical growth theory assumes that total regional income is either used for consumption or for savings purposes. The share which is used for each of these purposes is determined by the exogenously supplied *marginal propensity to save*, s_r. Given the prices of consumption goods, real domestic consumption under consideration of total income can be derived as:

EQ. 18
$$\sum_i CD_{ir} + GD_{ir} = \frac{(1-s_r)Exp_r}{P_r^C},$$

where all variables are defined as before, *Exp* is total expenditure of the RA and *p* is the price of domestic consumption goods.

The remaining part of total income yields nominal savings, which are entirely spent on domestic investment. Given the price of the investment good, real investment is then:

EQ. 19
$$I_r = \frac{s_r \cdot Exp_r}{p_r^I},$$

where I_r is investment in region r and p_r^I is the price of the domestic S&I good.[52]

If nominal domestic savings are not equal to investment, the shortfall is compensated for by foreign borrowing or lending, as will be explained in section 3.8.2.

Since investment is actually modelled as a production process, it has to fulfil the same equilibrium conditions as all other sectors of production, i.e. the zero-profit condition needs to be accomplished. Thus, the resulting unit profit function would be:

EQ. 20
$$\left(p_{ir}^D, a_{ir}^D\right)\left(1-t_{ir}^Y\right) = \sum_j a_{jir} p_{jr}^{ID}\left(1+t_{jir}^{ID}\right),$$

where all variables are defined as before.

Our simulations will be based on this latter, Endogenous Investment Approach. Nevertheless, in the context of our static simulations in the next chapter we will undertake a sensitivity analysis applying and examining the effects also using the Fixed Investment Approach.

With further extensions Harrison et al. (1997) test this second form of investment in their model. By fixing the rate of return to capital, they assume that a country is on its long-run equilibrium, steady-state path. Short-run increases in the rate of return to capital will lead to an increase in investment (expanding the endogenous stock of capital) until the marginal productivity of capital again reaches its benchmark level. They observe that additional positive welfare effects are the consequence. Although their approach is labelled as being "dynamic", it must be pointed out that it is not a genuinely dynamic technique because the endogenous adjustment of the S&I-good takes place during one simulation run. Hence, no forward looking, intertemporal

[52] In the equations we use Rutherford's (1998b) notation for the S&I good. *"Cgd"* stands for capital good. Thus, S&I and cgd are used synonymously.

investment decisions are reflected in this approach.[53] This so-called *Steady State Approach* has been applied in other studies, for example in Francois et al. (1994, 1995) and Harrison et al. (1996a, 1997).

3.6.2 Capital Transfers

It is very likely that further EU-CEEC integration will boost capital mobility. When we speak of internationally mobile capital, we solely focus on *direct investment* since it constitutes an actual production factor. This includes investment of states or multinational firms who set up factories and infrastructural resources abroad. All forms of *portfolio investment* are ignored.

In this context, the question arises from which region to which region capital is likely to flow? To answer this question it is necessary to differentiate between two different forms of capital flows: (i) private direct investment and (ii) official (state controlled) investment activities.

With respect to **private direct investment**, economic theories are rather ambiguous as to whether European economic integration will lead to capital flows from the EU into the CEEC or vice versa. When applying the *Heckscher-Ohlin Theory* and particularly the derived Stolper-Samuelson (1941) theorem, capital mobility is basically a question of factor returns. Some theoretical and empirical studies do not, however, confirm the basic results of the Heckscher-Ohlin theory. Lucas (1990 :92), for instance, provides empirical evidence that contrary to the expectations, capital does not flow from rich to poor countries and that there are hardly any income equalising effects. The traditional *Neoclassical Growth Theory* based on Ramsey (1928) and refined by Solow (1956) comes to the same results as the H-O theory. Due to the assumption of its decreasing marginal productivity (i.e. diminishing returns), capital is believed to flow into those countries which are capital scarce, i.e. the CEEC. It is precisely this assumption that is seen differently by the *New Growth Theory*, which assumes a constant or even increasing marginal productivity of capital in highly developed countries. This theory defines "capital" in a much broader sense to include human capital and knowledge (Lucas, 1988), research and development (Romer, 1990) and government investment in material and immaterial infrastructure (Barro and Sala-i-Martin, 1990) in the definition. Additionally it assumes so-called *spillover-effects* which are assumed to lead to a constant or increasing marginal productivity of capital. With respect to capital mobility, this implies that regions which are more developed (such as the EU) are not only more abundant in capital but also that their larger marginal productivity will prevent capital from flowing into lower developed regions (such as the CEEC) or even attract capital from there.

[53] See Piazolo (1998), section 2.2 for a discussion of dynamic investment modelling.

Also the *Theories of Customs Union and the Common Market* (e.g. Yannopoulos, 1990) as well as the *Theory of International Production* (e.g. Dunning, 1972) do not offer a clear answer to this question since capital movements are described as the result of complex strategic decisions by multinational firms, which are independent of overall capital endowments or productivities. Thus the flow direction of private direct investment is generally unclear and will therefore not be modelled.

In contrast to this, the direction of capital flows in the context of **official investment activities** is much more certain. Full membership in the EU will certainly entitle the CEEC to participate in the structural policy of the EU and lead to a considerable amount of official transfer payments. The manifold regional and structural policy ensures that financial aid flows from richer to poorer EU member states. Instruments of this policy are: (i) the different structural funds financed through the EU's budget, (ii) the cohesion fund also financed through EU's budget and (iii) a number of other projects which are financed by the European Investment Bank (EIB) and the European Investment Fund (EIF).[54] These resources flow into regions which have gaps in development and living standards compared with the EU average. Currently it is mainly the three southern European member states, Ireland and different structurally weaker regions in other EU countries (e.g. the "neue Länder") who benefit from this policy. With the admission of the relatively less developed CEEC, however, it is likely that large sums of EU's structural and cohesion resources will be directed towards them.[55]

We model these forms of capital transfers as shifts of capital endowments from the EU to the CEEC. As will be described in chapter five, we simulate several different scenarios concerning the amount of these transfers.

3.6.3 Recursive Dynamic Capital Formation

The successive, loop-by-loop increase in capital endowments through the previous period's investment is also a very important feature of the recursive dynamic approach. Each period's amount of investment is determined by the quantity of the Savings and Investment Good produced as we explained above. Thus the intertemporal decision making process of forward-looking, optimising firms and households or the intertemporal allocation of resources is not taken into account.[56] Intertemporal capital accumulation is given by:

EQ. 21
$$K_t = (1 - \mu_{t-1}) \cdot K_{t-1} + I_{t-1}$$

where K_t is capital stock in period t, μ is the exogenously given depreciation rate and I is investment which is determined each period by the exogenously supplied constant marginal propensity to save. The depreciation rate has been obtained from the GTAP3

54 For further details see Weidenfeld and Wessels (1997), p. 293.
55 For an estimation on nominal transfer payments see Breuss (1998), pp. 5-8.
56 See Keuschnigg and Kohler (1997) and Gaitan and Pavel (2000) for discussion and application.

dataset and is fixed to a value of 0.04 for all international regions.[57]

Capital accumulation implies a periodical update of factor endowments. As EQ. 21 displays, K_t as well as I are both values which are defined in stocks. Remember, however, from section 2.4.1 that the SAM only displays the remuneration of each factor of production and ignores actual stocks of machines etc., i.e. the SAM uses a flow concept. Thus there is an incompatibility between these two concepts which requires a so-called *"stock-to-flow conversion"*, where units of capital stocks are scaled into units of capital services. As Springer (1998 :42) explains, this is done by firstly calculating the gross rate of return on capital using benchmark data, rk_0. With information on the gross return on capital, EQ. 21 can then be rewritten to obtain the flow concept by:

EQ. 22
$$K_t^{flow} = (1-\mu_{t-1}) \cdot K_{t-1}^{flow} + I_{t-1} \cdot rk_0$$

3.7 LABOUR MIGRATION

Analysing the impact of East-West migration flows on both the EU and the CEEC is one major aim of this study. As Golder (1999) describes, free labour migration in an integrated economic area is determined by the supply (push-migration) and the demand for migrants (pull-migration) according to the following theoretical approaches.

The **Neoclassical Approach** sees migration as an arbitrage phenomenon caused by differing real wage and income levels which is larger, the greater the wage differentials are. The distance between two regions approximates to the transaction costs. Empirically, this approach has not been able to explain why, despite internationally decreasing transport costs and considerable wage differentials, only very little migration has taken place. Straubhaar (1988) as well as Malmberg and Fischer (1997) explain this contradiction with other factors representing extra transaction costs which reduce the willingness to migrate. These are *(i)* job specific aspects such as pleasant working environments or so-called *regionally specific insider advantages*, *(ii)* intertemporal expectations about future wage flows, *(iii)* imperfect information about future prospects abroad combined with risk aversion and *(iv)* expectations about possible unemployment abroad because neoclassical theory by definition excludes the possibility of unemployment due to the assumption of perfectly flexible wages.[58]

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[57] Also compare with Springer (1998), p. 39.

[58] The basic neoclassical model has been modified several times. For instance Harris and Todaro (1970) and Todaro (1980) explain rural-urban migration by dropping the assumption of full employment and assuming expected rather than effective wage differentials to be the determining variables. The Harris-Todaro model itself has also been subject to various refinements. Bhagwati and Srinivasan (1974) include wage and production subsidies, Cordon and Findlay (1975) capital mobility, Fields (1975) analyses quantity rather than price adjustments for labour, Stiglitz (1974) includes endogenous wage determination and Calvo (1978) as well as Schmidt, Stilz and Zimmermann (1994) consider the influence of trade unions.

The **Human Capital Approach**[59] understands migration as an investment decision of an agent who is assumed to calculate the discounted present value of his expected financial net profits in each region. Migration then takes place if the discounted yield abroad minus the costs of moving surpasses the discounted yield at home. The important contribution of this approach is that it catches individual preferences including a number of pecuniary and non-pecuniary factors, and agents are believed to act according to a dynamic, longer run behaviour. Extensions of this approach include asymmetric and imperfect information (Katz and Stark, 1987; Burda, 1995) or uncertainty (Bauer, 1995) explaining migration networks. Although the inclusion of individual preferences can be seen as an advantage, their empirical testability is made more difficult.

The **New Economics of Labour Migration**[60] contains several explanations. The so-called *Family Migration Approach*, for instance, interprets migration as a collective phenomenon of families or larger households who intend to minimise the risk of losing the family's income by geographically diversifying their resources, i.e. the family members. In that sense, this approach resembles modern portfolio theory. Mincer (1978) provides evidence that the size of a household and the number of gainfully employed family members influences the migration decision considerably. Using the *Relative Deprivation Approach*[61], the migration decision is thus not only dependent on wage differentials between countries but also on wage distributions within a country. Thus, the New Economics of Labour Migration is mostly applicable to situations in less highly developed countries, where the family plays a much more important role than in industrialised countries.

Migration in the context of the **Network Migration Approach**[62] is regarded more in a dynamic context. Due to social, ethnic and informational networks, risks and costs of moving for each migrant decrease.[63] Thus the probability of successful migration for each additional migrant increases, the more information from fellow countrymen exists. This also explains the observed agglomeration effects of immigrants in certain areas. A relatively new trend in this context is cross border migration within multinational companies. As Wolter and Straubhaar (1997 :4) describe, "internal migration" allows the transfer of firm-specific know-how which can be used at other locations.

3.7.1 Modelling Migration

As the presented approaches suggest, migration is determined by economic, demographic and political factors. Particularly the economic and political factors are suitable for inclusion into a CGE model. Nevertheless, each of them suggests a different way of designing migration.

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59 This approach can be traced back to Sjaastad (1962) and Becker (1962).

60 See, for instance, Stark and Bloom (1985).

61 See Stark and Bloom (1985), Stark and Taylor (1988), Stark and Yitzhaki (1988).

62 See Carrington, Detragiache, Vishwanath (1996) and Massey (1990a, 1990b).

63 This approach implies a minor direct correlation between wage differentials, official employment possibilities and migration decisions.

Politically induced migration which is fairly independent of so-called *push* and *pull* migration suggests **exogenous** modelling. Governments decide exogenously about allowing or restricting the inflow and outflow of migrants for a variety of reasons. This sort of migration is more common between countries which do not have treaties on the free movement of labour. Hence this is more the type of migration which still *currently* describes the situation between the EU and the CEEC. The corresponding way to model exogenous migration would be to assume a certain number of migrants each year, irrespective of wage differentials and other economic factors. Breuss and Tesche (1994, 1996) as well as Weyerbrock (1995) follow the exogenous approach in their CGE models.

Economically induced migration is normally dependent on a variety of economic variables; this means that all migration is modelled **endogenously**. This is the typical sort of migration we would expect in an integrated area like the EU, where there is free mobility of labour. In this context, most CGE-studies follow the neoclassical approach by solely considering *wage differentials* between two regions as the main migration-determining variable. For instance Hinojosa-Ojeda and Robinson (1991) and Hinojosa-Ojeda et al. (1995) use wages as the only explanatory variables.

Migration in this Model:

This study is particularly interested in analysing possible migration effects in an *integrated* economic area. Thus labour mobility will not be considered as an exogenous event which is determined by politicians' disposition on whether to allow immigration or not but rather as an endogenous phenomenon.

Free labour mobility between the CEEC and the EU is determined as:

EQ. 23

$$migrate_t^{CEEC,EU} = \beta_0 + \beta_1 \log\left(1 - \frac{y^{CEEC}}{y^{EU}}\right)_{t-1} + \beta_2 \log\left(\frac{UE^{EU}}{UE^{CEEC}}\right)_{t-1} + \beta_3 \log\left(MS^{EU}\right)_{t-1} + \beta_4 \log(D^{EU-CEEC}),$$

where *migrate* is the migration rate in time period t measured as a percentage of total population in the CEEC, y is per capita income in each region, UE is the unemployment rate in each region, MS is the migrant stock of CEEC citizens living in the EU, D is the average geographical distance between both regions and β_0-β_4 are the corresponding coefficients, which we will determine econometrically in the next chapter (see TABLE 12, p.92).

The explanatory variables in EQ. 23 are either determined endogenously by the CGE-model or exogenously "outside" the model. Per capita income (y) and migrant stock (MS), for instance, alter endogenously in the course of each simulation run, thereby affecting the migration rate of the next period. In contrast to this, the relative unemployment rate has been fixed at its assumed 1995 value and is treated as an exogenous dummy variable.[64] This means that its initial value does not change any more in the course of the simulations since the assumption of perfect wage flexibility prevents any variation. Likewise, the average assumed distance between the CEEC and the EU has been fixed at a value of 1500 km.

The reader may ask himself why unemployment has then been included in the equation in the first place. As we mentioned, the β-coefficients in EQ. 23 will be estimated quantitatively in Chapter 4 using an econometric model of migration. There, an exclusion of the unemployment rate is not possible since this is likely to lead to an omission bias of the other coefficients. Thus the next chapter's econometric model determines the variables and coefficients which must be contained in EQ. 23. Since our CGE-model, by definition, does not consider unemployment, we treat this variable as an exogenous parameter.

In the recursive dynamic scenarios it is necessary to adjust the values of population and of employment numbers for each loop anew:

$$employ^{t}_{CEEC} = employ^{t-1}_{CEEC} - Mig^{t-1}$$

$$employ^{t}_{EU} = employ^{t-1}_{EU} + Mig^{t-1}$$

In each loop the recursive dynamic model will influence wage levels in both regions depending on the amount of migration which has taken place in the previous period. In other words, the price of labour (i.e. wages) alters to restore the equilibrium on the labour market. The resulting new wage differentials are then taken as the basis for the endogenous migration flows in the next loop.

The specification of our CGE-model and the construction of the dataset imply several assumptions which should be remembered in the context of discussing the issue of migration: (i) we only consider migration from and into aggregate areas. Thus no particular form of subregional migration patterns can be observed. (ii) Once migrants enter the immigration region they are believed to be perfectly mobile within the region (as domestic workers). (iii) Immigration often permits the exploitation of economies of scale which cannot be considered by our model since we assume constant returns to scale. (iv) Immigration can lead to an increase in the receipts and/or expenditures of governments. Since we assume a constant government share in total output, we neglect this point. (v) We ignore the fact that immigrants can also bring capital into the immigration region and ignore all forms of remittances. (vi) We assume that all migrants leave the labour market at home and enter the labour market in the immigration region.

[64] For the EU and the CEEC we determined an average unemployment rate of 10,5% and 15% respectively.

3.7.2 Skill Categories of Labour

One of the purposes of this study is to give special attention to a phenomenon called the *"brain drain effect"* which has been examined in detail by Straubhaar and Wolburg (1998). It stresses the idea that the emigration of highly skilled workers, i.e. of workers with managerial and special technical skills, is damaging the emigration economy since they can hardly be replaced.

To include the idea of this brain drain effect and to study the special interaction and mutual interdependence between skilled and unskilled labour, we assume that there are two types of labour in the economy: *skilled* and *unskilled*. The substitutability between skilled and unskilled workers is assumed to be zero (Leontief technology) which means that unskilled people cannot substitute their skilled colleagues and vice versa (skilled workers normally do not want to substitute less skilled workers).

There are obviously a lot more different skill levels in reality. The *International Standard Classification of Occupations* (ISCO-88)[65] differentiates between 117 occupations with different skills which are structured into 10 broader categories. Depending on the aim of an analysis, these categories are more or less aggregated.

The differentiation into two different skill categories confronts us with a problem in the actual simulations. All coefficients used in Eq. 23 only consider employment in general. Differentiation of the coefficients into skilled and unskilled migrants, incomes, unemployment rates, etc. would, however, be necessary. Unfortunately, such diversified data does not exist so that the estimation of different coefficients is not possible. For this reason we assume that all coefficients are equally valid for both skill categories. This implicitly means that skilled and unskilled workers have similar migration propensities. In sensitivity analyses we will later relax this strict assumption and test the model with differing migration coefficients for each skill level.

3.7.3 Income Ratio of CEEC Workers in the EU

Eq. 23 suggests that workers from the CEEC move into the EU mainly for economic reasons. The principal variable in their decision to migrate or not is the expected income abroad. Only if income in the EU surpasses income in the CEEC are workers willing to bear the transaction costs of moving. This implies that the economic situation of migrants is assumed to improve after migration. An important question in this context is how strongly migrants' income will increase, because their income level constitutes the overall production costs and the aggregate income of the RA. Will workers originating from the CEEC earn seventy, eighty or hundred percent of the income of their EU-colleagues? On the one hand, experience from the German *"Gastarbeiter"* phenomenon in the 1960s seems to suggest that the relative wage of foreign employees in the EU rises with their skill level. Thus, whereas blue collar workers are likely to work for much less than their western European counterparts, white collar employees are likely to get closer to the average EU income. On the other hand, we know that contrary to white collar salaries, blue collar wages are often determined by general pay agreements

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[65] ISCO-88 is one of the main international standards provided by the International Labour Organisation.

which are negotiated between employer organisations and trade unions. Such pay agreements certainly do not take account of a worker's country of origin.

Unfortunately there is only very little empirical work on this issue. Although Golder and Straubhaar (1999: 25) provide evidence with respect to the income distribution of foreigners and natives in Switzerland, their findings are not applicable to our study since they differentiate between several earnings levels without consideration of skill levels. Therefore we are forced to answer this question hypothetically: we assume that wages and salaries are paid irrespective of the geographical origin of a worker. Hence as soon as a CEEC-migrant moves into the EU and gets a job, we believe that he will earn 100% of his EU colleagues' remuneration. This assumption will later be checked in a sensitivity analysis.

In our CGE model, migration is simulated as a shift of labour endowments from eastern to western Europe. Hence, for the CEEC the labour endowments including emigration are defined as:

EQ. 24
$$W_{lc,t}^{CEEC} = \left(1 - migrate_{t-1}^{CEEC,EU}\right) \cdot W_{lc,t-1}^{CEEC} ,$$

where W is the endowment of labour category lc, involving skilled and unskilled labour and all other variables are defined as previously. The corresponding labour endowments in the EU under the assumption of full wage adaptation of CEEC-workers are then determined by:

EQ. 25
$$W_{lc,t}^{EU} = W_{lc,t-1}^{EU} + \left(\frac{y^{EU}}{y^{CEEC}}\right)_{t-1} \cdot migrate_{t-1}^{CEEC,EU} \cdot W_{lc,t-1}^{CEEC} ,$$

where the term in brackets ensures that income of CEEC migrants adapts to the EU level.

3.8 Model Closure

Besides the *zero-profit condition* which has been presented throughout the representation of the model, the MC-format also requires that the market-clearance and the income-balance conditions be met (recall section 2.3.2).

3.8.1 Market Clearance

The *market-clearance-condition* ensures that all factor and goods markets are cleared, i.e. that demand for a commodity is less or equal to supply. In our case this implies that within each region we have market-clearance conditions for domestic output, imports, exports, Armington aggregate supply and primary factors. Hence there are quite a few market-clearance equations implicitly contained in this model. We shall abstain from illustrating them and refer to their illustration in the Appendix.

3.8.2 Income Balance

The last equilibrium condition next to zero-profit and market-clearance which needs to be fulfilled is the *income-balance-condition*. It needs to be met for the income and expenditure of the RA. It also plays an important role in the so-called *model closure*, i.e. in making sure that the circular flow of income among the economic actors is completely determined and does not contain any "leakages".

Income balance for the RA is easily followed. Total disposable income (which must equal expenditure, *Exp*) is composed of income from the supply of production factors (skilled and unskilled labour, capital and land), tax revenue, and the current account balance:

Eq. 26

$$
\begin{aligned}
Exp_r = & \sum\nolimits_f p^F_{fr} F_{fr} && \text{factor income} \\
& + \sum\nolimits_i t^Y_{ir}\left(p^D_{ir} D_{ir} + p^X_{ir} X_{ir}\right) && \text{indirect taxes} \\
& + \sum\nolimits_{ij} t^{ID}_{ijr} p^{ID}_{ir} Y_{jr} a_{ijr} && \text{taxes on intermediate goods} \\
& + \sum\nolimits_{fi} t^F_{fir} p^F_{fr} FD_{fir} && \text{factor tax revenue} \\
& + \sum\nolimits_i t^G_{ir} p^{GD}_{ir} GD_{ir} && \text{public tax revenue} \\
& + \sum\nolimits_i t^C_{ir} p^{CD}_{ir} CD_{ir} && \text{consumption tax revenue} \\
& + \sum\nolimits_{is} t^X_{irs} p^X_{ir} M_{irs} && \text{export tax revenue} \\
& + \sum\nolimits_{is} t^M_{isr}\left(p^X_{is} M_{isr}\left(1+t^X_{isr}\right) p^T T_{isr}\right) && \text{tariff revenue} \\
& \pm p^C_n B_r && \text{current account balance}
\end{aligned}
$$

where all variables are defined as before, F is factor supply, and B is the current account balance.

The last variable may in fact constitute either a source of income or expenditure. It depends on the visible balance of the current account which is a part of the balance of payments of one country vis-à-vis the other regions. This can be explained by looking at the following well-known macroeconomic identity:[66]

Eq. 27 $$Y_r = CD_r + I_r + GD_r + X_r - M_r \quad \text{and} \quad Y_r = CD_r + S_r + TAX_r \ ,$$

where Y is national output, *CD* is private consumption, *I* is private domestic investment, *GD* is government spending, *X* is exports, *M* is imports, *S* is private domestic savings

[66] Compare with Heffernan and Sinclair (1990), p. 207. Interest expenditures (receipts) on foreign debts (credits) are not considered.

gross of depreciation and *TAX* is taxes, all expressed in aggregate real terms. Under the assumption that TAX = GD (government income balance) it follows that:

EQ. 28 $$\underbrace{X_r - M_r}_{CA} = S_r - I_r \quad \text{when} \quad TAX = GD.$$

If a country runs a current account (CA) surplus (exports > imports), its overseas claims will be larger than its liabilities so that according to EQ. 28, domestic savings will surpass domestic investment. Accordingly, a deficit (exports < imports) implies that foreign assets have increased at home because domestic savings are below domestic investment.

For the income of the RA the current account balance therefore represents foreign lending or borrowing. In this setting we ignore all interest claims or liabilities which would normally come about in this context. Thus the income/expenditure balance of the RA is assured by the trade balance and vice versa.

Within the budget constraint of the RA, foreign borrowing constitutes an endowment so that the current account balance in nominal terms must be defined as:

EQ. 29 $$B_r = \sum_i p_{ir}^M M_{ir} - \sum_i p_{ir}^X X_{ir}$$

Finally, the world's budget constraint must also be in equilibrium. Since world's exports have to equal world's imports, it is obvious that all regions' current accounts have to sum up to zero:

EQ. 30 $$\sum_r B_r = 0$$

3.9 THE DATA

The data used in our CGE application are provided by the *Global Trade Analysis Project* (GTAP) of Purdue University, USA. This is a consortium which focuses on the application of general equilibrium analyses and on the provision of balanced CGE datasets. For our studies we applied the most recent dataset available: the Version 4 database contains detailed bilateral trade, transport and protection data which characterises economic linkages among regions and is linked together with individual country input-output databases which account for intersectoral linkages among the 50 sectors within each of 45 regions. All monetary values of the data are in $US millions and the base year for Version 4 is 1995. The dataset is described in detail in McDougall et al. (1998).

3.9.1 SECTORAL AND REGIONAL AGGREGATION

From the very detailed GTAP4 database it is necessary to carry out regional and sectoral aggregations to analyse the questions at hand. It would, for instance, not be useful for us to work with all 45 regions and 50 sectors when studying the interaction between CEEC and the EU.

TABLE 3 provides information on the sectoral and regional aggregation which has been undertaken in this study. There are eight sectors of production and one Savings and Investment Sector which catches the domestic savings and investment decision of each region. Production sectors were created by clustering the 50 different commodities into eight different groups. This was done with the motivation to obtain a representative but not too detailed reflection of the economic structures in the different regions. In aggregating we tried to minimise the so-called *aggregation bias*. This kind of bias can occur if distortions do affect only a few of all aggregated commodities within one sector.

TABLE 3: SECTORS AND REGIONS

Sectors	Regions
- Agriculture (Agri)	- ROW: Rest of the World.
- Minerals and Energy (Ener)	- EU: European Union: EU-15.
- Food and Clothing (Fo & Cl)	- CEEC: Central and Eastern European Countries: Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia, Slovenia, Estonia.
- Manufacturing (Manu)	
- High-tech sector (Htech)	
- Private services (Pr.serv)	
- Transport services (Trans)	
- Public services (Pu.serv)	
- Savings and Investment Good (S&I)	

With respect to the regions, we work with three international blocks as TABLE 3 describes: the central and eastern European Countries (CEEC), the countries of the European Union (EU) and the rest of the world (ROW). The regional aggregation has partly been deliberately chosen, partly it is pre-determined by the GTAP4 dataset. The aggregation of the CEEC, for instance, is pre-processed and cannot be broken down by the user. The EU could have been disaggregated into the Scandinavian countries, Germany, the United Kingdom and the Rest of the EU.[67] For reasons of clarity and presentability of results and since the usefulness of the permitted degree of disaggregation by the GTAP4 dataset is limited, we abstained from disaggregating the EU.

We are aware of the fact that aggregations on the basis of both sector and region imply a form of simplification which assumes a completely even distribution of potential

[67] Compare with McDougall et al. (1998), table 8-2.

effects. An aggregated EU block does not, for instance, express anything about how costs and benefits of enlargement are shared out among the various member states. Thus our analysis is completely restricted to the overall effects and ignores all questions of political distribution.

3.9.2 Participation Rate and Skill Levels

The differentiation into skilled and unskilled labour was based on the *International Standard Classification of Occupations* (ISCO) provided by the ILO.[68] The occupational split which has been used is summarised in Table 4.

The GTAP4 dataset provides information on aggregate labour payments by skill level. Unfortunately, it does not provide data on the labour force (in absolute numbers) and the amount of people who are actually employed as skilled or unskilled workers in each region. Thus labour payments *per* worker for each skill category (i.e. aggregate labour payments / employed workers) cannot be calculated from the GTAP4 dataset. This latter variable, however, is an important proxy for the (differing) wage levels in both regions (CEEC and EU) which is required to calculate the migration potential between eastern and western Europe.

Table 4: The Classification of Workers by Occupation

Professional workers (Skilled Labour)
ISCO 1: managers and administrators (including farm managers)
ISCO 2: professionals
ISCO 3: para-professionals
Production workers (Unskilled Labour)
ISCO 4: tradespersons
ISCO 5: clerks
ISCO 6: salespersons and personal service workers
ISCO 7: plant and machine operators, and drivers
ISCO 8: labourers and related workers
ISCO 9: farm workers

Source: Own table after McDougall et al. (1998), p. 18-8.

We eliminate this deficiency by collecting and calculating statistics on the total labour force and the number of workers employed under each skill level for every region. These are then combined with the information contained in our GTAP4 aggregation. Table 5 displays the information. Data on the labour force, as a percentage of population, is easily available. On average, the labour force participation rate is 46% on the EU-labour market, whereas it is 49% in case of the CEEC. Information concerning the skill levels, in contrast, is only available for the EU. Following the definitions in

[68] For further details see McDougall et al. (1998), chapter 18.

TABLE 4, 32% of all employees in the EU can be regarded as skilled and 68% as unskilled.

For the CEEC we have to follow a more complicated approach. We analyse their enrolment in first level, second level and post-secondary education and try to deduce the skill distribution from that. Enrolment in most educational levels can easily be related to skill levels. Enrolment in *post-secondary* education, for instance, can be assumed to lead to a skilled job afterwards. Likewise, *no schooling* and *first level* education will most likely result in an unskilled job. *Second level* enrolment, in contrast, is difficult to relate. Since its share is rather large (54%) we do not want to assign it to either one skill group. We therefore split this group up according to the average skill ratios observed for the three southern European countries (SEC), i.e. Greece, Portugal and Spain. This implies that 24% of the labour force in the CEEC are assumed to be skilled and 76% are believed to be unskilled.

3.9.3 TRADE PROTECTION AND SUPPORT

The GTAP4 dataset provides detailed data on the average level of import tariffs and estimated agricultural export and output subsidies.[69]

Protection data for our special aggregation have been calculated by taking average values of applied tariff rates by commodity and import region and aggregating them using trade-weights. In the case of agricultural products, where non-tariff-barriers have played a very important role in the past, the GTAP4 consortium has made use of direct and indirect estimates which were derived using OECD data and protection information from the GTAP3 dataset.

Output subsidies to agriculture are based on *producer subsidy equivalent* calculations performed by the OECD for the year 1995. These subsidies play an important role in the EU. The *Common Agricultural Policy* (CAP) of the EU leads to a system where a large share of farmers' revenue comes directly from price protection measures on EU-markets. Information about export subsidies has been derived from computations on the basis of price comparisons for exportables between domestic market price and world price.

[69] For a detailed description see McDougall et al. (1998), chapters 4, 13.

TABLE 5: TOTAL LABOUR FORCE AND OCCUPATION BY SKILL LEVELS[70]

	Population (millions)	Labour force % of pop.	Skilled labour % of labour force		Unskilled labour % of labour force	
			ISCO 1-2	ISCO 3	ISCO 4-5	ISCO 6-9
Austria	7,9	46	13,6	14,1	28,1	44,3
Belgium	10,0	41	23,8	10,4	29,4	36,3
Denmark	5,2	57	17,2	17,5	29,7	35,6
Finland	5,1	52	n.a.	n.a.	n.a.	n.a.
France	57,5	44	14,6	18,5	29,5	37,5
Germany	80,9	50	14,3	19,5	25,7	40,5
Greece	10,4	42	17,1	8,8	32,3	41,7
Ireland	3,5	37	25,6	4,1	35,3	35,0
Italy	57,1	43	11,7	13,9	28,5	45,8
Luxembourg	0,4	37	16,0	14,6	28,5	41,0
Netherlands	15,3	46	21,7	18,2	27,7	32,4
Portugal	9,8	49	9,8	13,4	29,9	46,9
Spain	39,5	41	13,9	8,4	27,9	49,8
Sweden	8,7	54	n.a.	n.a.	n.a.	n.a.
U. Kingdom	57,9	50	28,9	8,0	34,0	29,1
Weighted total	**369**	**46**	**18**	**15**	**29**	**39**
			32		**68**	

Sources: EUROSTAT Labour Force Survey 1995, provided by Eurocadres at http://www.etuc.org/eurocadres/who/3b-01.htm
UN Human Development Report 1996, tables 16 and 32.

	Population (millions)	Labour force % of pop.	Education enrolment: Post secondary % of pop.	Second level % of pop.	First level % of pop.	No schooling % of pop.
Bulgaria	8,9	51	15,0	35,7	44,4	4,7
Czech Rep.	10,3	53	8,5	58,6	31,4	0,3
Estonia	1,6	54	13,7	45,1	39,0	2,2
Hungary	10,2	46	7,0	80,6	11,2	1,3
Poland	38,3	49	7,9	47,8	42,8	1,5
Romania	23,0	46	6,9	63,2	24,4	5,4
Slovakia	5,3	51	9,5	50,9	37,9	0,7
Slovenia	1,3	49	10,4	42,4	45,1	0,7
Weighted total	**99**	**48**	**8**	**54**	**33**	**2**

Sources: UN Human Development Report 1996, tables 16 and 32.
Own calculations from UNESCO Statistical Yearbook 1998, table 1.3.

[70] NB: Because of country-specific settings in the spreadsheet program, the figures in the following tables use a comma as decimal separator.

3.10 The Model's Predictive Value: Critical Remarks

3.10.1 The Time Horizon

An important issue in the context of CGE-models concerns the time between two states of equilibrium. Unfortunately, it is extremely difficult to provide a precise answer to this question. If reality strongly resembled theory, economists would just have to observe a moment of general equilibrium, wait until the economy was shocked and count the years until the next state of equilibrium was reached. The inter-equilibrium time could then be determined easily. The first problem is that a state of general equilibrium in a real economy is something which is not easily identifiable, as there are always certain variables which are not in equilibrium. Unemployment, for instance, is an indication that demand does not equal supply on the labour market. Does the observation of a clear disequilibrium phenomenon such as unemployment imply a general disequilibrium (i.e. the economy is still on the way to the next state of general equilibrium) or just a local disequilibrium which can exist simultaneously within a general equilibrium? Secondly, assuming that we could identify a state of general equilibrium, there is the problem that economies do not tend to experience one clear shock every couple of years which could be used for the observation. In a way, economies are under successive, constantly changing shocks and there are all kind of rigidities with the corresponding effects on the markets.

Perhaps we could proxy the time horizon of a CGE model by analysing how flexible all kinds of prices are. After all, price flexibility ensures the next equilibrium. It is generally accepted nowadays that prices are sticky in the short-run and flexible in the long-run. But how much time does it take to reach the long-run? Harrison et al. (1997) argue that "[...] the model assesses an adjustment of about 10 years [...]"[71] without providing an explanation for their perception.

Thus, the question concerning the time horizon has to be answered insufficiently using GE theory and remains a starting point for criticism. Due to this uncertainty with respect to the time horizon we are forced to employ a reasonable assumption. We assume a periodical length of about one year because: (i) the migration parameters reflect annual migration rates, (ii) we only focus on short-run static CGE-effects and neglect all long-run dynamic effects and (iii) the amount of investment in the GTAP4 dataset only relates to one year, 1995.

3.10.2 Theory vs. Reality

Discussion of the time horizon leads to another general issue: the question as to whether a CGE-model does a good job in reflecting reality. Critics argue that states of general equilibrium simply do not exist in reality, and nobody has been able to prove that they are wrong. This is so because equilibrium theory and applications tend to follow economic logic rather than empirical demonstrability. All ideas which are found in CGE

[71] Harrison et al. (1997), p. 1408, footnote 2.

models, such as market clearing, price adjustments or utility maximising agents, are details which are not only advocated by general equilibrium modellers but are also part of unquestionable basic economic theory which dates back to Adam Smith, David Ricardo and Léon Walras. General equilibrium theory just combines these mostly accepted elements to a model of the whole economy. Of course, certain forms of intervention require special consideration in the model because they are not compatible with standard economic theory. It is precisely the task of modellers to identify these elements and take them into account.

Another mistake which is commonly undertaken by economists is that simulation results are taken too literally. If results do not coincide with the real development, CGE models are accused of being wrong. In this context it is important to point out that policy analysis using CGE models always requires the use of the ceteris-paribus assumption in one or the other form. On one side this assumption is very helpful since it ignores all other potential influences in the analysis therefore being inevitable for a modeller. On the other side one should keep in mind that it can also be very restrictive and partially unrealistic. In our study, for instance, neither the monetary sector nor the adaptation process of the CEEC nor questions of distribution of costs and benefits within each region are considered. Therefore it is important to remember that CGE models cannot foretell the whole future. They are only capable of showing up tendencies when answering a clearly identified and restricted question. Eventually, a convinced CGE user should perhaps claim that a general equilibrium does in fact exist and then ask any opponent to disprove this claim.

3.10.3 Model Structure and Policy Question: Compatible?

A third point which is often seen critically is the compatibility of the employed model to the political question being analysed. Since same or similar CGE models are often applied in a number of different fields, critics may argue that the model was originally designed to analyse other issues than the one on which the researcher is focusing. In our particular case the question may therefore arise as to whether the GTAP-in-GAMS model which served as our model of orientation is useful for the question of EU-CEEC integration.

CGE-models in general do not have an exclusive field of research to which they must strictly adhere after they have been designed. In fact, a CGE model can analyse all those questions which the SAM – and hence the model structure too – incorporates. As we explained previously, we apply the model in order to study the effects of trade integration (tariff and NTB reduction) between the EU and the CEEC and then factor mobility according to our assumptions. These policy experiments are caught by our model structure so that the compatibility between model and policy question must be answered positively.

Besides the main model structure which is pre-determined by the SAM, it may be necessary to additionally incorporate special characteristics of individual regions into the model. On the one hand, this is ensured through the calibration process. As explained in the previous chapter, calibration "tailors" the model to any individual region by determining the specific shift and share parameters for the region. On the other hand, modellers additionally have the choice between constant or increasing returns to scale and whether perfect or imperfect competition should be assumed, a question which we have already answered in section 3.3.2.

We would like to recall in this context that a modified version of the model has been applied in other studies concerning international integration. Harrison et al. (1995, 1996b, 1997), for instance, studied the effects of world-wide trade integration, and Hertel et al. (1997) as well as Brockmeier et al. (1998a) apply a similar model to questions of CEE integration. Their *GTAP-model* is based on the same dataset but uses a different programming language.[72] Hence the model seems to be well-suited for the present question.

3.11 SUMMARY

This chapter has provided a non-technical description of the computable general equilibrium model which we use for our policy simulations and which is based on the so-called *GTAP-in-GAMS model*. It is also similar to the *Uruguay model* applied in Harrison et al. (1995, 1996b, 1997). It is a comparative, recursive dynamic, open economy model with nine sectors of production and three international regions: The EU, the CEEC and the ROW. The predominant part of the model is comparative static. The recursive dynamic part models capital transfers, labour migration and intertemporal capital formation.

Production occurs according to a nested production function at constant returns to scale. Each sector and region uses different technologies due to varying calibrated shift and share parameters. Prices and quantities on the goods markets are assumed to be fully flexible in order to clear the markets. Factor markets are initially characterised by fixed endowments as well as perfect factor mobility inside a region but international immobility. Factor prices are also assumed to be fully flexible. In the course of our simulations, we allow for international capital and labour mobility and endowment changes.

Demand is characterised by households maximising utility subject to a budget constraint. Although there are two types of consumers, i.e. public and private households, overall wealth is measured using a Representative Agent who is a combination of both household types. The government share in total output is assumed to be constant. The RA earns income through the provision of productions factors (private income) as well as through the collection of taxes and tariffs (public income). Expenditure occurs for consumption and investment.

The most important link between different international regions is through trade in goods, except for the Savings and Investment Good which is non-tradable. Imports and exports are modelled according to the Armington assumption which assumes that domestic and foreign goods are imperfect substitutes. Tariffs and NTB hinder free trade in the benchmark equilibrium.

[72] Section 5.7 discusses other CGE studies of CEE integration more in depth.

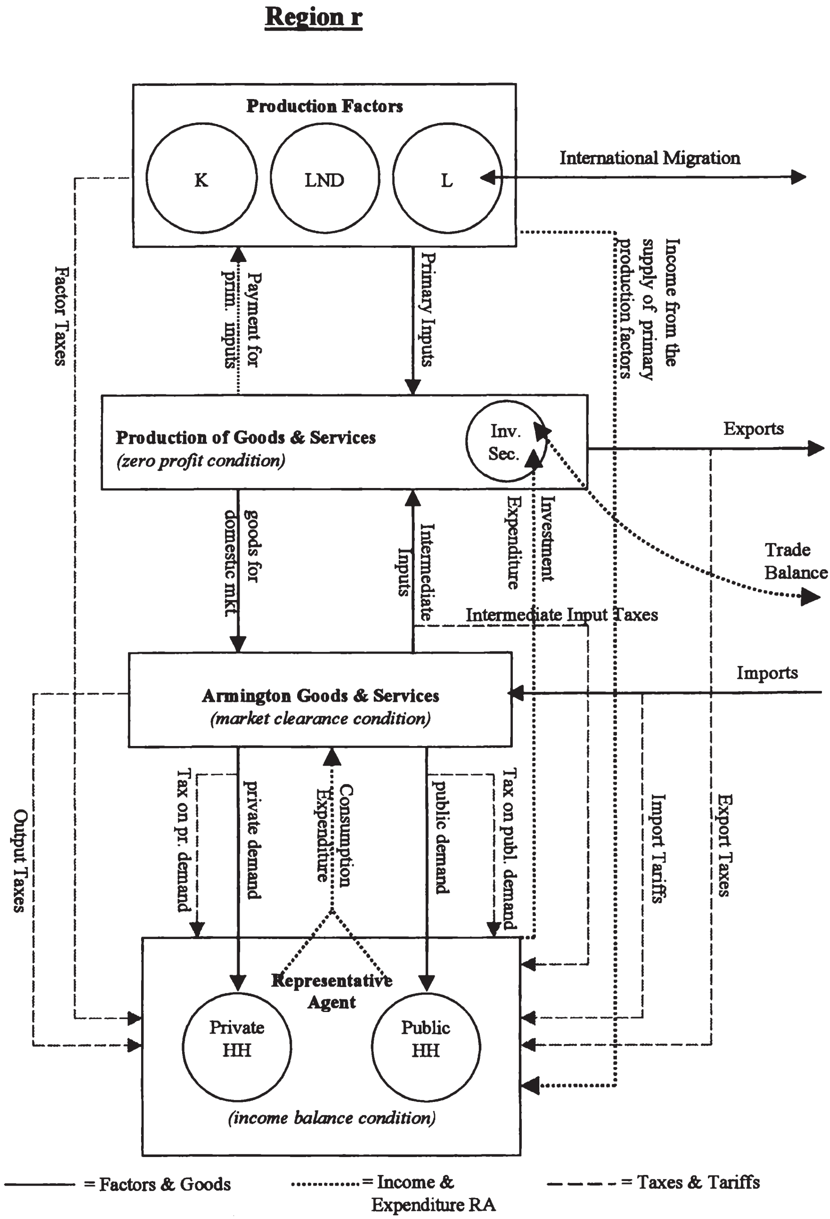
Real investment takes place according to an exogenously provided marginal propensity to save. If domestic investment deviates from domestic savings, the current account surplus or deficit ensures that income balance is achieved and the model is cleared. Capital transfers from West to East are simulated. In the recursive dynamic run, the current period's investment is assumed to lead to real capital formation with an increase in the next period's capital endowments.

International labour migration is modelled according to the migration parameters estimated in Chapter 4. We differentiate between skilled and unskilled labour which are both characterised by the same migration propensities and which are assumed to be non-substitutable. Workers who migrate are believed to earn the same level of income as their domestic colleagues.

We apply our own aggregation of version 4 of the GTAP dataset which benchmarks the model to the year 1995. Hence all policy simulations compare a counterfactual scenario with the original equilibrium in 1995.

This model is used to evaluate some of the components and characteristics of the eastern enlargement of the EU. Purely dynamic effects are neglected. Finally, the model is not capable of foretelling the future but should be seen as a device to quantify a few carefully identified policy experiments. The algebraic description of our model is provided in the Appendix.

FIGURE 5: GRAPHICAL DESCRIPTION OF THE STATIC MODEL



4 Estimating the Amount of Potential CEEC-EU Migration: Lessons From the South

4.1 Introduction

The analysis of free labour mobility between the CEEC and the EU using a CGE-model is one central aspect of this study. For this reason it is necessary to undertake an estimation of the quantity and the direction of potential labour migration which would take place if all barriers to the free movement of people between the East and the West were abolished. It is our special aim in this chapter to estimate the important migration coefficients which are used in Eq. 23 of our CGE-model.

We will undertake such a quantification by looking at EC's past experience namely the admission of the southern European countries (SEC) Greece, Portugal and Spain. Looking at their migratory pattern after accession to the common market, we can derive important knowledge for the potential mobility of labour in context of the eastern enlargement of the EU. The other integration elements, i.e. free trade and capital transfers are not covered in this chapter.

In the second section of this chapter we will briefly discuss the benefits and criticisms of an analogy between SEC and CEEC. A third section will describe the performance of migration and the two most important migration determinants. Thereafter we will analyse the migration performance in the context of the southern enlargement of the EC. The fourth section focuses on a graphical representation of South-North migration and is complemented by the fifth section which presents an econometric assessment. In a sixth section we will translate the estimated parameter values to conduct extrapolations with respect to potential CEEC-EU migration. The seventh section summarises.

4.2 Southern and Eastern Europe: Analogies?

To quantify CEEC-EU migration flows we will adopt the method of extrapolation. Strictly speaking, extrapolation means the approximation of a function value outside an interval by using knowledge about the function value inside this interval. In practice this means that scientists for instance look at the past behaviour of a variable in order to deduce its future pattern. Often, however, there is no knowledge about past behaviour at all. This is the case in the context of our analysis. A free movement of labour between the CEEC and the EU has never taken place. It is thus impossible to project from past experience what the future will look like. This deficiency may justify the use of a different form of extrapolation namely one where we look at the experience made with the southern EC enlargement process and consider it to be representative for the potential eastern enlargement.

Despite the practicality of a South - East analogy, its weaknesses should also be mentioned. First of all, the clustering of both regions, i.e. southern as well as CEE, strongly neglects historical and peculiar bilateral migration patterns. Secondly, any form of time specific circumstances are not considered. We could for instance imagine a generally decreasing migration propensity with the progressing velocity of globalisation, i.e. trade and capital mobility. Thirdly, an analogy implies treating the migrants from the CEEC in the same way as the migrants from the SEC. Thus regionally specific characteristics are ignored. It is possible that a different degree of proximity as well as contrasting cultural ties to the EU imply distinct migration performances within both regions. There are also other differences which can be found when comparing these two groups of countries. The CEEC have, for instance, been undergoing a transformation process from centrally planned to market economies which is unique in history. This obviously places an extra burden on the CEE economies which is not considered in a potential South - East comparison.

Despite these differences there are, however, important similarities, particularly from a political and historical perspective. Firstly, as Straubhaar and Wolter (1996: 273) and Straubhaar (1998: 150) point out, the political environment prior to democratisation was strikingly similar. Before the application for admission to the EC/EU could occur, both the SEC as well as the CEEC experienced dramatic political changes. Dictatorships had to be overcome and democracies were established thereafter. Greece and Portugal, for instance, only democratised in 1974 and Spain was only able to open up after the death of General Franco in 1975. Hence, political transition has not been a peculiarity of eastern Europe alone. Secondly, there is a rather strong correspondence between the southern and the eastern enlargement with respect to the political discussion concerning immigration flows into the EC/EU. The debate in both cases was or is dominated by a strong fear of uncontrolled immigration from the new member states. This explains why the issue of labour mobility is given highest importance on the agenda of current enlargement negotiations. Thirdly, the SEC were also economically far behind when their applications for EC-membership were submitted. Despite other economic differences, in this respect the CEEC' situation relates considerably to the past experience.

Thus, "of course it is, and remains, speculation as to how far the empirical experiences of EC's Southern enlargement are relevant to EU eastern enlargement."[73] Nevertheless, the southern enlargement of the EC is still the most suitable and similar example of economic integration which exists and shall therefore be the basis for the following descriptive as well as quantitative analysis.

4.3 Migration, Income and Unemployment: A Descriptive Analysis

In the previous chapter we presented the different theoretical approaches which seek to explain the phenomenon of migration. The factors which determine the degree of

[73] Straubhaar and Wolter (1996), p. 275.

mobility reach from simple wage expectations to more sophisticated factors such as job specific aspects, attitudes of migrants towards risk, job finding probabilities etc. The problem with most of these theories is that their practical, i.e. empirical use is rather limited. Thus, when it comes to empirical work, only few statistically available variables remain. The following descriptive analysis will sketch the dependent (i.e. migration flows) and independent variables (i.e. migrant stocks, income and unemployment). We will illustrate their pattern in the CEEC and compare it with the performance in the SEC in order to identify similarities and differences between both regions.

4.3.1 MIGRATION FLOWS

How has East-West migration developed since the fall of the iron curtain and does that performance differ from the South-North migration pattern? A comparison of the annual flow of migrants between the EU and the CEEC as well as the Southern-EU member states yields first insights into similarities between the two regions. TABLE 6 displays migration flows which are divided into immigration, emigration and net migration. Both absolute numbers of migrants as well as percentage values of total population are presented.

The first observation is that the mobility of people between the EU and the CEEC is rather large. What is surprising is that it is even larger than the amount of migration taking place between the EU[74] and the southern EU-member states Greece, Portugal and Spain. The data reveal strong immigration and emigration from and to eastern Europe. Net migration figures also show that with the exception of 1993 and 1994 more people have been immigrating from the CEEC than from southern Europe. A look at percentage values (displayed below the absolute numbers) mainly confirms these findings: in the CEEC a greater percentage of total population has migrated compared with the ratio of the SEC. At first glance, this result is rather surprising. After all, it is Greece, Portugal and Spain who, in contrast to the CEEC, have had the possibility of free mobility since 1988 for the former and 1993 for the latter two. So, why do we observe moderate migration flows in those countries which have had the chance to move freely inside Europe? Or putting it differently, why have so many citizens from the CEEC had the chance to move into the EU already?

Firstly, migratory movements, particularly with respect to CEEC, have been mainly influenced by one single EU country: Germany. In the time period of our study, 78% of all net EU immigration stemming from the CEEC went into Germany. In contrast to most other EU member states, Germany has signed several, large-scale bilateral immigration treaties (Werkverträge: seasonal working permits). Its geographical position in the centre of Europe, its economic size and its special political and historical role with respect to the CEEC have led to this rather liberal immigration policy resulting in a disproportionately high influx of eastern Europeans.

[74] In this context "EU" refers to all EU-member states except Greece, Portugal and Spain.

TABLE 6: MIGRANT FLOWS TO AND FROM EU (IN 000'S AND IN % OF EMIGRATION COUNTRIES' POPULATION)

	1990	1991	1992	1993	1994	1995
			Immigration to EU			
CEEC	226,2	162,3	347,9	220,9	148,5	148
% of pop	0,23	0,17	0,36	0,23	0,15	0,15
Gr, Por, Sp	45,4	51,8	47	44,1	58,2	64,2
% of pop	0,08	0,09	0,08	0,07	0,10	0,11
			Emigration from EU			
CEEC	166,6	130,3	220,2	272,2	154,8	129,5
% of pop	0,17	0,13	0,23	0,28	0,16	0,13
Gr, Por, Sp	27,1	31	31,3	34,8	47,2	51,6
% of pop	0,05	0,05	0,05	0,06	0,08	0,09
			Net Migration to EU			
CEEC	59,6	32	127,7	-51,3	-6,3	18,5
% of pop	0,06	0,03	0,13	-0,05	-0,01	0,02
Gr, Por, Sp	18,3	20,8	15,7	9,3	11	12,6
% of pop	0,03	0,04	0,03	0,02	0,02	0,02

Note: Data on CEEC countries only for: former CSFR,H,PL,SLO,BUL,ROM
Data on EU countries only for: B,DK,F,D,LUX,NL,S,GB

Source: OECD: International Migration Statistics Database, 1997

Secondly, in the first years of transition, the CEEC have still been experiencing political but above all economic instability. The change from planned to market economies implied dismissals, unemployment and poverty for many citizens. The resulting consequence has surely been the search for a temporary job in western Europe. In other words, the EU has experienced a larger degree of push migration from the East than from the South which has surely also influenced the degree of permeability of the EU-CEEC border. *Thirdly*, there might have been something we can call the "panic argument". This point also advocated by Straubhaar (1999: 96) suggests that people's immigration is lower and their repatriation larger if permission to enter and leave a foreign country in the future is not restricted. If immigration is believed to be allowed for a certain time period only (restricted permission), potential immigrants will panic and try to make sure they are in this migration wave. The argument resembles the situation of panic-buying of goods which are believed to be in short supply in the future. Since immigration policy towards CEE-citizens was rather uncertain in the first years of transition, many eastern Europeans tried to enter the EU before the doors were shut once and for all. *Finally*, the smaller stock of CEE immigrants (which will be covered in the next section in more depth) might have played a certain role in the comparably strong migrant flows. Following the family migration approach, small migrant stocks (such as that of the CEEC in the EU) will lead to relatively strong temporary migration flows since not many families in the emigration country have achieved to position one family member as an income provider abroad. The migrant stock of the SEC might in this respect reflect some form of saturation.

All in all, it is not unusual for considerable migration movements to take place between countries or regions whose labour markets are not officially integrated. Thus, the large amount of EU-CEEC migration movements should not really surprise us. As section 4.4 will demonstrate in greater detail, Spanish, Greek and Portuguese guestworkers also had a long tradition of living and working in northern Europe prior to the accession of these countries to the EC.

4.3.2 MIGRATION STOCKS

Migration theory often stresses the importance of people's networks in the destination countries. As TABLE 7 illustrates, in 1995 approximately 740'000 people originating from the CEE-transition economies lived inside the EU. It is likely that this number underestimates the real number of CEE residents. Although provided by the OECD it is, for instance, hard to believe that Austria does not have any residents originating from its direct neighbours, Hungary and Slovenia. Also excluded from this dataset are those CEE ethnic groups who have double citizenship and hold an EU passport. Although these people are EU citizens in the legal sense, they usually still have strong cultural ties to their home regions and contribute considerably to the aforementioned network effects.

We also calculated the ratio of migrant stocks in the EU to population of the emigration regions for the year 1995. For the CEEC we obtained a value of approximately 0.8% compared to a much larger ratio of 3% for the SEC which has been fairly constant in the 1990s. Interestingly, the SEC started from a comparably low level prior to their accession. In 1980 approximately only 1% of SEC' population lived in the Northern-EC member states.[75] Our calculations confirm earlier observations by Layard et al. (1992). They argue that immigration from the CEEC will in the long-run generate a migrant stock in the EU which will be similar to the 3% ratio observed in the context of the southern European experience.[76] Thus, on the basis of the current population in the CEEC, this would imply a migrant stock of approximately 3 million CEEC-citizens living across the EU in the long-run.

75 The OECD reports a stock of 626'500 migrants in the EC and a population of 56'951'000 for Greece, Portugal and Spain.

76 Compare with Layard et al. (1992), p. 24.

TABLE 7: MIGRANT STOCK IN EU-MEMBER STATES (IN 000'S), 1995

To:*	From:											
	Cz	Est	Hun	Pol	Sloven	Bul	Rom	Slov. Rep.	CEEC**	Gr	Por	Sp
Belgium				5,4						19,9	23,9	48,3
Denmark				5,3								
Finland		8,4	0,4	0,7								
France				47,1							649,7	216,0
Germany	18,3	2,5	56,7	276,7	17,3	38,8	109,2	6,7		359,5	125,1	132,3
Italy				22,0			24,5			14,8		17,8
Luxemburg											51,5	2,8
Netherlands										5,6	9,2	16,8
Portugal				0,2		0,3						8,9
Spain											37,0	
Sweden			3,0	16,0			4,2			4,6		2,9
Britain									75,0	17,0	30,0	31,0
Sum	18,3	10,9	60,1	373,4	17,3	39,1	137,9	6,7	75,0	421,4	926,4	476,8

Sum CEEC:	738,7
Sum Gr, Por, Sp:	1824,6

Note: *) EU countries with no reported immigr. are omitted **) Data only appear aggregated for GB
Ethnic minorities with EU citizenshsip and illegal immigrants not included.

Sources: OECD: International Migration Statistics Database, 1997
Statistisches Bundesamt: Arbeits- und Sozialstatistik, 1998

4.3.3 INCOME DIFFERENTIALS

According to neoclassical theory income differentials are the most important explanatory variable in defining migration. Differences in labour earnings are assumed to provoke the mobility of labour until the status of *factor price equalisation* is eventually reached. Although full equalisation is only a theoretical phenomenon, there is no doubt that differentials in income do play an important role.

There are several ways to define income. The variable which reflects a migrant's decision making process best is probably the *wage rate*. Due to difficulties in obtaining data about wages, economists often use GDP per capita as a proxy. TABLE 8 presents data on GDP per capita for the transition economies relative to that of the EU.[77] A value of 100% would imply that the respective country has a GDP/capita which is as high as the EU average. It can be seen that throughout the time 1990-97 there existed substantial differentials in per capita income in the transition economies. The "fittest" economies, the Czech Republic and Slovenia, reached relatively high income levels of approximately 57% getting fairly close to the currently least developed EU member state, Greece. OECD and IMF estimates[78] for 1998 present income levels for Slovenia of as much as 71%, and 62% for the Czech Republic. At the same time economies such

[77] Data are purchasing power parity adjusted.
[78] See International Monetary Fund (1999), p. 74.

as Bulgaria and Romania reached only 19-21% of the average per capita income of the EU. Thus, the economic performance of the transition economies has been varying significantly and is still below the level of the poorest EU members.

Table 8: GDP/Cap as Purchasing Power Parities Relative to EU Average (in %)

	Cz	Est	Hun	Pol	Sloven	Bul	Rom	Slov. Rep.	Gr	Por	Sp	EU
1990	50		31	23	44	25	22	33	57	62	74	100
1991			30	21	46	23	19		59	64	79	100
1992	41		29	22	44	21	18	30	61	66	77	100
1993	46	20	33	25	50	23	20	33	63	69	78	100
1994	54		35	28	55	24	22	37	65	69	76	100
1995	55		19	28	55	23	22	38	66	70	76	100
1996	57		35	30	56	21	23	40	67	70	77	100
1997	56		36	31	57	19	21	42	68	71	78	100
1998	62	38	51	38	71	24	28	49				100

Sources: Own calculations from:
WIIW: Countries in Transition 1998, country tables
IMF: International Financial Statistics, CD-rom
For 1998: OECD and IMF staff estimates, IMF(1999), p. 74.

Table 9: Ten Years after Transition: The Southern European Countries
GDP/Cap as Purchasing Power Parities Relative to EC Average (in %)

Year	Spain	Portugal	Greece
1975	79	49	51
1976	77	55	51
1977	76	56	63
1978	74	56	64
1979	72	56	64
1980	71	57	63
1981	70	59	62
1982	71	60	61
1983	71	59	60
1984	70	57	60
1985	70	57	60

Source: Own calculations from Eurostat Regio, CD-rom

For the purpose of comparison Table 9 displays income data of the three SEC relative to the EC average in the first ten years after their respective transformation into democracies.
In Greece and Portugal the military dictatorships were removed in 1974. In Spain this

took place one year later. It can be seen that in the year immediately after the beginning of transformation, per capita income values were considerably low. Greece and Portugal only reached 51% and 49% of the EC average, values which remind us of the situation of the more developed CEEC today.

TABLE 9, however, also shows that Greece and Portugal experienced some kind of convergence process to the EC-average. The CEEC (with exception of Bulgaria) seem to follow a pattern which is comparable to the Greek and Portuguese examples.

4.3.4 UNEMPLOYMENT

Unemployment often resulting in a deterioration of individual social standards or even poverty also acts as an important migration determinant, particularly if a country's social security system is underdeveloped. The transition process in CEE from a system of full employment to a market economy has induced large scale rationalisation with the effects of unemployment and/or lower participation. TABLE 10 presents official unemployment rates. The CEEC have not had such a bad performance as was probably expected at the beginning of the transition process. 1990 was still characterised by extremely low unemployment rates reflecting the system of state intervention of the centrally planned labour market.

TABLE 10: OFFICIAL UNEMPLOYMENT RATES (IN %)

	Cz	Est	Hun	Pol	Sloven	Bul	Rom	Slov. Rep.	Gr	Por	Sp	EU
1990	0,8	0,0	1,9	6,3	5,8	1,7	0,0	1,6	7,0	4,5	16,2	8,1
1991	4,1	0,1	7,8	11,8	10,1	11,1	3,0	11,8	7,7	4,3	16,4	8,2
1992	2,6	1,9	13,2	13,6	13,4	15,2	8,4	10,4	8,7	4,1	18,5	8,9
1993	3,5	6,5	12,1	16,4	15,4	16,4	10,2	14,4	9,7	5,5	22,8	10,5
1994	3,2	7,6	11,4	16,0	14,2	12,8	10,9	14,8	9,6	6,9	24,1	11,2
1995	2,9	9,7	11,1	14,9	14,5	11,1	9,5	13,1	9,1	7,3	22,9	10,7
1996	3,5	10,0	10,7	13,2	14,4	12,5	6,6	12,8	9,6	7,3	22,2	10,9
1997	5,2	9,7	10,4	10,5	14,8	13,7	8,8	12,5	9,6	6,8	20,8	10,8

Sources: WIIW: Countries in Transition 1998, country tables
Eurostat Regio, CD-rom
Sachverständigenrat (1995/96), statistical annex
Statistical Office Estonia, online services

Already in 1991, after the collapse of central planning, most CEEC experienced a sharp increase in unemployment reaching values close to 12%. A peak was passed in 1993/94 with unemployment figures moderately falling thereafter. All in all, unemployment in the CEEC has not been such an explosive issue in the course of transition. This was mainly due to decreasing participation rates which reacted to the changing environment on the labour market absorbing its shocks. In countries like Slovenia, Hungary and Bulgaria participation dropped by as much as 20-25%.[79] Other factors contributing to

[79] See Worldbank (1996), p. 26.

lower unemployment rates have been government encouragement and support of early retirement schemes and rather modest unemployment benefit in the CEEC. Typical western features like generous unemployment benefit resulting in higher unemployment rates have not been found in the CEEC yet.

How was the unemployment performance of the three SEC ten years after their transition, in the time period 1975-85? As TABLE 11 displays, all three experienced very low unemployment rates in 1975. Spain's unemployment rates rose steadily in subsequent years making a sudden jump in 1980. Portugal also encountered moderate increases initially, but showed a stagnation of unemployment rates in the early 80s. Finally, Greece's figures only started to climb with its accession to the EC in 1981. Hence, at the beginning of the 80s all three southern European countries suffered from rising unemployment. This pattern, however, seems to be rather time specific. It was possibly a consequence of the second oil price shock.

All in all, there is hardly any resemblance between the unemployment performance of the CEEC and the southern European countries. It seems that the unemployment performance is too dependent on country-specific, individual policy measures and economic structures, which makes a cross-country comparison difficult. Also a cross-regional comparison (southern vs. eastern Europe) is not practicable because CEE transformation has led to a very peculiar unemployment performance.

TABLE 11: TEN YEARS AFTER TRANSITION: THE SOUTHERN EUROPEAN COUNTRIES' OFFICIAL UNEMPLOYMENT RATES (IN %)

Year	Spain	Portugal	Greece
1975	2,3	4,4	2,3
1976	4,5	6,3	1,9
1977	5,2	7,4	1,7
1978	7,0	8,0	1,8
1979	8,6	8,1	1,9
1980	16,8	7,7	2,8
1981	16,8	7,4	4,0
1982	16,8	7,3	5,8
1988	16,8	7,8	7,9
1984	16,8	8,4	8,1
1985	16,8	8,5	7,8

Source: Eurostat Regio, CD-rom.

4.4 A GRAPHICAL REPRESENTATION OF THE SOUTH-NORTH MIGRATION PERFORMANCE

According to article 39 EC Treaty, membership in the EC implies the free mobility of labour. All migration between the SEC and the EC member states prior to their accession was quantitatively restricted and subject to bilateral migration treaties just as is currently the case between the EU and the CEEC. Membership of the EC, bringing the abolition of such restrictions, should undoubtedly have had a positive impact on migration. From a theoretical point of view, however, it is not completely clear whether this should inevitably have also increased net South-North migration flows, resulting in higher migrant stocks. Although most economic migration models would argue in favour of increased net South-North migration flows (due to the income differentials), there are arguments which claim the opposite: Straubhaar (1999: 96) asserts that on a potentially freely accessible labour market, free mobility might even encourage repatriation of foreigners who would otherwise not dare to leave the host country for fear they might not regain a work permit.

What does empiricism suggest in this respect? How did migrant flows react to the chance to unrestricted mobility? It should be borne in mind that the admission of the SEC was characterised by a seven-year transition period which only allowed free mobility of labour thereafter. Hence, Greek workers could only migrate freely from 1988, Portuguese and Spanish workers only from 1993 onwards.

Our descriptive analysis is based on migration data originating from the German statistical office (Bundesamt für Statistik) which provides long and differentiated time series. An exemplary character of Germany's migration experience for the EU is implicitly assumed. FIGURE 6 shows net migration flows into Germany in the period between 1967 and 1997. FIGURE 7 displays the stock of Greek, Portuguese and Spanish citizens living in Germany.

In the time until the early 1970s we observe a steady inflow of migrants from all three countries leading to an overall increase in the *stocks*. The positive slope of the curves reflects Germany's active guest worker policy between 1955 and 1973: Germany signed bilateral immigration contracts with Spain and Greece in 1960 and Portugal in 1964 which provided the basis for the rapidly rising inflow of foreigners.[80] These contracts, however, did not imply the free mobility of labour. No foreigner could come to Germany and apply for a job. The initiative had to be taken by German employers who intended to hire a worker from southern Europe. Thus, migration was mainly demand determined. The same kind of pull-migration policy was applied by most other EC member states. The beginning of the 1970s marked a turning point in Germany's immigration policy. In 1973 the first oil price shock and the resulting recession led to a growing labour market crisis with the resulting end of massive recruitment from abroad. Net immigration flows decreased sharply until 1974 when there was even a net outflow from Germany. With the exception of Portuguese citizens, the stock of foreigners also fell. A large scale exodus of foreign workers, however, did not take place, not even

[80] For an overview on German as well as European migration policies see Fassmann and Münz (1994).

when financial incentives were given in 1983 because economic and social prospects in the home countries were not attractive at all.

It is conspicuous that the amplitude of net *migration flows* (FIGURE 6) is very large in the late 60s and early 70s (the time period of active German immigration and repatriation policy) and relatively small from the mid 80s onwards. The introduction of the unrestricted mobility of labour in 1988 and 1993 led to a temporary increase in this magnitude in the case of Greece and Portugal. Migrant flows additionally seem to follow the pattern of Germany's business cycle rather closely. In times of economic upturn (late 60s, late 80s, early 90s) net immigration was also strong. In times of recession net emigration was dominant.

In 1988, the year in which free mobility for Greek workers was eventually granted, we observe a positive change in the curves reflecting net immigrant flows and stocks. Apparently, Greek workers used the chance to go, work and live abroad considerably. The number of Greeks living in Germany has been increasing and seems to be converging to a level of about 350'000 people.

The free labour mobility between Germany and Portugal as well as Spain is not as evident: the stock of Spanish citizens in Germany has remained almost unchanged since the beginning of the 90s, ignoring the year when free mobility was allowed. The stock of Portuguese citizens has increased since 1988. The stock of immigrants from each of the two countries seems to be gradually moving towards a value of 130'000 people. The year 1993 only shows an effect on Portuguese flow statistics: net immigration from Portugal rose by 26% and another considerable 91% in 1994 although it fell again afterwards. Spanish net migration flows did not show any effect at all following the introduction of the free mobility of labour.

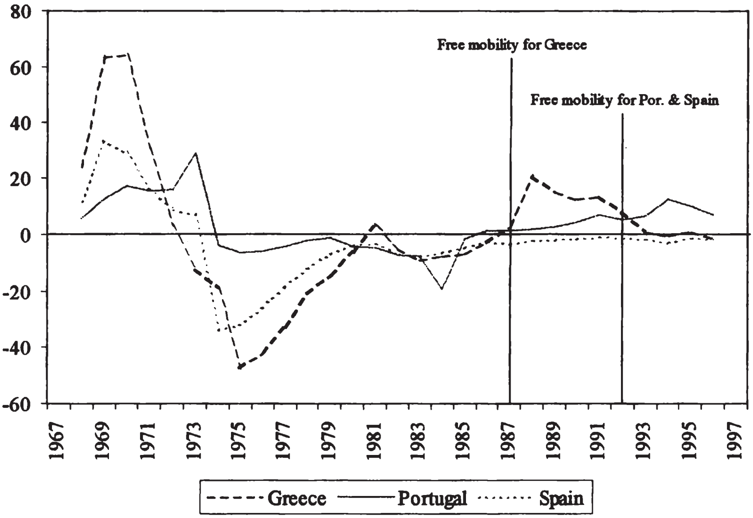
Since all data after 1990 concern unified Germany and data before 1990 only West Germany the question may arise as to whether this change might have had any significant influence on the pattern of the curves. It is unlikely that unification has influenced the stock observations at all. After all, almost no southern Europeans lived on the territory of the German Democratic Republic (GDR) before 1990. An exchange between people of the GDR with any of the countries of the western hemisphere did not take place. The stock and flow of migrants into the GDR originating from Greece, Portugal and Spain is likely to have been equal or close to zero. Unification, however, might have slightly influenced post-unification migration flows. The so-called *"Aufbau Ost"* (building of the East) particularly in the construction sector contributed to a higher demand for workers. Mainly Portuguese workers came to Germany and worked on eastern German construction sites. The steady increase in the stock of Portuguese people and the positive net immigration statistics in the early 1990s reflect this stronger demand for labour.

Summing up the observations from the descriptive analysis, it is possible to deduce the following points: (i) although unrestricted mobility of workers was not allowed until 1988 and 1993, bilateral contracts led to considerable net immigration into Germany in the 1960s resulting in larger stocks of immigrants. (ii) Migration flows have followed the business cycle pattern of Germany fairly closely. (iii) Strong political intervention in the migration policy (as in the 60s and 70s) has increased the magnitude of flows in both ways (immigration and emigration). (iv) The stocks of foreigners seem to approach some kind of long-run equilibrium level. (v) The free mobility of labour generates migration flows which are much more balanced (smaller amplitude), i.e. immigration almost equals emigration. Thus, in an integrated labour market, the mobility of people tends to follow the pattern of mutual exchange rather than that of one-sided immigration.[81] In this context it should not be forgotten that mutual exchange mainly concerns southern European citizens. Those who immigrated into Germany were counterbalanced by their fellow countrymen who emigrated from Germany back to their home country. Flows of German citizens migrating to the South have been a rather rare incident.

The experience made in the context of the southern EC enlargement enables some conclusions to be drawn with respect to the CEEC: firstly, the stock of CEE migrants living in the EU is already large and will probably become even larger in future. Germany, in particular, seems to be following an approach that permits large scale immigration even before EU accession has taken place. Individual migration policies by other EU member states are also likely to continue in the future because the Treaty of Amsterdam permits member states to negotiate special immigration agreements with non-member countries, provided they respect European laws and other international agreements. Continuous pre-accession immigration from the CEEC to the EU is therefore a likely scenario. Secondly, the resulting gradual formation of an immigrant stock will probably enhance further immigration movements if we believe in the efficiency of migration networks. Nevertheless, Layard et al. (1992 :24) as well as Bauer and Zimmermann (1999 :I) suggest that there is some kind of total value towards which the stock of immigrants converges. Southern European experience has shown that the stock comes to about 3% of the population of the emigration country. Free labour mobility between the EU and the CEEC may result in an additional temporary rise of net immigration flows. In the longer run, however, all labour mobility by CEEC citizens may tend to have the character of mutual mobility rather than that of one-sided immigration into the EU.

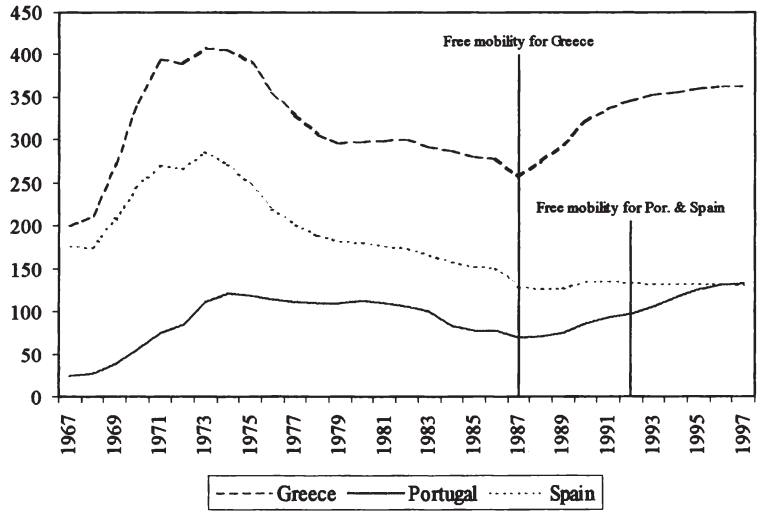
[81] An observation which Straubhaar (1999), Chapter 3, encountered with respect to Switzerland.

FIGURE 6: NET MIGRATION FLOWS INTO GERMANY (IN 000'S)



Source: Own figure from data from Statistisches Bundesamt, Bevölkerungsbewegung - Wanderungen.

FIGURE 7: STOCK OF FOREIGN POPULATION IN GERMANY (IN 000'S)



Source: Own figure from data from Statistisches Bundesamt: Fachserie 1, Reihe 2.

4.5 A Quantitative Analysis of the Migration Performance

Complementing the descriptive analysis in the previous section, we now provide an econometric estimate of South-North migration. The aim is to obtain coefficient values which can, under the assumption of correspondence, then be used for the quantification (extrapolation) of potential CEEC-EU migration flows in Eq. 23. On this basis, the computable general equilibrium model is capable of simulating the macroeconomic effects of migration.

4.5.1 Theoretical and Empirical Models

In the previous chapter we presented the different theoretical approaches which try to explain the phenomenon of migration. Each of these is based on different assumptions regarding the independent variables. These migration determinants range from simple wage differentials, unemployment rates and transaction costs to more sophisticated factors such as job specific aspects, intertemporal expectations, attitudes of migrants towards risk, job finding probabilities, time preference rates, imperfect information, population densities and ethnic and information networks. It is assumed that the lagged or predicted form of these factors is required in order to theoretically explain today's migration.

In contrast to theoretical models, empirical applications are forced to focus only on the quantifiable determinants. Straubhaar (1988), for instance, estimates bilateral migration rates to be dependent on per capita income and unemployment rate differences. All variables are specified in a non-logarithmic functional form. Estimates are conducted by OLS.[82] Lundborg (1991) estimates a fully logarithmic model where net migration rates depend on real wages, distance, migrant stock, unemployment and regional dummies. Barro and Sala-i-Martin (1995) estimate the annual rate of net migration for the US, Japan and Europe over several longer time periods. As independent variables they incorporate per capita income, fixed amenities (such as climate and geography), population density and technological progress.[83] Our approach differs in that we firstly analyse migration between heterogeneous countries, which is likely to follow a different pattern than intra-country migration or cross border migration between relatively homogeneous European countries on which Barro and Sala-i-Martin focus. Secondly, Barro and Sala-i-Martin do not differentiate between membership of an integrated market (such as the EC) and non-membership. Although migration between EC/EU members and non-members has existed, it was certainly far removed from anything that might be called free mobility of labour. The problem of analysing migration in non-integrated markets, however, is that the value of the dependent variables is underestimated. For that reason we have made sure that we only consider the time period where free mobility of labour on the European labour market was guaranteed.

[82] See Straubhaar (1988), p. 105.
[83] Compare with Barro and Sala-i-Martin (1995), pp. 401-410.

4.5.2 THE ECONOMETRIC MODEL

We estimate a pooled time series, cross sectional model of bilateral migration flows from each of the three southern European countries Greece, Portugal and Spain into each of the seven EC member countries Belgium, Denmark, France, Germany, Luxembourg, the Netherlands and the United Kingdom. Only those intra-European migration flows are considered which existed *after* the unrestricted mobility of labour between the South and the North had been made possible. In all three cases of enlargement this was seven years after admission to the EC, i.e. for Greece from 1988 and for Portugal and Spain from 1993 onwards. In the specification of dependent and independent variables as well as our functional form we follow most other recent empirical models:

EQ. 31:

$$migrate_t^{s,n} = \beta_0 + \beta_1 \log\left(1 - \frac{y^s}{y^n}\right)_{t-1} + \beta_2 \log\left(\frac{UE^n}{UE^s}\right)_{t-1} + \beta_3 \log(MS^n)_{t-1} + \beta_4 \log(D^{ns}) + u_t$$

The **dependent** variable, ***migrate***, on the left-hand side is the bilateral rate of migration taking place between emigration country *s* (South) and immigration country *n* (North) in period ***t***. It is expressed as a rate since it measures the percentage of the absolute number of migrants on the total population in s, ($mig^{s,n}/pop^s$). The model is estimated twice using two different forms of the dependent variable. In a first estimate we use *SEC' emigration rate* and in a second estimate *SEC' net migration rate*. With this differentiation we obtain an idea of the relationship and differing magnitude of absolute migration rates to net migration rates.

All **independent** variables are specified in logarithms, *log*. With a logarithmic model we follow the functional form of Barro and Sala-i-Martin (1995 :402). A logarithmic relationship makes sense because it is realistic to assume that the amount of push migration will not rise linearly with increasing values of the independent variables. This implies that free migration follows some kind of saturation pattern. There is an upper threshold which free mobility will not surpass; a point which coincides with Layard's (1992 :24) "3%-argument". β_i are the coefficients.

The ***first*** term on the right-hand side (r.h.s.) is the intercept term. The *second* r.h.s. variable is the logarithm of the difference of relative per capita income, y^s to y^n, of the previous time period, t-1. It is a proxy for differing wages and wealth expectations between s and n. The larger it is, the greater is the income difference of country s compared to n. Large income differentials should have a positive influence on migration into n so that the coefficient should be positive. The *third* r.h.s variable is the logarithm of the unemployment rate (*UE*) of n relative to that of s of the previous period. The theory suggests that higher relative unemployment possibilities in the immigration country deter people from immigrating. The coefficient should therefore be negative.

We include this variable in the econometric estimate despite the fact that our CGE model, by definition, does not allow for unemployment. The reason is that the omission of this variable could provide an estimation bias which we intend to prevent. Unemployment is therefore incorporated into the econometric model, the resulting coefficient will be included in the CGE model as an exogenous dummy. The *fourth* r.h.s. variable is the logarithm of the past period's stock of migrants (*MS*) from s living in n. In fact, this variable includes the stock of foreign or foreign-born population from origin country s. It has been included in order to estimate migrants' network effects. The more immigrants that live in a particular country, the more likely it is that they will drag further immigrants into that country. We should thus expect a positive coefficient for this variable. The *fifth* r.h.s variable is the absolute distance (*D*) between the capitals of s and n.[84] The distance is assumed to be a proxy for transport and transaction costs of moving as well as cultural differences between two countries. The fact that transportation costs increase with distance is obvious. Nevertheless it is also likely that cultural differences increase with distance. The financial burden of moving as well as the cultural strangeness of the immigration country are assumed to have a migration reducing effect. Hence, a negative coefficient is likely to exist. *Finally*, the last r.h.s. term (*u*) is the white noise disturbance term.

Apart from the distance which does not change, all independent variables have been lagged by one period. This has been done in order to model a migrants' decision making process. The individual judgement whether to stay or to move abroad is normally not an ad hoc decision where present variables are taken into account. It rather is a longer-term process where expectations about potential costs and benefits are formed by carefully evaluating past income and expenditure experiences and establishing ties to existing migrant networks.

The different independent variables included in EQ. 31 cover most of the theoretical approaches explaining migration which were presented in the previous chapter. Wage differentials, for instance, mainly incorporate the *Neoclassical Approach*. Unemployment rates and the distance between countries are both parameters which are implicitly incorporated into the *Human Capital Approach* although the dynamic, forward-looking component is missing. They mainly stand for the likelihood of finding a job abroad and for the costs of moving. Finally, the stock of migrants already living in a destination country is an idea taken from the *Network Migration Approach*.

Is Our Econometric Method Reasonable?

EQ. 31 suggests that the estimated coefficient values imply an aggregation of both, the emigration as well as the immigration region. Although this approach is necessary in order to later apply the estimated parameter values within our CGE-model, from the purely econometric perspective, the specification of our model might raise a few methodological questions since seemingly superior quantitative techniques could be applied. We will therefore briefly address these potential questions and explain why the application of a pooled cross sectional, time series econometric estimate *strictly* follows

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[84] The distance to Germany has been calculated by using the city of Frankfurt a.M. since pre unification data have also been used.

the parametric requirements of our CGE analysis applied in later chapters:

(i) For a pooled cross sectional, time series estimate, modern econometric science would normally suggest the use of the panel method with individual country intercepts (fixed effects) or varying parameter values, or both. Clearly, country-specific peculiarities could be identified and singled out by these means and problems such as "country clusters" could also be tackled. So, why do we apply a seemingly inferior technique?

The individual country features as provided by panel estimates or country dummies are precisely what we are not interested in. Since our CGE model studies migration movements between the CEEC as one aggregated and the EU as the other aggregated region, it is our aim to obtain bilateral migration parameters for only two aggregated regions. Now, problems like country clusters could alternatively be tackled by summing up the emigration or the immigration countries to one region prior to estimation. Due to the fact that this would reduce the number of observations and consequently also the degrees of freedom considerably, we have abstained from this procedure.

(ii) The relatively short time series dating back to 1993/1988 are probably sources of inaccuracies. The inclusion of further observations prior to this point could increase the number of observations and therefore improve the reliability of the estimates.

Unfortunately it is not possible to extend the time series since it is our aim to study the impact of *free* labour mobility. Prior to 1993 and 1988 no free mobility between the EC and Portugal, Spain or Greece took place. The inclusion of data reaching further back in time would then blur the required free-mobility parameters.

(iii) The number of observations and hence the reliability of the estimates could alternatively be increased by using monthly or quarterly rather than yearly data.

We are obliged to stick to yearly data because our CGE model is later also calibrated to annual data.

Thus, although from an econometric point of view there are several ways of improving the quantitative methodology, the imperative necessities of our subsequent CGE-model hinder us from doing that.

4.5.3 DATA

The following yearly data have been used for the estimations:

- Bilateral flows of foreigners [a]
- Population in potential immigration country [a]
- Gross domestic product per capita in both countries [a]
- Population density in both countries [b]
- Unemployment rates in both countries [b]
- Stock of foreign or foreign born population in immigration country [a]
- Absolute distance between countries' capitals

Sources:
[a] OECD International Migration Statistics Database 1997.
[b] Eurostat Luxembourg, Regional Statistics (REGIO) found on the International Statistical Yearbook CD-ROM 1998.

4.5.4 Estimation Results

Table 12 shows the regression results of Eq. 31 using the two different dependent variables.

Table 12(A) displays the results using **SEC' emigration rate** as a dependent variable. All coefficients have the expected signs. Since all independent variables are defined in logs and the dependent variable is not, the estimation's coefficients reflect semi-elasticities. Coefficient β_1 implies that a 10% increase in this year's difference of relative per capita income will, ceteris paribus, result in next year's increase of the emigration rate into country n by approximately 0.04 percentage points. β_1 is significant at the 95% confidence interval. With the relatively high value of the t-statistic, this coefficient turns out to be the most important independent variable in this estimate. Coefficient β_2, in contrast, displays a negative sign indicating that a 10% increase in the relative unemployment rate leads to a reduction in the emigration rate by 0.005 percentage points. β_2 is significant at a 95% confidence interval. Coefficient β_3 is also significant expressing the idea that each 10% additional foreign residents in immigration country n lead to network effects which enhance emigration in the consecutive period by 0.007 percentage points. Finally, distance appears to have a negative effect on emigration. Each 10% additional distance leads to a reduced net migration rate of 0.006 percentage points although this coefficient turns out to be insignificant at a 5% significance level.

We tested for the joint significance of the coefficients using the F-statistic. All four coefficients appeared to be jointly significant.

Table 12(B) shows the regression results using **SEC' net migration rate** as the dependent variable. All independent variables as well as the functional form remain unchanged. The signs of all coefficients are correct just as in the previous estimates. Without exception, all coefficient values are smaller. Now only β_1 and β_3 are significant at a 5% significance level. All other coefficients and the intercept term are insignificant. It looks as if relative unemployment rates were not very important in determining the net migration rate.

All in all, estimations from this second regression are a weaker form of the former estimations. This is not particularly surprising since the dependent variable also takes smaller values. Additionally, return migration from the EC to the SEC which is implicitly included in net migration rates must be determined by means other than economic factors. In view of this, smaller coefficient values and the insignificance of the unemployment parameter seem to make sense. The smaller importance of economic determinants is also supported by the significantly lower values of R^2 and adjusted R^2: The explanatory power is reduced by almost 40%.

TABLE 12: REGRESSION RESULTS SEC' MIGRATION RATES

(A) ESTIMATION OF SEC' EMIGRATION RATE

Dependent variable: emigration rate$_t^{s,n}$ Observations: 32			
Indep. Variables		Coefficient	t-Statistic
intercept	β_0 =	-1,29	-2,93
$\log(1-(y^s/y^n))_{t-1}$	β_1 =	0,39	6,62
$\log(UE^n/UE^s)_{t-1}$	β_2 =	-0,051	-2,82
$\log(MS^n)_{t-1}$	β_3 =	0,066	9,64
$\log(D^{ns})$	β_4 =	-0,062	-1,02
F-statistic		34,04	
R^2		0,84	
Adj. R^2		0,81	
S.E. of regression		0,05	
Durbin-Watson		2,06	

Source: Own estimations

(B) ESTIMATION OF SEC' **NET** EMIGRATION RATE (INCLUDES RETURN MIGRATION)

Dependent variable: net migration rate$_t^{s,n}$ Observations: 32			
Indep. Variables		Coefficient	t-Statistic
intercept	β_0 =	-0,42	-1,18
$\log(1-(y^s/y^n))_{t-1}$	β_1 =	0,17	3,55
$\log(UE^n/UE^s)_{t-1}$	β_2 =	-0,016	-1,11
$\log(MS^n)_{t-1}$	β_3 =	0,023	4,13
$\log(D^{ns})$	β_4 =	-0,043	-0,88
F-statistic		7,30	
R^2		0,52	
Adj. R^2		0,45	
S.E. of regression		0,04	
Durbin-Watson		2,04	

Source: Own estimations

We also tried to include a variable in both estimates that aims to quantify the concentration of people in a country by proxying the receptivity of immigrants. This was done by using data on population densities (following the example of Barro and Sala-i-Martin, 1995 :402) in emigration as well as immigration regions. Population density was measured as the average number of inhabitants per square kilometre. The larger its values in the potential immigration country, the lower the receptivity of further migrants was assumed to be. Thus, the coefficient was expected to be negative. Although estimations including data on population densities provided a coefficient with the expected sign we eventually omitted this variable because it led to a failure of diagnostic tests.

Diagnostic Tests:
Autocorrelation (serial-correlation) means that the disturbance terms are correlated over time, i.e. that the residuals are not randomly distributed. It can lead to an invalidation of the standard errors and t-ratios although coefficients may be unbiased. In our estimate it is not possible to test for autocorrelation since the residuals may either come from a cross sectional or alternatively from a time series observation. Therefore, our results are based on the hypothesis that there is no correlation across the residuals from the various countries. For the same reason we also assume that our series are *stationary*. We tested for *heteroscedasticity* which exists when the variance of the disturbance term u_t is not constant. Heteroscedasticity poses a problem since it leads to biased standard errors and t-ratios. The coefficient estimates, however, mostly continue to be unbiased. Applying *White's Heteroscedasticity Test*[85] we found that our disturbances are homoscedastic. Finally, we conducted a *normality* test which checked whether the residuals are normally distributed. The Jarque-Bera statistic provided satisfactory evidence that the residuals are normally distributed.

4.6 EXTRAPOLATIONS

Overall, the estimations displayed in TABLE 12 appear to be reasonable. In view of the relatively small number of observations which may be the source of inaccuracies this is all the more noteworthy. As mentioned previously, the estimation results reflect the pattern of net migration between Greece, Portugal, Spain as net emigration countries and the northern EU member states as typical net immigration countries. The coefficient values obtained allow us to form expectations about the amount of net migration between the CEEC and the EU. This is a procedure which we called *extrapolation* in the introduction to this chapter. To carry out such calculations the estimated coefficient values are combined with actual CEEC and EU data on per capita income, unemployment, migrant stocks and distance. In doing so we assume average unemployment rates in the EU of 10.5% and of 15% in the CEEC, a stock of CEEC-citizens living in the EU of 1 million and determine the distance between two geographical centre points in both the EU and the CEEC to be 1500 km. With respect to

[85] See White (1980), pp. 817-838.

the income differentials we calculate different scenarios assuming values between 40-70%. As a result we obtain potential CEEC-EU migration rates expressed in percent of CEEC' total population. It is important to remember that all results implicitly assume that (i) the southern European countries are exemplary for the CEEC and that (ii) free mobility of labour between CEEC and the EU does exist.[86] Since the supposed economic conditions reflect the current economic situation, our calculations simulate the hypothetical situation of the CEEC becoming a member of the EU and permitting the free mobility of labour today.

4.6.1 MIGRATION RATES

Complementary to the two regressions undertaken above we also obtain two sets of extrapolation results displayed in TABLE 13. The first reflects CEEC' *emigration* rates (A), the second reports *net migration* rates between the CEEC and the EU (B).

The four rows differ in that they contemplate different values for *income differentials* between the CEEC and the EU. Whereas row (1) assumes an income differential of "only" 40% between the CEEC and the EU, row (4) calculates with a substantial value of 70% (thus the CEEC are believed to have a very low income compared with the EU). As income differentials rise, the migration rates increase.

As can be seen in TABLE 13(A), **CEEC' emigration rates** vary between 0.19% and 0.40% of its population depending on which income scenario we consider in the calculations. It is evident that this is quite a large range of emigration potential. Average per capita GDP calculated from TABLE 8 suggests that all CEEC come to a value of approximately 45% of EU's average income. Putting it differently, the income difference between both groups of countries then amounts to 55%. Hence, rows (2) and (3) calculated with an income differential of approximately 50-60% reflect the actual income difference between the CEEC and the EU. Potential emigration rates should consequently lie somewhere between 0.27 - 0.34% of CEEC' population p.a.

TABLE 13(B) displays the calculated **net migration rates** between the CEEC and the EU resulting from our extrapolations. All migration rates are substantially lower than in part (A) since they implicitly include return migration of CEEC-citizens. Focusing on the actual income differentials in rows (2) and (3) we obtain net migration rates of 0.1 - 0.13% of CEEC' population p.a.

Altogether, our calculations advocate that there would be net immigration from the CEEC into the EU if free mobility of labour between the CEEC and the EU was permitted. The substantially smaller values of net migration rates compared to pure emigration rates suggest that there would be a considerable amount of return migration. Thus, people would return back home after a certain period of time living and working inside the EU.

[86] Remember that econometric estimations were only about the period of free mobility of labour. Thus, coefficient values will also reflect free mobility only.

TABLE 13: EXTRAPOLATION OF CEEC-EU MIGRATION RATES

(A) CEEC-EU **EMIGRATION** RATES (WITHOUT RETURN MIGRATION)

Dependent variable: CEEC' emigration rate (as % of population in CEEC)		Independent variables: $1-(y^s/y^n)_{t-1}$ (income differentials)	Other variables (ceteris paribus)
(1)	0,19	40%	$(UE^n)_{t-1}$: 10,5%
(2)	**0,27**	**50%**	$(UE^s)_{t-1}$: 15%
(3)	**0,34**	**60%**	$(MS^n)_{t-1}$: 1'000'000
(4)	0,40	70%	(D^{ns}) : 1'500 km

Bold type: Current income differentials.
Source: Own calculations.

(B) CEEC-EU **NET MIGRATION** RATES (INCLUDES RETURN MIGRATION)

Dependent variable: CEEC' emigration rate (as % of population in CEEC)		Independent variables: $1-(y^s/y^n)_{t-1}$ (income differentials)	Other variables (ceteris paribus)
(1)	0,06	40%	$(UE^n)_{t-1}$: 10,5%
(2)	**0,10**	**50%**	$(UE^s)_{t-1}$: 15%
(3)	**0,13**	**60%**	$(MS^n)_{t-1}$: 1'000'000
(4)	0,15	70%	(D^{ns}) : 1'500 km

Bold type: Current income differentials.
Source: Own calculations.

It is likely, however, that the calculated migration rates in TABLE 13(A)+(B) currently still underestimate potential free migration flows originating from CEEC. Since the CEEC have still not reached an equivalently high ratio of migrant stock in the EU as the SEC (we mentioned this point earlier in section 4.3.2), it is probable that immigration from the CEEC would initially be larger. Also *return migration* will only be of significance if there is a sufficiently large stock of CEEC migrants living in the EU already. As long as this long-run equilibrium stock of migrants is not reached, it is likely that net immigration will be larger than what is suggested by the estimates. In other words, the CEEC-EU migration pattern will resemble the calculated coefficients more closely as soon as CEEC' migrant stock has accumulated to a ratio equivalent to that of the SEC: as Layard et al. (1992 :24) suggest, this should amount to about 3% of the population. Hence, the calculated migration rates should be understood as long-run values. In the short-run, they can instead be interpreted as a lower threshold.

4.6.2 ABSOLUTE NUMBER OF MIGRANTS

In a next step we take the extrapolated values of the migration rates from TABLE 13 and multiply them with the number of population in the CEEC (using 1997 data). The outcome is an estimate of the magnitude of CEEC' migration into the EU (TABLE 14). Again we differentiate between pure emigration (part A) and net migration (part B).

The calculations in TABLE 14(A) advocate that under the assumption of an EU-CEEC income differential of 50-60% and ignoring return migration, approximately 270'000 to 340'000 immigrants p.a. would be moving from the CEEC into the EU if free mobility of labour was permitted. With progressive income convergence, push migration from the CEEC would decrease over time. As soon as we incorporate return migration into our calculations, we obtain a magnitude of net migration of approximately 99'000 - 129'000 persons from CEEC as TABLE 14(B) illustrates.

TABLE 14: EXTRAPOLATION OF THE CEEC-EU MAGNITUDE OF MIGRATION

(A) MAGNITUDE OF CEEC EMIGRATION TO EU

Supposed population in CEEC: 99'000'000		
(Scenario)	Income Differential	Magnitude of Migration
(1)	40%	188'100
(2)	**50%**	**267'300**
(3)	**60%**	**336'600**
(4)	70%	396'000

Bold type: Current income differentials.
Source: Own calculations.

(B) MAGNITUDE OF CEEC **NET** MIGRATION TO EU (INCLUDES RETURN MIGRATION)

Supposed population in CEEC: 99'000'000		
(Scenario)	Income Differential	Magnitude of Migration
(1)	40%	59'400
(2)	**50%**	**99'000**
(3)	**60%**	**128'700**
(4)	70%	148'500

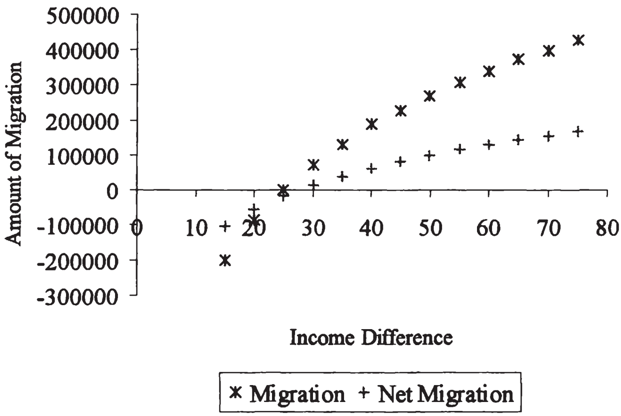
Bold type: Current income differentials.
Source: Own calculations.

The findings from our extrapolations are illustrated in FIGURE 10. On the x-axis we have depicted a whole range of different income scenarios ranging from relatively homogeneous 15% income differentials to a very heterogeneous 75% ceteris paribus. The ceteris paribus assumption implies that all other variables (unemployment, stock of migrants and distance) remain unchanged. The y-axis outlines the corresponding amount of migration p.a. The first curve displays the pure emigration potential from the

CEEC and is based on the coefficient values from TABLE 12(A). The second curve focuses on the net migration potential corresponding to TABLE 12(B). It is interesting to see that emigration from the CEEC can even turn negative (implying net immigration to the CEEC) as soon as we get close or below income differentials of about 25%. Income incentives in the EU would in such a case not be high enough to attract a larger number of CEEC citizens. Their return migration would then exceed the emigration flows.

As mentioned previously, the amount of return migration is likely to be overestimated for the CEEC as long as the stock of CEEC migrants has not reached its long-run level. Hence, return migration will initially lie somewhere between zero (implying that there is only emigration from the CEEC) and the amount which is implicitly suggested by the estimated parameter values of net migration. The two illustrated curves in FIGURE 8 could then be interpreted as a corridor displaying potential net migration which, depending on the real degree of return migration, is bounded on one side by the curve of net migration and bounded on the other side by the curve of emigration. Hence we might view our coefficient values as lower and upper boundaries for potential CEEC-EU net migration.

FIGURE 8: CEEC' MIGRATION AND NET MIGRATION POTENTIAL



Source: Own graph

4.6.3 DISCUSSION AND COMPARISON WITH OTHER STUDIES

Depending on the degree of return migration our results suggest that between 100'000 and 340'000 migrants annually would be moving from the CEEC into the EU on a net basis if free mobility of people were permitted. At first sight, this amount of annual net migration, particularly the upper boundary, seems to be very high. There are two points which should be mentioned in this context. Firstly, it is necessary to define for whom this net migration figure is high. For an immigration region such as the EU, consisting of 380 million inhabitants, the calculated net migration flows would only amount to 0.03 - 0.08% of the population, depending on the assumed scenario. Effects of immigration are then likely to be rather small. For the CEEC as a net emigration region, a departure of 0.1 - 0.34% of its population could, in contrast, be quite substantial if not harmful.

Secondly, the parameters used for these calculations were derived from the southern European experience in the first few years after free labour mobility was permitted. It is possible that the migration performance in these first years was in some way excessive and not really representative for the longer run. The sudden freedom might induce many more migrants to move than would do so under normal circumstances. Martin (1993: 136) and Straubhaar (1999: 28) call this kind of migratory pattern the *"hump effect"*. After an unreasonable initial period of strong immigration, net migration flows decrease thereafter.

The question of the extent of East-West migration has been subject of a variety of different studies each of which either follows a different methodology of quantification or concentrates on different emigration and immigration regions. Thus a comparison between our results and the outcomes of other analyses is only partly possible. However, in the following we provide an overview of recent examinations, without making any claim to completeness.[87] The different methodologies which have been used to estimate the potential of East-West migration can be structured into the following categories.

Firstly, there are studies which make use of plausibility considerations using historical migration experience. The most well-known study within this category is probably the previously cited publication by Layard et al. (1992). They transfer the experience made in context of South-North migration in Europe in the 1960s and 1970s to the potential degree of East-West migration. They assume[88] that similarly to the southern European experience 3% of CEEC' population will migrate into western Europe over a period of 15 years. Assuming that the potential emigration countries would be the same ones as we consider, East-West migration should amount to a total number of 3 million persons over a period of 15 years which would come to 200'000 migrants p.a. on average.

Korcelli (1992) focuses on the emigration potential from Poland in the 1990s. Under consideration of Poland's migratory history prior to the fall of the iron curtain as well as the future development of economic and demographic factors, Korcelli argues that the degree of emigration will amount to 40'000 - 70'000 persons p.a. A formal foundation of his results is not provided. Two thirds of these emigrants are assumed to have received higher education. The historical experience seems to suggest that 64% will move to Germany, 14% to Austria, Greece and Italy and 12% to the US.[89]

87 For an overview see also Weyerbrock (1995), Hönekopp (1999, 2000) and Bauer and Zimmermann (1999).
88 See Layard et al. (1992), p. 24.
89 Compare with Korcelli (1992), p. 301.

The **second** category includes so-called gravity estimates under special consideration of economic indicators. Franzmeyer and Brücker (1997) determine the amount of free migration to be a function of income differentials between two regions and their respective population. The applied migration parameters are derived from empirical observations of Barro and Sala-i-Martin (1995). In several extrapolations they combine their own projections of future economic growth (and hence of potential wage differentials) as well as demographic dynamics with three different migration scenarios: in a first, low migration scenario, the net migration potential from all ten CEE-associates is estimated at 590'000 persons p.a. in 1996. With income convergence this number will fall to 300'000 migrants p.a. by the year 2030. In a second, high migration scenario, net migration is estimated to initially come to 1.18 million persons p.a. and 530'000 p.a. by 2030. A third, progressive migration scenario calculates a migration hump starting with 590'000 migrants p.a., climbing to 640'000 p.a. by 2010 and again reaching 590'000 persons p.a. by 2030.[90]

The gravity approach of Franzmeyer and Brücker has also been used in several subsequent studies: Walterskirchen and Dietz (1998) as well as Birner et al. (1999) focus on the annual flow of migrants and commuters between Austria and its direct neighbours, the Czech Republic, Poland, Slovakia, Slovenia and Hungary. Both studies also combine migration parameters derived from Barro and Sala-i-Martin (1995) with actual and extrapolated income differentials between both regions. Walterskirchen and Dietz calculate an annual inflow into Austria of 47'100, 41'800 or 31'600 persons depending on whether free mobility is permitted in 1996, in 2005 or in 2015 respectively. For the EU as a whole, they come to a value of 200'000 immigrants p.a.[91] With income convergence, net immigration is assumed to decrease gradually until, at an income level of less than 30%, migration flows eventually level out.

Birner et al. predict an immigration potential for Austria of 140'000 persons in the period 2004-2013 (if free mobility is allowed in 2004) and 110'000 migrants for 2010-2019. Additionally, Austria will have to count with a commutant potential of about 156'000 persons during the same time period.[92]

The **third** category of studies makes use of opinion polls and representative surveys in the emigration regions. Fassmann and Hintermann (1997) analyse a representative survey of the total population over the age of 14 based on 4392 personal interviews. They ascertained the structure and motivation of potential migrants from Poland, Slovakia, the Czech Republic and Hungary in 1996. Their results suggest that the overall migration potential from these countries amounts to 721'000 migrants of which 320'000 will move to Germany and 150'000 to Austria.[93]

Shevtsova (1992) presents estimates on emigration pressure in the former countries of the Soviet Union. Based on opinion polls undertaken in the early 1990s as well as predictions of Russian migration experts, an outflow of 1.5 - 2 million persons p.a.

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90 See Franzmeyer and Brücker (1997), table 3.
91 Results are also reported in Walterskirchen (1998), p. 534.
92 Compare with Birner et al. (1999), figures 1.1 & 1.2 as well as 1.7 & 1.8.
93 Compare with Fassmann and Hintermann (1997), table 1, p. 14f.

between 1993-94 and 500'000-700'000 p.a. in the years thereafter is being predicted. The inclination to leave the country is largest in the 20-35 age group.[94] Political migration is assumed to play an increasingly important role in Azerbajan, Georgia and the central Asian States. National migration such as the repatriation of Polish, German, Jewish and Greek ethnic citizens represents a strong fraction. Most of the migrants, however, can be regarded as being economically induced. Western Europe, North America, Israel and South Africa must be regarded as the favourite emigration destinations.

The **fourth** and last category of methods to quantify the migration potential are econometric estimations. Orlowski and Zienkowski (1998) estimate migration to be a function of income differences, distance, absorption capacity, development prospects and unemployment rates. In a first estimate they study the cross sectional performance of Spanish, Portuguese and Greek migrants between 1983-95, a second estimate analyses intra-German migration flows. Their results suggest that the parameter for income differences is highly significant but also absorption capacity influences migration strongly. Geographical distance turns out to be only important for migration within Germany whereas unemployment rates and GDP-growth are insignificant altogether. Under the assumption of correspondence, they transfer the estimated parameters to calculate the degree of Polish emigration. In three different scenarios Orlowski and Zienkowski make contrasting assumptions with respect to relative incomes thereby calculating emigration values of 380'000, 771'000 and 1'472'000 persons over a period of 10 - 12 years.[95]

Bauer and Zimmermann (1999) estimate the migration potential from East European countries to the EU using the migration experience from Greece, Spain and Portugal between 1985-1997. They apply a log-linear equation with a fixed effects estimator. As dependent variable they use the emigration rate, explanatory variables are the relative unemployment rate and the relative real GDP per capita. The obtained coefficients are then combined with actual and expected data of the independent variables in the CEEC and the EU so as to simulate the emigration potential from seven different countries in CEE. Bauer and Zimmermann suggest that long-run East-West emigration rates should amount to an overall 2-3% over a period of 15 years.[96] With this result, they are slightly below the assumption of Layard et al. (1992). This implies that roughly 135'000 - 200'000 migrants p.a. would have to be expected.

A very ambitious econometric estimate of the amount of immigration from the ten CEEC has recently been undertaken by Boeri and Brücker et al. (2000). The projections of potential immigration into Germany and the EU are based on an econometric estimate of German immigration from 18 different countries in the period of 1967-98. Using cross-sectional as well as time series data, the researchers apply an error

94 Compare with Shevtsova (1992), p. 244.
95 See Orlowski and Zienkowski (1999), table 3.
96 See Bauer and Zimmermann (1999), p. I, 45, 46. The model is described in Appendix B.

correction model with income, employment and institutional variables being the long-term migration determining factors. The estimated parameters are combined with different scenarios/assumptions concerning the future development of income convergence and employment in the CEEC as well as the EU. In a first scenario, mobility of labour between the CEEC and the EU is permitted from 2002 onwards. The calculations suggest that initially approximately 220'000 immigrants p.a. would have to be expected in Germany alone. By the end of the decade, this number would fall to 95'000 persons p.a. Other scenarios simulate lower (higher) convergence rates thereby yielding a 10% larger (20% smaller) migration potential. The corresponding projection for the EU-15 suggests that 335'000 immigrants p.a. from the CEEC would have to be expected by 2002, by 2010 this number would come to roughly 150'000 persons p.a. The applied model advocates that 30 years after mobility is permitted, an equilibrium situation will arise in which migration between the EU and the CEEC levels out.[97]

The estimations of the different studies are summarised in TABLE 15. Since the countries and regions of origin vary, the comparability between our results and other analyses is only partly possible. The evaluations of Layard et al. (1992), Franzmeyer and Brücker (1997), Bauer and Zimmermann (1999) and Boeri and Brücker et al. (2000) coincide the closest with our definition of emigration and immigration regions. It can be seen that the majority of these studies predicts an immigration potential of about 150'000 to 300'000 migrants p.a. from the CEEC. It is a considerable observation that despite differing methodological approaches fairly similar results are calculated. Only the estimations by Franzmeyer and Brücker (1997) differ markedly, forecasting a much larger immigration potential. The use of rather high migration parameters explains this discrepancy.

4.7 SUMMARY

The aim of this chapter has been to quantify the potential of CEEC-EU migration which would exist if the CEEC were permitted the free mobility of labour. In this context, we estimated the necessary migration coefficients which are required to undertake the corresponding policy experiments using our CGE model.

In order to be able to form expectations, we made use of the method of extrapolation. This means that we studied the migration flows in the context of the enlargement of the EC towards Greece, Portugal and Spain and assumed a certain analogy between this Southern enlargement and a potential eastern EU enlargement. An econometric analysis of the southern European countries yielded migration parameters. Under the assumption of resemblance, these parameters were then used to calculate the amount of migration which would come about if the CEEC were to join the EU today.

The most controversial point of this analysis has probably been the assumed parallel drawn between the southern and the eastern EU enlargement. After all, it implies that the behaviour of migrants from CEE is exactly the same as that of the migrants from the

[97] Results are summarised in DIW (2000), tables 2-5.

SEC. Thus an analogy neglects individual and historical migration patterns between the emigration and the immigration region, and neither does it consider time specific changes in migration behaviour. However, the democratisation process which took place in the SEC to just the same extent as in the CEEC prior to transition and especially the fearful political discussion about massive immigration inside the EC/EU show strong similarity in both cases of enlargement.

Based on econometric estimates, we calculated emigration patterns of people from the CEEC moving to the EU. Depending on the assumed values of the migration determining variables (income differentials, unemployment rates, migrant stock in the EU and distance) and on the considered coefficients, our calculations suggest an annual migration potential to the EU of 270'000 - 340'000 citizens from the CEEC.

Additionally, we calculated emigration as well as return migration of CEEC citizens, i.e. **net** migration patterns. The results suggest that approximately 100'000 migrants would move from CEE into the EU on a net basis each year provided that there was free mobility of labour. In the course of economic and income convergence these magnitudes of migration are likely to decrease over the years.

We believe that our results initially overestimate the amount of return migration. As long as the CEEC have not built up a migrant stock comparable to the SEC in the EU, return migration is likely to be smaller. Our two econometric estimates can then be interpreted as upper and lower boundaries of potential net immigration from the CEEC.

Since our estimates are based on the hypothetical assumption of south-east analogy and on a simple econometric model they should be regarded as an approximate assessment. A detailed overview of other studies concerning the question of migration in an integrated Europe, however, suggests that we are more or less in line with what other researchers advocate.

TABLE 15: STUDIES CONCERNING THE EAST-WEST MIGRATION POTENTIAL

Study by	Migration Potential into EU	Country / Region of Origin **	Method
Layard et al. (1992)	3% of CEE population over 15 years (200'000 p.a.*)	CEEC (not specified)	Comparison to South-North migration pattern.
Korcelli (1992)	40'000-70'000 p.a.	PL	Examination of economic, demographic, and political pressures
Franzmeyer & Brücker (1997)	590'000 – 1'180'000 p.a.	CEEC-10	Gravity estimate using economic and demographic variables
Walterskirchen & Dietz (1998)	200'000 p.a.	PL, SK, SLO, CZ, H	As Franzmeyer & Brücker (1997)
Birner et al. (1999)	140'000 over period 2004-2013 to Austria only	CZ, SK, H, SLO	As Franzmeyer & Brücker (1997)
Fassmann & Hintermann (1997)	721'000 complete migration potential	CZ, PL, SK, H	Opinion poll in 1996
Shevtsova (1992)	1-2 million in 1993-94 0,5-0,7 million in 2-3 years thereafter	Former USSR	Public opinion polls
Orlowski & Zienkowski (1999)	380'000 – 1,5 million within 10-12 years	PL	Econometric estimation of South-North migration
Bauer & Zimmermann (1999)	2-3% of CEE population over 15 years. (135'000 - 200'000 p.a.*)	CZ, PL, SK, SLO, H, ROM, BUL	Econometric estimation of South-North migration
Boeri & Brücker et al. (2000)	335'843 in 2002, gradual decrease until 2030.	CEEC-10	Econometric error correction model

* Based on an assumed population of 100 million persons in the CEE and that migration is equally distributed over the years. ** Bulgaria (BUL), Czech Rep. (CZ), Hungary (H), Poland (PL), Romania (ROM), Slovak Rep. (SK), Slovenia (SLO).
Source: Own table after Weyerbrock (1995), table 3 and Hönekopp (2000), section 5.3.

5 SIMULATIONS AND DISCUSSION

5.1 INTRODUCTION

After the presentation of the theoretical structure of the CGE model in Chapter 3, it is now time to use the model and simulate actual policy scenarios that would arise in the context of the eastern enlargement of the EU.

Following Balassa's (1961) theory, economic integration of the CEEC will initially consist of several different integration elements. These will be: (i) the creation of a customs union with complete trade liberalisation and tariff harmonisation, (ii) capital transfers and (iii) labour migration. Depending on the outcome of the accession negotiations, CEEC' admission may initially either comprise *partial integration*, i.e. a transition period where, for instance, labour mobility is excluded, or *full integration* where all three integration elements are fulfilled and combined simultaneously. In the very long-run, CEEC' integration will even culminate in participation in the European Monetary Union, an integration stage that will not be considered in this study.

To be able to identify the effects of possible partial integration, we will initially simulate each of the three integration elements individually. These separate simulation results will subsequently also help to break down the outcome of the full integration scenario. Only static or recursive dynamic effects of integration will be considered. In this study we are only interested in the overall consequences for the EU and the CEEC. It is therefore important to remember that only aggregated regions are being analysed. Thus, we neither undertake a quantitative nor a qualitative statement with respect to the intra-regional distribution of the costs and benefits of integration.

This chapter is structured in the following way: Section 2 will look at complete trade liberalisation and ignore all forms of factor movements between the CEEC and the EU. Section 3 will focus on official capital transfers from the EU to the CEEC, neglecting labour mobility and trade liberalisation. Section 4 will study labour mobility under the assumption that capital movements do not exist and that trade liberalisation remains at pre-integration levels. We differentiate between pure emigration and net migration as well as between the mobility of both skilled and unskilled workers together and mobility of skilled workers alone (brain drain / brain gain). Sections 5 and 6 will then intend to provide a synthesis by including all three integration elements in one simulation. Whereas in section 5 we apply a purely static scenario distinguishing between a moderate and an extreme integration scenario, section 6 will spotlight a recursive dynamic, all-inclusive model which also considers the capital formation process within each region. Section 7 will provide an overview and a comparison with other CGE studies which have recently analysed the issue of East-West integration. Section 8 will finally summarise. All tables and graphs concerning the different policy experiments are provided at the end of each section.

All simulations undertaken by the base model make use of several exogenous parameters and elasticities. In fourteen different sensitivity analyses throughout this chapter we examine the sensitivity of the model to changing parameter values. In sensitivity analyses (SA) 1-6 we check the influence of trade, demand and labour substitution elasticities. In SA 7 we study a different form of modelling domestic investment. SA 8-13 focus on the model's sensitivity to different values of the income parameter of migration, the labour substitution elasticity and the income ratio of CEEC workers working in the EU. Finally, SA 14 is applied in the recursive dynamic model and explores the importance of domestic capital formation.

5.2 The Customs Union

The first step on the "integration ladder" is the introduction of a free trade area implying the fall of official tariff rates. Through the Europe Agreements which came into effect on 1 March 1992 there was already a clear commitment by the EC to gradually move to free trade with the CEEC. With exception of the so-called *sensitive sectors*, tariffs and quotas for many commodities disappeared as the agreements came into power.[98] Thus the first stage of integration has been reached already in some sectors whereas others are likely to benefit from the introduction of free trade sometime in the future. Experience from the southern enlargement of the EC suggests that membership in the EU is initially accompanied by the creation of a customs union.

A customs union between the EU and the CEEC would be a preferential trading arrangement where all official trade barriers would be removed and, at the same time, the CEEC would have to take over the EU's common external tariff vis-à-vis the rest of the world.

Customs Union Theory:

The orthodox customs union theory builds on relatively strict assumptions: (i) perfect competition on the commodity and factor markets, (ii) perfect factor mobility within the individual regions but not among the regions and (iii) analysis of static effects. These are precisely the assumptions upon which our general equilibrium model is based. However, since customs union theory is a partial equilibrium approach we can only predict some of all possible outcomes.

As Viner (1950), Lipsey (1960) and Johnson (1962) showed, customs unions must not unambiguously lead to economic benefits since two static effects take place: (a) a *trade creation* effect and (b) a *trade diversion* effect. Although the former might be a welfare gain, greater losses might be incurred by the latter. **Trade creation** occurs when inefficient production in a country within the union is replaced by imports from another country in the union which produces the goods more efficiently. Also the abolition of non-tariff barriers (NTB) yields to unambiguous trade creation.

Countries which are not members of the union can experience **trade diversion** as

[98] See Rollo and Smith (1993, 1997) for a detailed analysis on sensitive sectors.

relatively inefficiently produced imports from members of the union substitute imports from non-members. Welfare losses may then take place due to the union-induced shift in the source of imports from lower-cost external sources to higher-cost partner sources. Lipsey (1960) pointed out that under consideration of consumers' substitution effects, trade diversion can, in special situations, also have welfare increasing effects.

Whether the creation of a customs union leads to a net welfare gain or loss cannot be said clearly beforehand. It depends on (a) the slopes of the demand and supply functions (i.e. the price elasticities of demand and supply) and (b) the difference in commodity prices between the CEEC and the EU, which in turn depend on the imposed tariff rates before and after integration. The advantage of a CGE application is the exact determination of supply and demand functions and therefore the calculation of static welfare effects originating from trade integration, a task which would be impossible without a computer in view of the nested production and demand function which we assume.

Standard customs union theory has certain drawbacks: firstly, it neglects all cross-sectoral output effects and ignores consequences on the factor markets. Stolper and Samuelson (1941) concentrated on this issue of cross effects between free trade and factor prices in a 2x2 general equilibrium, Heckscher-Ohlin model. In the famous ***Stolper-Samuelson theorem*** they predicted a rise in the real return to the abundant factor and a fall in the real return to the scarce factor as a consequence of free trade. Secondly, all other state revenues related in some way to the production or consumption in different sectors (e.g. value-added tax) are not taken into account in the overall welfare measure. Hence partial equilibrium models can hardly be an accurate means of predicting welfare effects. Since general equilibrium models consider supply and demand on all product and factor markets simultaneously, their use is certainly superior.

Besides the short-run, static welfare effects which can be enumerated by our model, there are additional static and dynamic upshots which are also likely to come about. Firstly, there may be welfare enhancing terms of trade effects which arise if customs unions are large enough to influence world prices and which go at the expense of producers and consumers outside the union. Secondly, the creation of a customs union implies larger economic markets with intensified competition which is capable of activating hidden efficiency reserves, often also called *X-inefficiencies*. Pelkman (1984) showed that this may induce additional welfare gains. Thirdly, the realisation of internal and external economies of scale results in diminishing average costs for the firm[99] or lower average costs for whole industries and sectors (so-called *learning effects*), and changing market structures may in turn have an influence on innovation and also on economic growth.

[99] Internal economies of scale can be quantified using the concept of *Minimum Efficient Technical Scale* (METS) which measures if the production size of a firm has reached its optimal long-run level so that unit costs reach their minimum.

5.2.1 SCENARIOS

As long as EU-CEEC integration has not taken place, each international region has a different tariff, tax and subsidy system for all trade vis-à-vis itself (i.e. intra-EU trade, intra-CEEC trade), towards each other (i.e. EU-CEEC trade) and towards the ROW. The creation of a customs union would then imply that the CEEC would have to completely adopt the tariff, export tax and subsidy system of the EU. Thus, the following policy measures are being simulated.

Scenario 1: Trade Liberalisation

(a) complete abolition of tariffs and NTB between the EU and the CEEC
(b) complete abolition of tariffs and NTB for all intra-CEEC trade
(c) CEEC' adaptation of EU's external tariff and NTB-system vis-à-vis the ROW
(d) the ROW treating the CEEC equivalently to the EU in matters of protection, export taxes and subsidies
(e) CEEC' adoption of EU's export tax and subsidy system.

TABLE 16 (p. 117) illustrates actual pre-integration and assumed post-integration **protection rates** of the CEEC (in part A) and of the EU / ROW towards the CEEC (in part B), and their change (Δ) in percent. As can be seen in (A), we model trade integration for the CEEC as a reduction or abolition of trade barriers towards the ROW and the EU respectively. The only exception is an increase in protection rates for agricultural products towards the ROW. As (B) clarifies, integration will also imply that EU's protection towards the CEEC vanishes and that there is a moderate decrease in ROW's trade barriers vis-à-vis the CEEC.

TABLE 17 reflects actual pre-integration and assumed post-integration **export tax and subsidy rates** of the CEEC (in part A) and of the EU / ROW towards the CEEC (in part B). Positive values imply that an export tax exists, negative values indicate an export subsidy. As (A) suggests, integration implies that neither taxes nor subsidies for CEEC exports towards the EU would be allowed. Goods being exported into the ROW will, in contrast, be taxed and subsidised according to EU regulations, i.e. large subsidies in the agricultural and food & clothing sectors and modest export taxes in all other sectors. As (B) shows, the creation of a customs union will imply the complete abolition of the EU's protection and subsidy rates vis-à-vis the CEEC. The ROW, in turn, will treat the CEEC in the same way as the EU and impose the same rates.

5.2.2 EXPECTATIONS

Firstly, our simulations should expound **trade creation**, arising from three different sources: (A) the reduction in import tariffs, (B) the fall in export taxes and (C) the increase in export subsidies. FIGURE 9 (p. 122) illustrates all three effects. As can be seen, a fall in import tariffs (A) would be equivalent to a positive demand shift from domestic consumers D(h). It would reduce the import price and increase the quantity of imports demanded from the partner country. Tariff revenue (shaded area) would obviously cease. Hence, the reduction of import protection rates (also vis-à-vis the

ROW) should lead to an increase in imports of the CEEC and the EU respectively.

A reduction in export taxes (B) could be interpreted as a positive domestic supply shock, $S(h)_0$ to $S(h)_1$. Consumers in the partner country would face lower prices and therefore consume more of domestic exports. Export tax revenues would be reduced. The fall of export tax rates which we model should therefore enhance exports.

Finally, a potential increase in export subsidies (C) would be similar to the export tax effect, i.e. reduce export prices and increase the export demand of the partner country. Subsidies would place an additional burden on the national budget. As TABLE 17 shows, the CEEC are assumed to increase their export subsidies for agriculture and food & clothing vis-à-vis the ROW. This can be expected to result in strong additional export enhancing effects.

Since the EU is an important trading partner for the CEEC, the degree of trade creation should be particularly pronounced in CEE. For the EU these effects can be expected to be much more moderate since the CEEC constitute only a small trading partner.

Secondly, there would be moderate **trade diversion**, a phenomenon which our results can not identify because the direction of trade is not explicitly displayed. Still, an increase in relative tariff rates of the CEEC towards the ROW would imply that relatively inefficient producers inside the union would be able to substitute former imports from the ROW. Also any reduction of export subsidies should reduce the quantity of trade. The expression *"relative tariffs"* describes the situation of the CEEC which are also assumed to adopt the EU's lower tariff rates towards the ROW. Thus the question as to whether or not trade diversion will eventually take place is mainly a question of which tariff rates, those towards the EU or those towards the ROW, will be reduced more. Hence, in the CEEC, unambiguous trade diversion should take place in the agricultural sector since tariff rates clearly rise. Possible trade diversion could occur in the minerals & energy, the food & clothing, the manufacturing and the high-tech sectors. No trade diversion should happen in the transport service sector. The EU, in contrast, should only experience moderate trade diversion with the ROW as a consequence of the lower trade barriers towards the CEEC.

Following the predictions of the *Stolper-Samuelson theorem*, free trade between the CEEC and the EU should have effects on **factor prices**. The real return to the abundant factor should rise, the real return to the scarce factor should fall. Since our model deviates from the 2x2 assumptions (two goods, two factors) of the theorem it should, however, be remembered that our results can only approximate the Stolper-Samuelson theorem.[100] A one-to-one correspondence is not possible.

With respect to the overall **welfare** consequences, Viner's (1950) customs union theory suggests that strong trade creation will result in a welfare increase for both partner regions. It is difficult, however, to formulate precise expectations concerning the size of

[100] As we explained in section 3.5.3, contrary to our model the H-O theorem assumes a world of identical production technologies.

the welfare effects since the precise shape and locus of the demand curves in each sector need to be determined,[101] a difficult task in view of the nested production and demand structure of our CGE-model. It can be expected, however, that the CEEC, in particular, will experience net trade creation and hence a welfare increase.

5.2.3 Simulation Results

Simulating the creation of a customs union between the EU and the CEEC yields the following static integration effects. Table 18(A) and (B) on p. 119 f. illustrates the results for the CEEC and the EU respectively.

The table is structured in the following way: we display results by individual sectors in the columns and/or aggregated results for the whole economy in the last column (*All sectors*). At the top of the table, there is information about welfare changes calculated in the form of Hicks' equivalent variation, the general domestic price level and the terms of trade. In the next part of the table we display the **supply** or production side of the economies. All domestic output is either sold on the domestic market or exported abroad. Results are divided into sector specific information on *quantities*, *nominal prices* and *real prices*. All values display percent changes from the benchmark equilibrium. Aggregated results contain sectoral weights. Real prices divide the nominal price level by the general price level.

The centre part of the table illustrates the **demand** side of the economy consisting of information on imports and of information on the intermediate, private and government demand for Armington goods.

The lower part of the table shows different results for the **factors of production** (we have excluded information on the factor *land & resources* from the tables). In this context we report changes of factor demand, of nominal and of real factor prices. For skilled and unskilled labour, factor prices represent wages whereas for capital they represent capital returns (i.e. interest + depreciation rates).

5.2.3.1 Simulated Integration Effects for the CEEC

The simulations concerning the scenario of complete trade integration between the CEEC and the EU provide interesting static effects. Mostly they coincide with the expectations which we formulated earlier.

Particularly the CEEC seem to benefit from a complete abolition of trade barriers. As Table 18(A) shows, there is a rise in overall **welfare** by 0.9%. To some readers, this degree of welfare expansion will seem unrealistically small. Indeed our results are likely to underestimate the full range of welfare effects which will probably come about as a consequence of a customs union. Slightly stronger gains are calculated by Baldwin et al. (1997 :138). In a conservative scenario they model EU-CEEC trade integration under the assumption of scale economies and imperfect competition and obtain an increase in real income by 1.5% for the CEEC. In addition to that, our model also ignores dynamic

[101] The shape of the supply curves is easily identifiable since CRTS always imply perfectly elastic supply (horizontal curve).

effects from trade integration.[102] Rutherford and Tarr (1998: 3) point out that simulation results may vary depending on whether or not dynamic gains such as the import of technologically advanced products or greater product variety are being considered. Brown et al. (1997), for instance, undertake a CGE-analysis of CEEC-EU trade integration also incorporating rationalisation effects by considering scale economies and increasing product variety. Their welfare effects range from 5% to over 7% for the CEEC.[103] Since dynamic effects tend to capture the medium to long term horizon, our study should thus be interpreted as a typical short-run evaluation.

Substantially lower import and rising export prices exercise a downward influence on the general domestic **price level** (-1.8%) benefiting domestic consumers and improving the **terms of trade** (the ratio of the index of export prices to the index of import prices) strongly (+6.3%).

Aggregate domestic **output** rises by a moderate 0.1%. We observe a varying sectoral distribution of effects. There is a strong output expansion in agriculture (+3.3%) as well as food & clothing (+2.3%) whereas manufacturing (-2.1%) clearly contracts. Although in our model this does not cause a problem because we assume perfect intersectoral mobility of labour and capital, such sectoral changes would in reality be followed by severe social costs such as temporary unemployment, costs of retraining, etc.

The non-tradable savings and investment sector increases its output by 0.9% which is identical to the welfare increase of the CEEC (+0.9%). This coincides with the model's assumption of a marginal propensity to save which holds investment as a constant fraction of expenditure in the economy.

As soon as we break up domestic output into the two different markets where it is being sold (i.e. domestic and export market), we obtain a rather more diverse picture. **Domestically sold products** experience an overall decrease of 1.2% (last column), which is mainly influenced by the rather strong fall of the manufacturing and the high-tech sectors. There are also some sectors, such as agriculture, private and public services, which experience a moderate increase. Nominal domestic product prices behave in a similar way. In most sectors there is a fall which amounts to a weighted decrease of 1.3% for all sectors. The weighted real price level, however, rises slightly (+0.5%) which is due to the even stronger fall of the general price level.

This contraction of the output pattern on the domestic market clearly reflects two previously mentioned integration effects: (i) the lower import protection rates of the CEEC towards the EU and the ROW (recall TABLE 16 A) and (ii) the lower export tax rates of the EU and the ROW towards the CEEC (recall TABLE 17 B). Both effects clearly lead to a decrease in the price of foreign goods boosting the competitiveness of foreign producers. Its result is a substitution towards a higher ratio of imports to the detriment of domestic producers.

[102] "Dynamic" in this context means a model structure where scale economies and rationalisation gains can be realised. It does not stand for forward looking agents and rational expectations.

[103] Brown et al. (1997), table 2.5.

We also observe an overall rise in **export** quantities by 6.8% with the agricultural sector even exporting 35% more than in the benchmark situation which confirms our predictions. Higher aggregate export prices (+2.9%) reflect the positive demand shock in the EU and the ROW for CEEC' commodities. As we illustrated in FIGURE 9(A) this shock comes from falling import protection rates. Contracted exports which we observe in the mineral & energy (-1%) as well as the transport service sector (-1%) can be explained with the adoption of EU's export tax structure forcing the CEEC to increase their export taxes vis-à-vis the ROW to 0.5% and 0.7% respectively. Due to lower **import** protection rates we observe strongly rising quantities of imported goods (in total +8.6%) and at the same time falling nominal import prices (-5.2%). Those sectors which experience a moderate increase in output and a decrease in imports (private and public services) are the ones whose protection rates have not altered in the course of integration. Their rising performance with respect to domestic sales must then mainly stem from overall increased domestic demand. The logical side effect of trade creation, namely the replacement of dearer domestic production, is also evident. Reduced production of goods which are intended for sale on the CEEC' domestic market is clear cut.

Overall, there are strong trade creation effects as formulated in our expectations. Our results do not permit us to identify the precise quantities traded with the other two international regions. We cannot therefore make any statement with respect to trade diversion, i.e. whether the reduction in protection rates towards the EU has been strong enough to drive out trade with the ROW.

The demand for **Armington composites** has to be divided into the three categories of domestic demand which are intermediate inputs, private and government demand. Whereas the demand for intermediates experiences only a very moderate increase of 0.2%, private and government demand each rise by 0.9% which is precisely the amount of welfare gain of the counterfactual equilibrium. This is not surprising since one of the model's assumptions was the *income-balance condition*, i.e. all money that is earned has to be spent. For government spending we further assumed a constant government share in total welfare.

In all three demand categories we can also observe a fall in the nominal prices of the Armington goods resulting from lower import prices. It may seem peculiar that prices of the same sector show different variations depending on the demand category where they are required. For instance, the price of minerals & energy experiences a nominal fall of 0.2% as an intermediate input, a fall of 0.1% as a private consumption good and no alteration at all as a government good. These sector-specific price differences are due to dissimilar tax rates in the different demand categories.[104] The aggregate price for each demand category (last column) also varies since it is additionally compounded by different sectoral weights: in the intermediate demand category the manufacturing sector is dominant whereas it is the food & clothing sector in the private demand category and public services in the government demand sector. Depending on their

[104] Recall from section 3.3.3. that there are specific tax rates for intermediate inputs, private and government demand.

individual price performance, the aggregate price is obviously strongly influenced. We therefore obtain aggregate nominal price reductions of 2.1% for intermediates, of 1.8% for private goods and of 1.7% for government goods.

The supplied quantity of the **factors of production** is still characterised by perfect factor mobility within one region but complete international immobility. This is why the last column in TABLE 18(A) displaying the factor supply does not have any value. Perfect internal factor mobility implies that factors move according to the return they achieve in each sector. The resulting arbitrage process eventually leads to identical factor returns throughout the whole region.

In the production function we have assumed that we have a Leontief type of relationship between value-added and intermediate inputs (EQ. 2). The changes mentioned in the price structure of intermediate inputs therefore also change the sectoral demand and consequently the price of value-added too. The resulting inter-sectoral reallocation of the factors is the logical consequence. It is thus natural that the change of *sector specific* factor supply (aggregate supply is constant) roughly follows the output pattern: an increase in the output quantity of a sector is complemented by an increase in value-added (compare the row *"Factor supply"* with the row *"Output quantity"*).

Within the value-added nest, labour and capital (and land) can be substituted with an elasticity of one, which implies Cobb-Douglas technologies (EQ. 3). This enables a certain degree of substitution between the different primary factors depending on the relative factor prices. It is precisely in the *private* and *public services* sector that this has been particularly strongly the case: the output increase has been accompanied by an increase in value-added with labour rising disproportionately thereby substituting capital.

Finally, the substitutability of skilled and unskilled labour has initially been assumed to be zero. Thus, both labour categories enter production in fixed ratios. This explains why the supply of both categories changes to exactly the same extent in the different sectors.

With respect to **factor prices** we observe a rather differentiated pattern. Whereas the capital price rises moderately by 1.1%, the price of skilled labour (i.e. wages) falls by 3% and unskilled labour wages rise by 2.7%. Why is there such a different wage performance despite equal labour demand changes? Remember that our model is based on the assumption of complete price flexibility on all markets also on the factor markets. In other words, prices adjust in order to ensure the equilibrium between supply (which is assumed to be fixed) and demand. Deviating wage shifts in the two individual labour markets must then be due to differing demand for skilled and unskilled labour. Thus the counterfactual equilibrium is characterised by a substantially higher demand for unskilled labour and a lower demand for skilled labour compared with the benchmark equilibrium. How can that happen if both labour categories rise and fall in exactly the same proportion? It is a consequence of the combination of the Leontief technology on the labour market and the sectorally differing output performance which require either a greater proportion of skilled or unskilled labour. FIGURE 11 (p. 125) illustrates the situation on the basis of two exemplary sectors. Sector (a) requires a high proportion of unskilled labour whereas sector (b) necessitates a lot of skilled labour for production. For the sake of analysis, we ignore the other primary production factors and all other sectors for a moment. As illustrated, in sector (a) there is a tendency to increase output from I_0 to I_1 due to, e.g. cheaper intermediate inputs. This tendency leads to a significantly increased demand for unskilled labour whereas skilled labour demand only rises very moderately. At the same time, sector (b) faces an output fall releasing skilled labour on a large scale and unskilled labour on a small scale. Combining the output tendencies in both sectors, it is possible to say that there is an overall rise in the demand for unskilled labour and an overall fall in the demand for skilled labour, with labour prices adapting to clear the markets. This contrasting demand performance will then be reflected in rising wages for unskilled and falling wages for skilled workers.

This is precisely the case in our simulations. The strongest output increase takes place in the agricultural as well as the food & clothing sector. Both these sectors produce intensively using unskilled labour relative to skilled labour. The positive production shift therefore mainly results in an increased demand for unskilled labour, as FIGURE 12 illustrates. In contrast to that, skilled labour experiences an overall decrease in demand resulting in the aforementioned wage effects.

Deflating factor prices yields real factor prices. On a real basis, wages for skilled labour fall by 1.1%, for unskilled labour they rise by 4.6% and capital return increases by 3%.[105] Thus the strongest beneficiaries within the CEEC are blue collar workers and capital owners. An approval of trade liberalisation from these groups should therefore be likely, quite in contrast to white collar workers.

As we saw, the strongest positive reactions to liberalisation take place in the agricultural and the food & clothing sectors, particularly on the export side. Since unskilled labour is used intensively in agriculture, and capital in food & clothing, a rise in both real factor prices confirms the Stolper-Samuelson theorem which implies that our model approximates the H-O type of world fairly well.

5.2.3.2 Simulated Integration Effects for the EU

The simulation results for the EU presented in TABLE 18(B) already differ from those for the CEEC outwardly: all values in this table have two rather than one decimal digit because effects in the EU are very small. This way we can at least illustrate the tendency.

Looking at the extent and importance of EU-CEEC trade from an EU-perspective, it is almost self-explanatory why CEEC' integration has so little impact on the EU. FIGURE 10(A) and (B) display EU's exports and imports respectively. On average the EU's trade with the CEEC accounts for only 2-3%. It is therefore no surprise that the simulation of trade liberalisation results in only minimal effects for the EU. In this respect our results resemble other CGE studies: Hinojosa-Ojeda et al. (1992), for instance, estimate that Hungarian trade integration does not have any impact on Austria's real GDP[106] at all and Baldwin et al. (1997 :138) calculate an increase of only 0.2% of real EU income.

[105] Using a different model, Brown et al. (1997 :44/45) come to similar results. They calculate an increase in the real return on labour of 3-5% and a decrease in the return on capital of 2-3% in the CEEC.

[106] See Hinojosa-Ojeda et al. (1992), table 9.

TABLE 18(B) shows that the EU experiences a decrease in welfare, minimal inflation and an improvement in its terms of trade. Aggregate **output** and **domestic sales** barely change. The moderate increase in **exports** reflects the changes of CEEC' import protection and the EU's export tax and subsidy rates. The EU, for instance, is not able to increase its exports of agricultural products to the CEEC despite a fall in protection rates in this sector (see TABLE 16 A). This is due to the elimination of all agricultural export subsidies by the EU, which comes about in the course of integration (see TABLE 17 B). The increased export prices reflect the strong positive demand shock for EU imports in the CEEC which result from the abolition of import protection rates. The elimination of EU export subsidies additionally induces a rise in export prices, for example in the food & clothing sector.

Most of the EU's **imports** increase slightly due to lower EU protection rates. The agricultural sector, especially, experiences a rise in imports. Despite the fact that the EU's agricultural protection rates are not the ones which decrease the most, this is all the more noteworthy. Probably a higher import price elasticity is responsible for this disproportionate rise. Import prices fall and behave as expected.

In total, the EU experiences moderate trade creation. Although not directly identifiable, it is possible that a small degree of trade diversion towards the ROW takes place. The minimal decrease in welfare seems to argue in favour of welfare decreasing trade diversion surpassing welfare enhancing trade creation.

The **demand for Armington goods** reflects the pattern of production and welfare changes. Whereas intermediate goods are demanded on a higher scale due to higher domestic production, private and government demand overall fall in course of the welfare decrease. In each of the three demand categories, sectoral and aggregate Armington prices behave similarly.

The sectoral distribution of the **production factors** again follows the sectoral output changes: an increase in output is accompanied by an increase in production factors and vice versa. In contrast to the effects in the CEEC, all production factors now change by roughly the same amount. Thus, a strong substitution between labour and capital does not take place. It is therefore also natural that nominal and real factor prices develop similarly. There is a slight rise in nominal and real factor prices.

We draw attention to the fact our model cannot illustrate long-run, dynamic effects in the context of the creation of a customs union since they are based on assumptions, such as rapidly changing technologies, increasing returns to scale and imperfect competition, which are not covered by the functional form of our model. It is unlikely, however, that a dynamic model would yield significantly different results. The monopolistic competition, increasing returns to scale model of Brown et al. (1997 :44) also derives very small effects for the EU. They calculate a welfare gain amounting to merely 0.1-0.2%. The low importance of a different functional form thus suggests that the EU's economic structure is unlikely to react to the integration of a small economic region such as the CEEC.

5.2.3.3 Sensitivity Analyses

In this section we apply seven different sensitivity analyses concerning different important key elasticity values. In SA 1-6 we concentrate on trade, demand and labour elasticities whereas SA 7 focuses on a different formulation of investment and government demand as the following table illustrates:

	Trade elasticities	Elasticity of substitut. of Armington demand	Labour elasticity
Base model:	$\sigma_{DM} = 4$ $\sigma_{MM} = 8$ $\eta = 2$	Cobb-Douglas	$\sigma_{lc} = 0$ (Leontief)
SA 1:	$\sigma_{DM} = 2$ $\sigma_{MM} = 4$ $\eta = 1$	as in base model	as in base model
SA 2:	$\sigma_{DM} = 6$ $\sigma_{MM} = 10$ $\eta = 4$	as in base model	as in base model
SA 3:	as in base model	CES with elasticity value of 2	as in base model
SA 4:	as in base model	CES with elasticity value of 0.5	as in base model
SA 5:	as in base model	as in base model	$\sigma_{lc} = 0.5$
SA 6:	as in base model	as in base model	$\sigma_{lc} = 1$ (Cobb-Douglas)
SA 7:	as in base model	as in base model	as in base model
	exogenous investment and exogenous government demand		

The results from all SA can be seen in TABLE 19 (p. 121). We only focus on aggregate values ignoring specific sectors. The column denoted *"Base"* replicates the aggregate simulation results from our base model. All other columns display the results of the corresponding elasticity change. As can be seen, the CEEC generally show a reaction to the SA. The effects in the EU hardly deviate from the results of the base model.

In **SA 1 and 2** we vary the important trade elasticities σ_{DM}, σ_{MM} and η (see EQ. 6, 7 and 16) which we derived from the "Uruguay model".[107] The CES substitution elasticity σ_{DM} determines the substitutability between domestic and imported Armington goods. σ_{MM} controls the substitutability of imports from different regions. The higher the elasticity values, the less will domestic and imported goods be imperfect substitutes. The CET elasticity, η, defines the substitutability between the domestic market and exports. Compared to the elasticity values of the base model, SA 1 decreases substitution and transformation elasticities whereas SA 2 increases them. As TABLE 19 suggests, SA 1 affects the extent of trade, the general price level and sales on the domestic market. Welfare shows some minor negative deviation. SA 2 shows deviating effects for trade, output and domestic sales. Thus, the simulation results are partly sensitive to trade elasticities.

[107] See section 3.5.1.

SA 3 and 4 analyse the effects of a deviation of the CES substitution elasticities of aggregate Armington goods for private- and government demand. As EQ. 9 illustrates, the base model implies the substitution of aggregate Armington goods for private (CD) and public consumption (GD) to be Cobb-Douglas. In terms of a CES function this means an elasticity of substitution of one. In SA 3 this functional form is altered by modelling an elasticity value for the substitution of aggregate Armington goods of two, implying greater substitutability. Only minor deviations from the base model can be observed. A decrease in both substitution elasticities to 0.5 also only shows small effects on simulation results. Thus, both substitution elasticities for private and government demand are relatively insensitive to deviations.

SA 5 and 6 focus on the substitution elasticity of the production factor labour (EQ. 4). In the base model we assume that both labour categories are being used in fixed ratios (i.e. we have a Leontief relationship with $\sigma_{lc} = 0$). The sensitivity analyses then investigate if an increase in the substitutability between skilled and unskilled labour has any significant effects. In SA 5 we therefore recalculate the model with $\sigma_{lc} = 0.5$. Factor prices deviate considerably from the base model. The price for skilled labour rises and that for unskilled labour falls. This effect is even more profound as soon as we further increase the substitution elasticity to one. Thus, it is clear that greater substitutability implies that endowment prices are brought more and more into line. In the hypothetical case of perfect substitutability we should therefore face identical factor prices in both labour categories.

SA 7 differs from the other sensitivity analyses in that it does not alter exogenous elasticity values. Instead, it is a change in the model's assumptions with respect to the behaviour of investment and government demand. As explained in section 3.6.1, investment is modelled endogenously in our base model. This modelling is altered in SA 7, where we apply the *Fixed Investment Approach*. Additionally, government demand is now assumed to be constant irrespective of real GDP, contrary to the base model where we assume a constant government share in total output. As the results in TABLE 19 illustrate, mainly welfare reacts positively. Since fixing the government demand implies that more resources are available for private consumption, it is natural that private demand quantities increase whereas government demand quantities do not change. There are also pronounced effects on factor prices of skilled and unskilled labour.

All in all, the effects of the different sensitivity analyses on welfare are rather moderate. Compared to the base model's results merely a different modelling of investment and government demand (SA 7) leads to stronger deviations. A careful consideration of the right functional form therefore seems appropriate. In terms of the values of the other endogenous variables of our model, the sensitivity analyses do partly cause stronger deviations. A careful choice of the trade elasticities and particularly of the labour substitution elasticity is advisable. Since our trade elasticities are based on values used in other CGE studies and our labour elasticity has been chosen on the basis of plausibility considerations we must admit that this constitutes a weakness of our results. A stronger empirical justification of the values would we useful.

TABLE 16: IMPORT PROTECTION RATES. PRE- AND POST-INTEGRATION

(A) IMPORT PROTECTION RATES OF THE CEEC

	towards ROW			towards EU			towards CEEC		
Sector:	pre int.	post int.	Λ in %	pre int.	post int.	Λ in %	pre int.	post int.	Λ in %
Agriculture	14,0%	19,3%	38%	25,1%	0%	-100%	0%	0%	
Min. & Energy	1,7%	1,6%	-6%	0%	0%		2,4%	0%	-100%
Food & Clothing	20,3%	17,6%	-13%	10,4%	0%	-100%	16,2%	0%	-100%
Manufacturing	9,5%	6,7%	-29%	3,2%	0%	-100%	5,8%	0%	-100%
High tech	11,4%	7,3%	-36%	3,8%	0%	-100%	8,2%	0%	-100%
Priv. services	0%	0%		0%	0%		0%	0%	
Transport serv.	1,5%	0,5%	-67%	0%	0%		0%	0%	
Public services	0%	0%		0%	0%		0%	0%	

(B) IMPORT PROTECTION RATES TOWARDS THE CEEC

	of the EU			of ROW		
Sector:	pre int.	post int.	Λ in %	pre int.	post int.	Λ in %
Agriculture	9,4%	0%	-100%	7,1%	8,8%	24%
Min. & Energy	2,3%	0%	-100%	1,1%	0%	-100%
Food & Clothing	12,3%	0%	-100%	10,6%	13,5%	27%
Manufacturing	7,6%	0%	-100%	7,8%	2,7%	-65%
High tech	7,8%	0%	-100%	11,3%	3,9%	-65%
Priv. services	0%	0%		0%	0%	
Transport serv.	0%	0%		0%	0%	
Public services	0%	0%		0%	0%	

Source: GTAP4 dataset [parameter tm(i,r,s)].

TABLE 17: EXPORT TAX AND EXPORT SUBSIDY RATES. PRE- AND POST-INTEGRATION

(A) EXPORT TAX AND EXPORT SUBSIDY RATES OF THE CEEC

	towards ROW		towards EU		towards CEEC	
Sector:	pre int.	post int.	pre int.	post int.	pre int.	post int.
Agriculture	6,4%	-14,5%	-2,9%	0%	5,3%	0%
Min. & Energy	-0,2%	0,5%	0%	0%	0%	0%
Food & Clothing	-4,6%	-10,4%	-2,2%	0%	-3,5%	0%
Manufacturing	0%	0,4%	0%	0%	0%	0%
High tech	0%	0,3%	0%	0%	0%	0%
Priv. services	0,2%	0,7%	0%	0%	0%	0%
Transport serv.	0%	0,8%	0%	0%	0%	0%
Public services	0%	0,2%	0%	0%	0%	0%

(B) EXPORT TAX AND EXPORT SUBSIDY RATES TOWARDS THE CEEC

	of the EU		of the ROW	
Sector:	pre int.	post int.	pre int.	post int.
Agriculture	-6,9%	0%	3,3%	2,2%
Min. & Energy	0%	0%	1,3%	1,5%
Food & Clothing	-3,5%	0%	-1,4%	-0,5%
Manufacturing	0,4%	0%	0,6%	0,1%
High tech	0,4%	0%	1,2%	1,4%
Priv. services	0,8%	0%	2,8%	5,4%
Transport serv.	1,0%	0%	4,5%	3,5%
Public services	0,2%	0%	1,7%	1,0%

Note: Positive values imply export tax rates, negative values export subsidy rates.
Source: GTAP4 dataset [parameter tx(i,r,s)].

TABLE 18: EFFECTS OF TRADE LIBERALISATION, SCENARIO 1
(% CHANGE FROM BENCHMARK)

(A) CEEC

	CEEC	Scenario:	Agriculture	Min. & Energy	Food & Clothing	Manufacturing	High tech	Priv. services	Transport serv.	Public services	Savings and investment	All sectors
			1 Trade integration									
	Equivalent variation (real GDP)											0,9
	General price level											-1,8
	Terms of trade											6,3
Supply Side	Output	quantity	3,3	-1,7	2,3	-2,1	0,3	0,2	-1,2	0,6	0,9	0,1
	Domestic market	quantity	1,4	-1,8	-0,6	-4,6	-4,8	0,2	-1,2	0,6	0,9	-1,2
		nominal price	-0,4	0,0	-2,1	-2,3	-4,2	-0,5	0,3	-1,5	-2,3	-1,3
		real price	1,5	1,9	-0,3	-0,4	-2,4	1,4	2,2	0,3	-0,5	0,5
	Exports	quantity	35,3	-1,0	17,3	4,3	8,9	0,0	-1,0	2,9	-	6,8
		nominal price	15,1	0,4	6,3	2,2	2,4	-0,4	-0,5	2,2	-	2,9
		real price	17,3	2,3	8,3	4,1	4,4	1,3	2,3	1,5	-	4,8
Demand Side	Imports	quantity	0,0	2,3	13,0	13,1	7,7	-2,8	4,0	-4,0	-	8,6
		nominal price	0,0	-1,1	-5,2	-6,4	-7,2	0,3	-0,9	-0,5	-	-5,2
		real price	1,9	0,7	-3,4	-4,6	-5,4	2,2	0,9	1,4	-	-3,4
	Intermediate demand	quantity	2,2	-1,2	1,9	-0,5	0,2	0,2	-0,1	-0,1	-	0,2
		nominal price	-0,3	-0,2	-2,9	-3,4	-5,8	-0,4	0,2	-1,5	-	-2,1
		real price	1,5	1,6	-1,0	-1,6	-4,0	1,5	2,0	0,3	-	-0,3
	Private demand	quantity	-0,7	-0,9	1,6	2,3	5,1	-0,6	-1,2	0,5	-	0,9
		nominal price	-0,4	-0,1	-2,6	-3,2	-5,8	-0,4	0,2	-1,5	-	-1,8
		real price	1,5	1,8	-0,8	-1,4	-4,0	1,4	2,1	0,3	-	0,0
	Government demand	quantity	-0,5	-0,8	1,8	2,4	4,7	-0,4	-1,1	0,7	-	0,9
		nominal price	-0,4	0,0	-2,6	-3,2	-5,3	-0,4	0,2	-1,5	-	-1,7
		real price	1,5	1,8	-0,8	-1,4	-3,5	1,5	2,1	0,3	-	0,1
Factors of Production	Factor supply	skilled labour	3,9	-1,5	1,9	-2,4	0,1	0,3	-1,4	0,9	-	-
		unskilled labour	3,9	-1,5	1,9	-2,4	0,1	0,3	-1,4	0,9	-	-
		capital	5,4	-1,0	2,7	-1,8	0,6	-0,1	-0,7	-1,1	-	-
	Nominal factor prices	skilled labour										-3,0
		unskilled labour										2,7
		capital										1,1
	Real factor prices	skilled labour										-1,1
		unskilled labour										4,6
		capital										3,0

Source: Own calculations

(B) EU

	EU	Scenario:	Agriculture	Min. & Energy	Food & Clothing	Manufacturing	High tech	Priv. services	Transport serv.	Public services	Savings and investment	All sectors
			1 Trade integration									
	Equivalent variation											-0,01
	General price level											0,02
	Terms of trade											0,04
Supply Side	Output	quantity	-0,19	-0,01	0,08	0,08	0,01	-0,01	0,00	-0,02	-0,01	0,01
Supply Side	Domestic market	quantity	-0,19	-0,01	0,02	0,04	-0,02	-0,01	-0,01	-0,02	-0,01	-0,01
		nominal price	0,01	0,03	-0,03	0,00	0,01	0,03	0,03	0,04	0,02	0,02
		real price	0,00	0,02	-0,05	-0,01	-0,01	0,02	0,02	0,02	0,00	0,01
	Exports	quantity	-0,24	0,01	0,31	0,21	0,05	-0,02	0,03	-0,05	-	0,11
		nominal price	-0,01	0,04	0,12	0,09	0,04	0,03	0,05	0,02	-	0,06
		real price	-0,03	0,03	0,10	0,07	0,03	0,01	0,03	0,01	-	0,05
Demand Side	Imports	quantity	0,80	0,05	0,09	-0,02	0,03	0,11	-0,05	0,06	-	0,06
		nominal price	-0,24	0,02	-0,05	0,02	0,00	0,00	0,04	0,02	-	-0,01
		real price	-0,25	0,01	-0,06	0,00	-0,02	-0,01	0,03	0,00	-	-0,02
	Intermediate demand	quantity	0,03	0,03	0,03	0,03	0,00	0,00	0,01	-0,01	-	0,01
		nominal price	-0,04	0,03	-0,03	0,01	0,01	0,03	0,03	0,03	-	0,02
		real price	-0,06	0,01	-0,05	-0,01	-0,01	0,02	0,02	0,02	-	0,00
	Private demand	quantity	0,07	-0,03	0,04	0,00	0,00	-0,03	-0,03	-0,03	-	-0,01
		nominal price	-0,07	0,03	-0,03	0,01	0,00	0,03	0,03	0,04	-	0,02
		real price	-0,08	0,02	-0,05	-0,01	-0,01	0,02	0,02	0,02	-	0,00
	Government demand	quantity	0,21	-0,01	0,06	0,02	0,02	-0,01	-0,01	-0,01	-	-0,01
		nominal price	-0,19	0,03	-0,04	0,01	0,00	0,03	0,03	0,04	-	0,03
		real price	-0,20	0,02	-0,05	-0,01	-0,01	0,02	0,02	0,02	-	0,02
Factors of Production	Factor supply	skilled labour	-0,21	-0,02	0,08	0,08	0,01	-0,01	0,00	-0,02	-	-
		unskilled labour	-0,21	-0,02	0,08	0,08	0,01	-0,01	0,00	-0,02	-	-
		capital	-0,21	-0,01	0,09	0,09	0,01	-0,01	0,00	-0,02	-	-
	Nominal factor prices	skilled labour										0,05
		unskilled labour										0,04
		capital										0,04
	Real factor prices	skilled labour										0,03
		unskilled labour										0,02
		capital										0,02

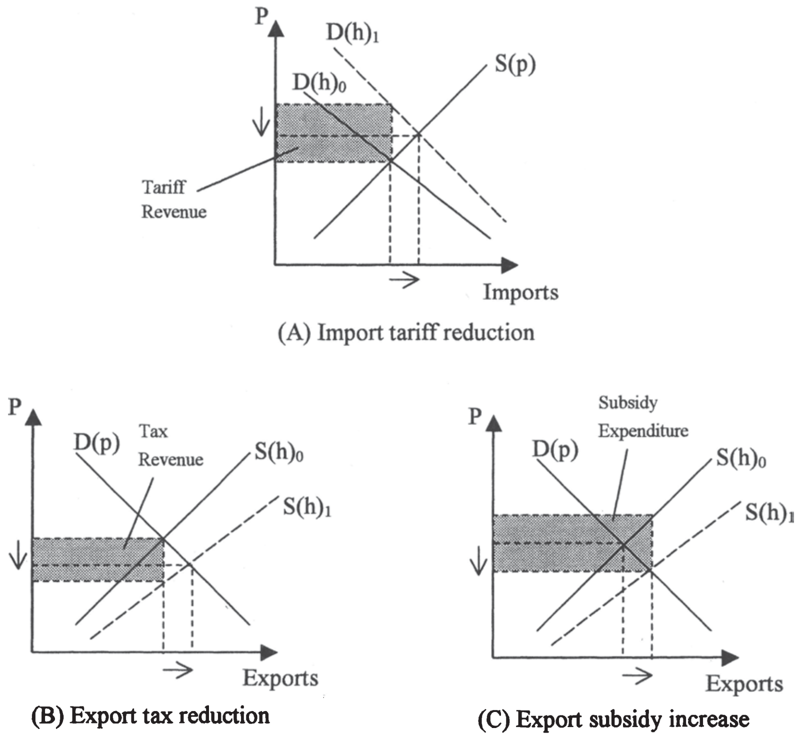
Source: Own calculations

TABLE 19: SENSITIVITY ANALYSES 1-7 (% CHANGE FROM BENCHMARK)

CEEC			Base	SA 1	SA 2	SA 3	SA 4	SA 5	SA 6	SA 7
	Equivalent variation (real GDP)		0,9	0,7	0,8	0,8	0,9	0,8	0,8	1,3
	General price level		-1,8	-0,9	-1,7	-1,9	-1,8	-1,8	-1,8	-1,8
	Terms of trade		6,3	5,8	6,0	6,3	6,3	6,3	6,3	6,3
Supply Side	Output	quantity	0,1	0,1	0,0	0,2	0,0	0,1	0,1	0,0
	Domestic market	quantity	-1,2	-0,5	-2,4	-1,2	-1,3	-1,2	-1,2	-1,3
		nominal price	-1,3	-1,0	-1,2	-1,4	-1,3	-1,3	-1,3	-1,4
	Exports	quantity	6,8	3,1	12,7	7,3	6,6	6,8	6,8	6,8
		nominal price	2,9	2,8	2,6	2,8	2,9	2,9	2,9	2,9
Demand Side	Imports	quantity	8,6	5,0	14,1	9,1	8,4	8,6	8,7	8,6
		nominal price	-5,2	-5,0	-5,3	-5,2	-5,2	-5,2	-5,2	-5,2
	Intermediate demand	quantity	0,2	0,2	0,1	0,4	0,0	0,2	0,2	0,1
		nominal price	-2,1	-1,8	-2,0	-2,2	-2,1	-2,1	-2,1	-2,1
	Private demand	quantity	0,9	0,7	0,8	0,8	0,9	0,8	0,8	1,3
		nominal price	-1,8	-0,9	-1,7	-1,9	-1,8	-1,8	-1,8	-1,8
	Government demand	quantity	0,9	0,7	0,8	0,8	0,9	0,8	0,8	0,0
		nominal price	-1,7	-0,8	-1,8	-1,8	-1,6	-1,3	-1,2	-1,9
Factors of Prod.	Nominal factor prices	skilled labour	-3,0	-1,9	-5,0	-3,5	-2,5	0,8	1,2	-4,8
		unskilled labour	2,7	3,3	3,3	2,7	2,6	1,7	1,7	3,1
		capital	1,1	2,0	1,0	1,0	1,2	1,2	1,2	1,1
	Real factor prices	skilled labour	-1,1	-1,0	-3,3	-1,6	-0,7	2,7	3,1	-3,0
		unskilled labour	4,6	4,2	5,1	4,7	4,5	3,6	3,6	5,0
		capital	3,0	2,9	2,8	3,0	3,0	3,1	3,1	3,0
EU	Equivalent variation (real GDP)		-0,01	-0,01	-0,01	-0,01	-0,01	-0,01	-0,01	-0,02
	General price level		0,02	0,02	0,01	0,02	0,02	0,02	0,02	0,02
	Terms of trade		0,04	0,04	0,05	0,04	0,04	0,04	0,04	0,04
Supply Side	Output	quantity	0,01	0,00	0,01	0,01	0,01	0,01	0,01	0,01
	Domestic market	quantity	-0,01	-0,01	-0,02	-0,01	-0,01	-0,01	-0,01	-0,01
		nominal price	0,02	0,02	0,03	0,02	0,02	0,02	0,02	0,03
	Exports	quantity	0,11	0,07	0,18	0,12	0,10	0,10	0,10	0,10
		nominal price	0,06	0,07	0,06	0,06	0,06	0,06	0,06	0,06
Demand Side	Imports	quantity	0,06	0,02	0,15	0,07	0,05	0,06	0,06	0,06
		nominal price	-0,01	0,01	-0,02	-0,01	-0,01	-0,01	-0,01	0,00
	Intermediate demand	quantity	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
		nominal price	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02
	Private demand	quantity	-0,01	-0,01	-0,01	-0,01	-0,01	-0,01	-0,01	-0,02
		nominal price	0,02	0,02	0,01	0,02	0,02	0,02	0,02	0,02
	Government demand	quantity	-0,01	-0,01	-0,01	-0,01	-0,01	-0,01	-0,01	0,00
		nominal price	0,03	0,04	0,05	0,03	0,04	0,03	0,03	0,04
Factors of Prod.	Nominal factor prices	skilled labour	0,05	0,02	0,17	0,00	0,09	0,04	0,04	0,07
		unskilled labour	0,04	0,07	-0,02	0,07	0,02	0,04	0,04	0,03
		capital	0,04	0,05	0,05	0,04	0,04	0,04	0,04	0,04
	Real factor prices	skilled labour	0,03	0,00	0,15	-0,02	0,07	0,03	0,03	0,06
		unskilled labour	0,02	0,05	-0,03	0,05	0,00	0,03	0,03	0,01
		capital	0,02	0,03	0,03	0,02	0,02	0,02	0,02	0,02

Source: Own calculations

FIGURE 9: TRADE CREATION EFFECTS

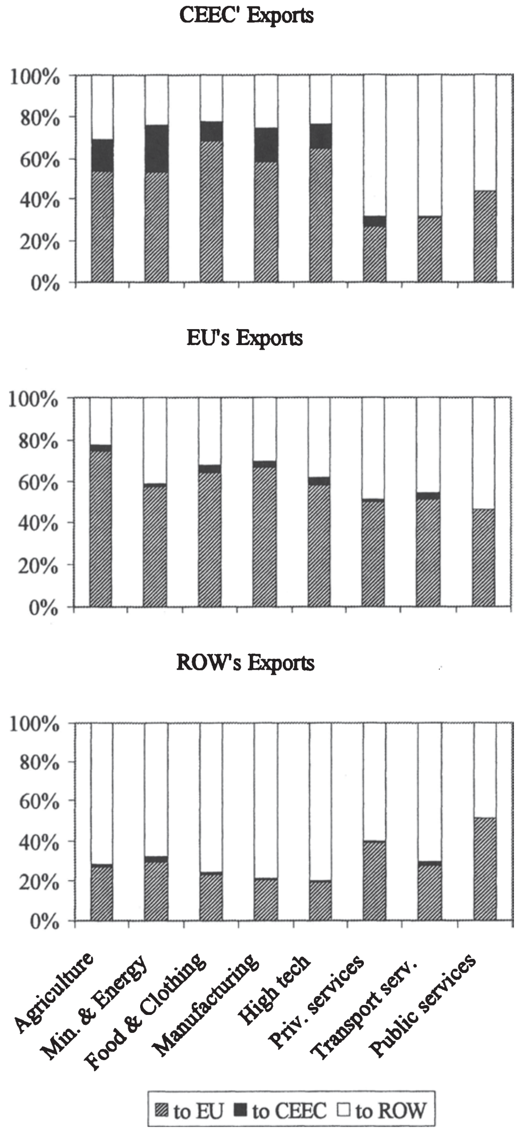


Note: S and D stand for the *supply* and *demand* of imports and exports respectively, p and h stand for *home* and *partner* country respectively.

Source: Own graphs after Brockmeier (1996), figures 4 and 5.

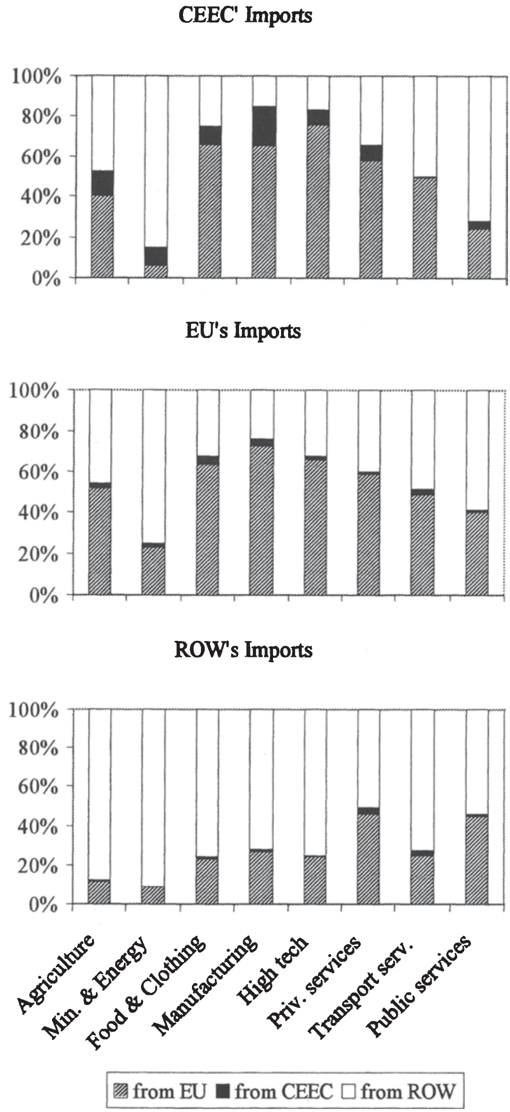
FIGURE 10: COMMODITY TRADE STRUCTURE IN BENCHMARK YEAR

(A) EXPORTS



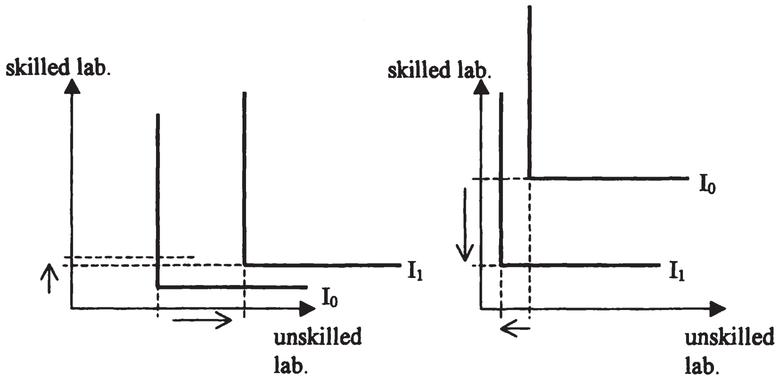
Source: Own calculations from GTAP4 dataset [parameter vxmd(i,r,s)].

(B) IMPORTS



Source: Own calculations from GTAP4 dataset [parameter vxmd(i,r,s)].

FIGURE 11: SKILLED AND UNSKILLED LABOUR



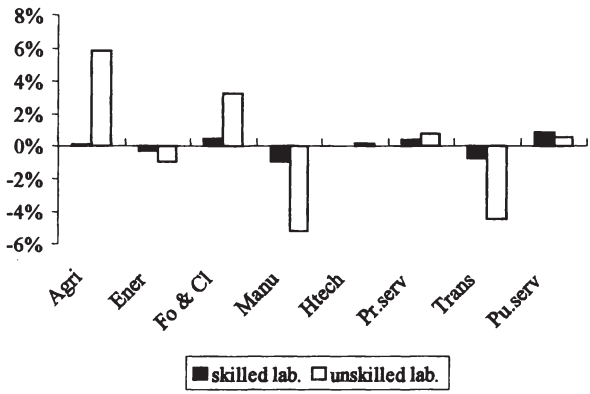
(a) Sector, intensive in unskilled lab. e.g. Agriculture

(b) Sector, intensive in skilled lab. e.g. Minerals & Energy

Note: I stands for isoquant.

Source: Own graph.

FIGURE 12: ABSOLUTE CHANGE IN LABOUR DEMAND IN CEEC RELATIVE TO BENCHMARK



Note: Sectoral abbreviations are explained in TABLE 3, p. 65.

Source: Own graph.

5.3 CAPITAL TRANSFERS TO THE CEEC

Besides the establishment of a customs union between the CEEC and the EU, factor mobility will also constitute an important integration element. The realisation of the so-called "four freedoms", i.e. the unrestrained mobility of goods, services, capital and labour determine the existence of a so-called *common market*.

In modelling capital transfers, we purely concentrate on those capital flows which would come about through official EU channels, i.e. the considerable amount of official transfer payments in the context of the EU's regional and structural policy which would take place once the CEEC were to become full members of the EU (recall section 3.6.2). All forms of private FDI are ignored because economic theory is ambiguous with respect to private capital flows. Standard neoclassical growth theory suggests capital flows from higher to lower developed regions (i.e. from the EU to the CEEC) whereas the endogenous growth theory advocates that capital either remains in the developed regions or even flows from poor to rich.

5.3.1 SCENARIOS

A realistic statement about the amount of capital which will flow into the new member countries in central and eastern Europe is extremely difficult. It will depend on the admission negotiations with the CEEC and on a previous reform of EU's structural policy. The transfer scenarios which we will conduct will therefore be highly hypothetical.

TABLE 20: EU'S EXPENSES FOR STRUCTURAL POLICY MEASURES (MILLION ECU)

	Budget Plan 1996-98
Structural Policy *) • Structural funds • Cohesion fund	93'745
Overall budget EU *)	267'024
GDP **)	2'102'511
Structural Policy / Budget	37%
Structural Policy / GDP	0.46%
Structural Policy / Capital Endowments in EU ***)	1.53%

*) Source: Weidenfeld and Wessels (1997), p. 234.
**) GDP calculated knowing that the budget amounts to 1.27% of GDP.
***) Ratio calculated using information on GDP and capital endowments contained in the GTAP4 dataset.

From 1996-98 on average 37% of the EU's budget was used for structural policy measures as TABLE 20 illustrates. This amounted to approximately 0.46% of EU's GDP or, using the information in the GTAP-dataset, to 1.53% of the EU's capital endowments. This last ratio is the basis for our simulations. For simplicity, we will assume that structural policy measures of the EU merely consist of a reallocation of real capital. In other words, the western EU member states are believed to transfer some of their capital endowments to the eastern members who, in our case, are the CEEC. In assuming that, we obviously neglect the individual character of the diverse projects. We do not consider the sector and regionally specific allocation of structural resources and neither do we evaluate special projects such as environmental or infrastructural aid.

On the basis that the proportion of structural policy measures to the EU's capital endowments remains constant at the calculated 1.53%, we simulate three different hypothetical scenarios of net[108] capital transfers flowing from the EU into the CEEC:

Scenarios 2-4: Capital Transfers

Scenario 2: The CEEC receive net **25%** of EU's structural policy resources.

Scenario 3: The CEEC receive net **50%** of EU's structural policy resources.

Scenario 4: The CEEC receive net **75%** of EU's structural policy resources.

5.3.2 EXPECTATIONS

Expectations of Factor Mobility in General:

The question arises as to what consequences in general we should expect from factor mobility between the EU and the CEEC?

In the **static** environment, factor mobility is likely to result in quantity, allocation and distribution effects influencing relative factor returns (i.e. interest rates and wages), production possibilities, trade and welfare.[109] Under the typical Heckscher-Ohlin assumptions (identical technologies), factor mobility will induce a convergence of factor returns until complete factor price equalisation has been reached. In terms of welfare, the factor receiving region will experience an increase in the overall payment of factor rewards which will increase its overall national income (net domestic product). The opposite will be true for the factor providing region: fewer payments of factor rewards will lead to a decrease in national income. Overall, aggregate net welfare of *both* regions must increase since factor mobility is an improvement in the allocation of resources. Thus the increase in production and welfare in the factor receiving country will surpass the welfare loss of the factor-providing region because the former will initially have a higher marginal factor productivity than the latter.

In the case of several production sectors, factor mobility will additionally lead to inter-sectoral dependencies with interesting cross effects. Rybczynski (1955) studied the implications of factor mobility in a general equilibrium environment using a two-sector, two-factor Heckscher-Ohlin model. In what became famous as the *Rybczynski theorem*,

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[108] "Net" means that CEEC' membership subscriptions are already subtracted.

[109] For a good overview of static effects see Hansen et al. (1992), p. 74.

he proved that when the endowment of a factor increased, the industry which used that factor relatively intensively would (i) expand, and (ii) expand more than proportionately to the increase in endowment. The other industry would at the same time contract. The Rybczynski theorem plays a particularly important role for the formulation and interpretation of our subsequent general equilibrium simulations. It should be noted, however, that just as in case of the Stolper-Samuelson predictions, the Rybczynski theorem also relies on typical neoclassical, 2x2 assumptions which our model does not entirely fulfil. Deviations from its forecasts therefore have to be anticipated.

In additional to the short-term - static effects, it is very likely that long-term **dynamic** effects (growth effects) will arise from factor mobility. They depend on the growth theory which is applied. In the *neo-classical* world with equalising prices for goods and factors as well as similar technologies, economies converge to the same steady state. Factor mobility will then speed up the convergence (growth) process but it will not influence the long-run steady state. Under the assumptions of the *new growth theories*, factor mobility is likely to enhance economies of scale resulting in a self-sustaining agglomeration process and leading to the typical core-periphery pattern. Our model will not consider dynamic effects.

Expectations of Capital Transfers in Particular:

The transfer of capital from the capital abundant EU to the capital scarce CEEC will lead to an increase in the price of capital in the EU and an opposite effect on the price of capital in the CEEC. Thus there should be a tendency towards factor price equalisation between both regions. In the production process, higher (lower) capital prices should imply a substitution[110] towards (away from) the other production factors. The price of labour should therefore rise (fall) in the EU (the CEEC). Overall, the outflow of capital should have a negative effect on the domestic production and on welfare in the EU and a positive effect on the CEEC.

The Rybczynski theorem allows us to formulate expectations with respect to the sectoral distribution of the effects. FIGURE 13 (p. 134 f.) illustrates relative factor endowments for the CEEC and the EU in the benchmark situation. In FIGURE 13(A) we can see that in the CEEC capital is used relatively intensively in the energy, the food & clothing and the manufacturing sector and relatively extensively in the public service and the agricultural sectors. A transfer of capital from the EU into the CEEC should then, in line with Rybczynski's theorem, lead to a disproportionately high expansion in the capital intensive sectors and a disproportionately low expansion in the capital scarce sectors. In contrast to this, industries in the EU should experience a contraction mainly in the energy and the private service sectors since these are the most capital intensive as FIGURE 13(B) illustrates. This contraction, however, should prove to be very moderate because only a small proportion of EU's capital endowments is actually transferred.

[110] Remember that on the value-added nest we assume an elasticity of substitution of one (Cobb-Douglas).

5.3.3 Simulation Results

Table 21 (A+B) on p. 131 f. displays the simulation results for the CEEC and the EU respectively. The model specification in terms of elasticity values and other exogenous parameters is identical to the base model in section 5.2. All three transfer scenarios are illustrated in each table. For scenario 2 (25% transfer payments) we display sector specific as well as aggregate results (column *"All sectors"*). For scenarios 3 (50% transfer payments) and 4 (75% transfer payments) we only display aggregate results because the tendency in sectoral deviations no longer changes. It is merely the amplitude that varies.

5.3.3.1 Simulated Transfer Effects for the CEEC

Transfer payments into the CEEC in the context of the EU's structural policy measures seem to be an effective policy tool. Our simulation results suggest that the CEEC benefit a lot, as Table 21 (A) illustrates. In the moderate transfer scenario (scenario 2) we already observe a more than 3% increase in welfare, supply and demand. Thus, the sheer relative size of the EU already causes very small amounts of transferred capital to have a substantial effect on the CEEC economies. The increase in capital endowments leads to higher production which takes place on both the domestic and export markets. Increased wealth also leads to greater consumption which is reflected by a rise in imports and private as well as government demand. The effects on product prices are almost negligible.

Given the history of structural policy measures in Europe, it is likely that capital transfers would be particularly directed into sectors such as agriculture. The overall welfare effects for the CEEC would in such a case turn out to be smaller than those suggested by our results since our model assumes perfect capital mobility within one region implying an efficiency-oriented distribution mechanism.

The Rybczynski theorem is mainly confirmed. As expected, the strongest output rise takes place in the capital intensive sectors (minerals & energy, food & clothing, manufacturing) whereas the capital scarce sectors (public services, agriculture) increase output the least. A look at absolute values (not displayed in the table) confirmed that output quantities in capital intensive sectors increased disproportionately to their sectoral capital demand. Since capital transfers mainly benefit CEEC' capital-intensive sectors and somewhat neglect all labour-intensive industries, it might be appropriate to design structural measures to temporarily cushion the effects on the latter.

The transfer payments in scenario 2 induce an overall rise in capital endowments in the CEEC of 9%. Depending on the sector-specific amount of capital in the benchmark year as well as the counterfactual output increase, sectoral capital quantities react with differing strengths to the overall supply change. Those sectors with a low capital-labour ratio such as public services and agriculture experience the strongest relative increase in capital supply.

Factor prices behave in different ways. Wages for skilled (+4.9%) and unskilled labour (+2.7%) ascend, reflecting the stronger demand for production factors due to increased output, whereas capital prices fall (-5.6%) since the positive supply shift exceeds the positive demand effect.

Scenario 3 and scenario 4 increase the amount of capital which is being transferred by an even greater proportion. Capital endowments rise by 17.9% and 26.7% respectively. The effects of this boost on all the other variables are similar, with the magnitudes of the effects changing but not the sectoral proportions. In scenario 4 we observe a considerable 8.7% welfare increase in the CEEC.

Our model is homogeneous to the degree of one with respect to income. This means that doubling both endowments (labour & capital) should also double output and demand at constant prices. The fact that an increase in capital endowments in the CEEC results in an almost proportional increase of output and demand, illustrates how scarce capital in the CEEC must be. If capital were more abundant in this region, we should not observe such a strong welfare effect as a consequence of the rise in capital endowments. Thus capital must be the growth-restricting factor. We can only repeat that any increase in its endowments (e.g. through injection by the EU) proves to be an extremely effective growth tool.

5.3.3.2 Simulated Transfer Effects for the EU

The EU's effects from capital outflows are illustrated in TABLE 21 (B). All results are very moderate because from the EU's viewpoint it is only a very small ratio of capital which is actually being transmitted to the CEEC. Remember that questions of how the effects of capital outflow are distributed among the different EU-member states are not considered. In scenario 2 only 0.38% of total EU capital endowments are used for structural policy measures in the CEEC. It is not surprising that all effects have the opposite sign compared with those for the CEEC. After all, a "departure" of capital implies less production possibilities and income in the EU which is reflected in declining welfare and output quantities. Decreasing demand for imports and Armington goods is the logical consequence.

The minerals & energy sector suffers the most from reduced capital endowments. Its output decreases by 0.23%. As it is the sector with the highest relative capital endowment ratio in the EU (as FIGURE 13(B) illustrates) the Rybczynski theorem also works in the opposite sense: capital intensive sectors contract disproportionately.

Factor prices in the EU follow the changed conditions of demand and supply on factor markets. Whereas labour prices decrease due to less demand for labour, capital prices increase due to a lower supply.

Scenarios 3 and 4 intensify the observed consequences. The volume of capital being relocated increases and so do the negative supply and demand side effects in the EU as well as the factor price effects. Their magnitude, however, still remains very small. Even in scenario 4 which is the projection with the strongest capital outflow, we only observe a welfare fall of 0.38%.

TABLE 21: EFFECTS OF TRANSFER PAYMENTS FROM THE EU TO THE CEEC, SCENARIOS 2-4 (% CHANGE FROM BENCHMARK)

(A) CEEC

	CEEC	Scenario:	2										3	4
			25% transfer payments										50%	75%
			Agriculture	Min. & Energy	Food & Clothing	Manufacturing	High tech	Priv. services	Transport serv.	Public services	Savings and investment	All sectors	All sectors	All sectors
	Equivalent variation (real GDP)											3,1	6,0	8,7
	General price level											0,0	0,0	-0,1
	Terms of trade											-0,3	-0,6	-0,9
Supply Side	Output	quantity	2,2	4,3	3,1	3,8	2,5	3,3	3,5	1,8	3,1	3,2	6,3	9,1
	Domestic market	quantity	2,3	4,3	3,2	3,8	2,8	3,3	3,5	1,9	3,1	3,3	6,3	9,2
		nominal price	1,0	-0,8	-0,1	-0,5	0,1	-0,2	-0,4	1,6	-0,1	-0,1	-0,2	-0,2
		real price	1,0	-0,8	-0,1	-0,5	0,1	-0,2	-0,4	1,6	-0,1	-0,1	-0,1	-0,2
	Exports	quantity	0,5	4,8	2,7	3,8	2,1	3,0	3,2	-1,0	-	3,0	5,9	8,5
		nominal price	0,1	-0,6	-0,3	-0,5	-0,2	0,1	-0,4	-0,5	-	-0,4	-0,7	-1,1
		real price	0,1	-0,6	-0,3	-0,5	-0,2	-0,3	-0,5	0,1	-	-0,4	-0,7	-1,0
Demand Side	Imports	quantity	6,4	1,0	2,8	2,2	3,3	2,5	1,9	9,4	-	2,7	5,2	7,6
		nominal price	0,0	0,0	0,0	-0,1	0,0	0,0	0,0	0,0	-	0,0	-0,1	-0,1
		real price	0,1	0,0	0,0	-0,1	0,0	0,0	0,0	0,0	-	0,0	0,0	0,0
	Intermediate demand	quantity	2,9	3,7	3,0	3,4	3,0	3,2	3,3	3,1	-	3,2	6,3	9,1
		nominal price	0,9	-0,7	-0,1	-0,4	0,0	-0,2	-0,3	1,6	-	-0,1	-0,3	-0,4
		real price	0,9	-0,7	-0,1	-0,4	0,1	-0,2	-0,3	1,6	-	-0,1	-0,2	-0,3
	Private demand	quantity	2,1	3,9	3,1	3,5	3,0	3,3	3,4	1,5	-	3,1	6,0	8,7
		nominal price	0,9	-0,8	-0,1	-0,4	0,0	-0,2	-0,3	1,6	-	0,0	0,0	-0,1
		real price	1,0	-0,8	-0,1	-0,4	0,1	-0,2	-0,3	1,6	-	0,0	0,0	0,0
	Government demand	quantity	2,5	4,4	3,6	3,9	3,4	3,7	3,9	1,9	-	3,1	6,0	8,7
		nominal price	1,0	-0,8	-0,1	-0,4	0,1	-0,2	-0,3	1,6	-	0,4	0,8	1,2
		real price	1,0	-0,8	-0,1	-0,4	0,1	-0,2	-0,3	1,6	-	0,4	0,8	1,2
Factors of Production	Factor supply	skilled labour	1,4	-0,2	-0,7	0,1	-0,3	-0,4	-0,1	0,7	-	0,0	0,0	0,0
		unskilled labour	1,4	-0,2	-0,7	0,1	-0,3	-0,4	-0,1	0,7	-	0,0	0,0	0,0
		capital	10,2	8,9	8,3	9,1	8,8	9,1	9,0	10,9	-	9,0	17,9	26,7
	Nominal factor prices	skilled labour										4,9	9,5	13,9
		unskilled labour										2,7	5,2	7,5
		capital										-5,6	-10,4	-14,5
	Real factor prices	skilled labour										4,9	9,6	13,9
		unskilled labour										2,7	5,2	7,5
		capital										-5,5	-10,3	-14,5

Source: Own calculations

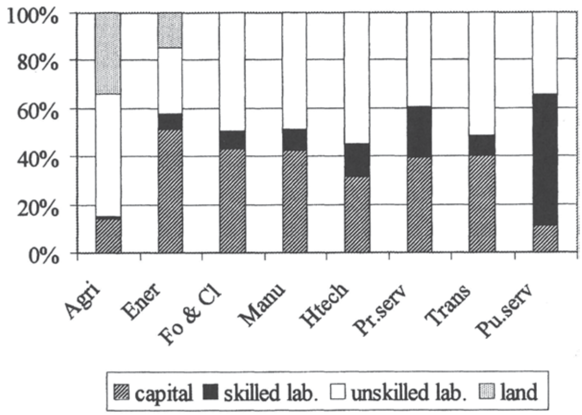
(B) EU

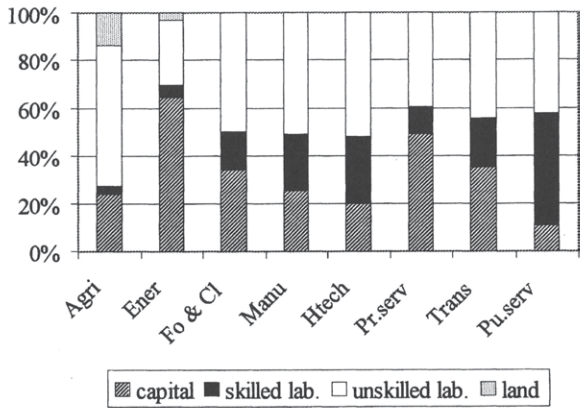
		Scenario:	2										3	4
			25% transfer payments										50%	75%
	EU		Agriculture	Min. & Energy	Food & Clothing	Manufacturing	High tech	Priv. services	Transport serv.	Public services	Savings and investment	All sectors	All sectors	All sectors
	Equivalent variation											-0,13	-0,25	-0,38
	General price level											0,03	0,05	0,08
	Terms of trade											0,02	0,03	0,05
Supply Side	Output	quantity	-0,11	-0,23	-0,14	-0,14	-0,05	-0,13	-0,13	-0,09	-0,12	-0,12	-0,25	-0,37
	Domestic market	quantity	-0,12	-0,23	-0,14	-0,14	-0,07	-0,13	-0,13	-0,09	-0,12	-0,13	-0,26	-0,38
		nominal price	0,02	0,12	0,02	0,01	-0,02	0,03	0,03	-0,07	0,01	0,01	0,03	0,04
		real price	-0,01	0,09	0,00	-0,02	-0,05	0,00	0,00	-0,10	-0,02	-0,01	-0,03	-0,04
	Exports	quantity	-0,07	-0,32	-0,13	-0,14	-0,02	-0,14	-0,13	-0,01	-	-0,09	-0,18	-0,28
		nominal price	0,05	0,07	0,03	0,01	0,00	0,02	0,03	-0,04	-	0,01	0,03	0,04
		real price	0,02	0,05	0,00	-0,02	-0,02	0,00	0,00	-0,06	-	-0,01	-0,02	-0,04
Demand Side	Imports	quantity	-0,17	0,16	-0,07	-0,06	-0,14	-0,06	-0,04	-0,23	-	-0,08	-0,17	-0,26
		nominal price	0,03	0,02	0,01	-0,01	0,00	0,01	0,00	-0,03	-	0,00	0,00	0,00
		real price	0,01	-0,01	-0,02	-0,04	-0,03	-0,02	-0,02	-0,06	-	-0,03	-0,05	-0,08
	Intermediate demand	quantity	-0,13	-0,15	-0,13	-0,12	-0,10	-0,13	-0,12	-0,11	-	-0,12	-0,24	-0,36
		nominal price	0,02	0,09	0,02	0,00	-0,01	0,03	0,02	-0,07	-	0,01	0,03	0,04
		real price	0,00	0,07	-0,01	-0,02	-0,04	0,00	0,00	-0,10	-	-0,01	-0,02	-0,03
	Private demand	quantity	-0,12	-0,22	-0,12	-0,10	-0,09	-0,13	-0,13	-0,03	-	-0,13	-0,25	-0,38
		nominal price	0,03	0,12	0,02	0,00	-0,01	0,03	0,03	-0,07	-	0,03	0,05	0,08
		real price	0,00	0,09	-0,01	-0,02	-0,04	0,00	0,00	-0,10	-	0,00	0,00	0,00
	Government demand	quantity	-0,21	-0,30	-0,19	-0,18	-0,17	-0,20	-0,20	-0,10	-	-0,12	-0,24	-0,36
		nominal price	0,03	0,12	0,02	0,00	-0,01	0,03	0,03	-0,07	-	-0,06	-0,11	-0,17
		real price	0,00	0,09	-0,01	-0,02	-0,04	0,00	0,00	-0,10	-	-0,08	-0,16	-0,25
Factors of Production	Factor supply	skilled labour	-0,04	-0,01	-0,01	-0,04	0,03	0,04	0,00	-0,04	-	0,00	0,00	0,00
		unskilled lab.	-0,04	-0,01	-0,01	-0,04	0,03	0,04	0,00	-0,04	-	0,00	0,00	0,00
		capital	-0,36	-0,36	-0,38	-0,43	-0,36	-0,38	-0,39	-0,48	-	-0,38	-0,77	-1,15
	Nominal factor prices	skilled labour										-0,27	-0,54	-0,82
		unskilled lab.										-0,03	-0,06	-0,08
		capital										0,28	0,57	0,86
	Real factor prices	skilled labour										-0,30	-0,60	-0,89
		unskilled lab.										-0,05	-0,11	-0,16
		capital										0,26	0,52	0,78

Source: Own calculations

FIGURE 13: RELATIVE FACTOR ENDOWMENTS IN BENCHMARK YEAR

(A) CEEC





Note: Sectoral abbreviations are explained in TABLE 3.

Source: Own calculations from GTAP4 dataset [parameter evoa(f,r)].

5.4 MIGRATION BETWEEN THE CEEC AND THE EU

The mobility of labour is an element which is of particular interest in the discussion on the eastern enlargement of the EU. Extensive speculations about the economic repercussions which might result from East-West migration have been made on both sides of the border.

In this section we will continue to apply a purely static model. This means that we will only study the effect of one migration wave. In subsequent sections we will then proceed to use a recursive dynamic model, where we will analyse the effects of migration over various time periods.

5.4.1 SCENARIOS

We determine potential labour migration between the CEEC and the EU according to EQ. 23 using the coefficient estimates from our econometric analysis in section 4.5. We assume that the calculated migration elasticities (the β-parameters) are equally valid for both labour categories, skilled and unskilled labour. This supposition will later be subjected to an examination in the context of sensitivity analyses.

In our scenarios we differentiate between scenario 5, *general labour migration*, i.e. migration of skilled and unskilled labour alike and scenario 6, migration of skilled labour only (the *brain drain / brain gain* effect). Equivalently to the econometric estimations in TABLE 12 (A) and (B) we further distinguish between two different migration concepts: in scenario (i) we focus on CEEC' *emigration* whereas in scenario (ii) we analyse the effects of CEEC' *net migration* into the EU. The scenarios can be summarised as follows:

	Skilled Labour	Unskilled Labour	Substitution Elasticity of skilled to unskilled
Scenario 5(i): Emigration of skilled and unskilled labour from the CEEC (*general migration*)	Migration parameters as in TABLE 12(A): $\beta_0 = -1.29$; $\beta_1 = 0.39$; $\beta_2 = -0.051$; $\beta_3 = 0.066$; $\beta_4 = -0.062$	Migration parameters as in TABLE 12(A): $\beta_0 = -1.29$; $\beta_1 = 0.39$; $\beta_2 = -0.051$; $\beta_3 = 0.066$; $\beta_4 = -0.062$	$\sigma_{lc} = 0$ (Leontief) will be altered in sensitivity analysis
Scenario 5(ii): Net migration of skilled and unskilled labour from the CEEC *(general migration)*	Migration parameters as in TABLE 12(B): $\beta_0 = -0.42$; $\beta_1 = 0.17$; $\beta_2 = -0.016$; $\beta_3 = 0.02$; $\beta_4 = -0.043$	Migration parameters as in TABLE 12(B): $\beta_0 = -0.42$; $\beta_1 = 0.17$; $\beta_2 = -0.016$; $\beta_3 = 0.02$; $\beta_4 = -0.043$	$\sigma_{lc} = 0$ (Leontief) will be altered in sensitivity analysis

Scenario 6(i): Emigration of only skilled labour from the CEEC *(brain drain / brain gain)*	Migration parameters as in TABLE 12(A): $\beta_0 = -1.29$; $\beta_1 = 0.39$; $\beta_2 = -0.051$; $\beta_3 = 0.066$; $\beta_4 = -0.062$	No emigration at all: $\beta_0 - \beta_4 = 0$	$\sigma_{lc} = 0$ (Leontief) will be altered in sensitivity analysis
Scenario 6(ii): Net migration of only skilled labour from the CEEC *(brain drain / brain grain)*	Migration parameters as in TABLE 12(B): $\beta_0 = -0.42$; $\beta_1 = 0.17$; $\beta_2 = -0.016$; $\beta_3 = 0.02$; $\beta_4 = -0.043$	No emigration at all: $\beta_0 - \beta_4 = 0$	$\sigma_{lc} = 0$ (Leontief) will be altered in sensitivity analysis

We ignore remittances of migrants to their relatives back home. We are aware of the fact that these kinds of capital flow do in some countries contribute substantially to the availability of capital endowments. However, since remittances are primarily a capital mobility issue and only indirectly concern labour mobility, we omit them from this analysis.[111] The rest of the model specification (i.e. elasticity values and other exogenous parameters) is identical to the base model in section 5.2.

5.4.2 EXPECTATIONS

Expectations with respect to the static effects of East-West labour migration can be formulated in analogy to capital transfers discussed in the previous section. Standard neoclassical theory and particularly the Rybczynski theorem again have some predictive value.

Migration from the CEEC to the EU will change the supply of labour in both regions and can be expected to exercise an upward influence on labour prices (i.e. wages) in the CEEC and a downward bias on labour prices in the EU. Since skilled and unskilled labour are assumed to be non-substitutable, however, there are likely to be further allocational and price effects which cannot be captured by the Heckscher-Ohlin theorem. Although we use the same migration parameters (β-parameters) for both labour categories, there is likely to be a proportionally different migration performance of skilled and unskilled labour. Distinct relative EU-CEEC wages within each category may be responsible for this contrasting migration performance. Additionally, relative labour endowments in the CEEC are surely different to those in the EU. Hence, the proportion of skilled to unskilled labour emigrating from the East will not correspond to the proportion of labour immigrating to the West. In short, the final effect on labour prices is difficult to project.

The brain drain / brain gain simulations can be expected to provide interesting results with respect to the different factor prices. Although they provide positive economic stimuli in the immigration areas, their skills will be lacking in the areas of origin. As a

[111] Recall the various assumptions concerning migration which we explained at the end of section 3.7.1.

consequence, wages of skilled labour, i.e. the mobile factor, should rise in the emigration and fall in the immigration region, wages of unskilled labour are likely to react inversely. Depending on aggregate labour costs, there should additionally be a substitutive process towards or away from the demand for capital, with the corresponding effects on capital prices. Recent studies by Straubhaar and Wolburg (1998), however, demonstrate that the effects on the emigration regions need not necessarily be negative.

With respect to the sectoral distribution of the effects we may again use the Rybczynski theorem in combination with FIGURE 13 illustrating relative factor endowments in both regions. The labour intensive sectors in the CEEC should then experience the strongest contraction in output whereas the labour intensive sectors in the EU could encounter a disproportionately high expansion. In terms of overall welfare, migration should have a negative effect on the domestic product and on welfare in the CEEC, and a positive effect on the EU.

5.4.3 Simulation Results

TABLE 22 and TABLE 23 (p. 145 f.) display the simulation results of general labour migration (scenario 5) and the brain drain phenomenon (scenario 6) respectively, where part (A) shows the results for the CEEC and part (B) displays the effects on the EU. Within each table we also display the two different migration concepts we use: for the pure emigration scenario (scenario i) we display sector specific as well as aggregate results. For the net migration concept (scenario ii) we only display aggregate results since relative sectoral deviations will not alter. As in the previous case it is merely the amplitude of sectoral effects which varies.

5.4.3.1 Simulated Effects of General Migration

Simulated Migration Effects for the CEEC:

In the CEEC an outflow of both, skilled and unskilled labour leads to the consequences illustrated in TABLE 22(A).

We will initially focus on the concept of **pure emigration** which is displayed in scenario *5(i)*: emigration from the CEEC obviously decreases the supply of skilled and unskilled labour in the CEEC. Our model calculates an overall departure of 0.5% of CEEC' labour force endowments (see *Factor supply* in the table). This is seen to have a negative effect on real GDP and on the overall supply and demand of goods, each decreasing by 0.3%, which confirms our expectations. After all, the exodus of labour implies a departure of consumers and producers with the consequence that the economy shrinks. It is natural that this development is then also reflected by lower supply and demand quantities. The drop in the macroeconomic variables turns out to be smaller relative to the amount of emigration. Nominal and real prices are not affected. An exception is the price for government goods which rises by 0.1% due to a relatively strong increase in the price of public services.

The sectoral distribution of the negative effects again closely follows the Rybczynski theorem. Our results show that due to emigration, the labour intensive sectors contract most (public services: -0.4%; high-tech: -0.3%) whereas the labour extensive sector contracts least (energy: -0.2%). Such a divergent sectoral performance does not really matter in our model because we assume perfect sectoral mobility of the production factors. In reality, however, sector specific skills and capital are not that easily transferable. Some sectors are then likely to suffer strongly under emigration.

In line with our expectations we observe an increase in the price of labour which is a logical consequence of its reduced supply. The different magnitude in the change of labour prices reflects the different value of endowments. The price of skilled labour which is relatively scarce increases (+0.7%) more than the price of the relatively abundant unskilled labour (+0.1%). This varying response is due to a positive demand shift for skilled labour within the CEEC (driving wages up even further). Fewer labour endowments require less capital in the production process which explains the decrease in its price (-0.2%).

The magnitude of simulation results is different as soon as we analyse the effects of **net migration** in our model. Results are illustrated in scenario *5(ii)* / TABLE 22(A). Net migration means that in contrast to scenario 5(i) we also allow return migration to take place. In simulating this form of migration we simply use a different set of β-parameters for calculations, namely that which we estimated in TABLE 12(B). Since this second set of β-parameters has lower values, it is not surprising that all simulation results are comparatively smaller. Roughly speaking, net migration causes about one third of the effects on most variables that emigration does.[112] This ratio is consistent with previous calculations concerning these two concepts of migration. In chapter 3, for instance, statistical observations of the southern enlargement of the EC showed that net migration was three times smaller than emigration. Consequently, the estimated β-parameters as well as the extrapolations for the eastern enlargement of the EU more or less reflected the same proportion. It is only consistent that the simulated effects on the other economic variables now follow a similar pattern.

Overall, general migration (gross or net) turns out to have only very small effects on the CEEC. In terms of winners and losers it is possible to stress that the greatest beneficiaries are the migrants themselves. Under the assumption that their income adapts to EU standards, they experience an extraordinary real wage boost. Those employees staying behind in the CEEC cannot, however, be regarded as the losers of emigration. Although there is an overall welfare decrease in the CEEC, real wages of skilled and unskilled workers rise slightly. Hence, the individual situation of the people remaining in the CEEC also improves. Capital owners, in contrast, who must accept a deterioration in capital prices can be regarded as those suffering from emigration.

Simulated Migration Effects for the EU:

It is intuitive that migratory movements lead to an increase in the endowment of labour in the EU. This rise, however, is not identical to the amount of labour which has decided

[112] Larger deviations from this ratio are mainly due to rounding.

to emigrate from the CEEC. As we explained in section 3.7.3, the adaptation of income to EU standards induces a disproportionate increase in aggregate EU labour endowments. The resulting economic effects are illustrated in TABLE 22(B).

Scenario *5(i)* again considers **pure immigration** into the EU ignoring potential return migration of CEEC-citizens. In the EU, immigration leads to an increase in labour endowments of 0.1% for skilled and 0.2% for unskilled labour (see *Factor supply* in the table). Since migrants also constitute increased consumption inside the EU, there is an increase in supply and demand quantities of goods and services of approximately 0.1%. Aggregate prices are hardly affected.

The sectoral reaction to higher labour endowments is ambiguous. There is a stronger output increase in the labour intensive sectors such as agriculture (+0.4%) and food & clothing (+0.2%) and a very small increase in both service sectors. The performance of the public services sector is surprising since it is relatively intensive in skilled labour (recall FIGURE 13). In the case of an increase in labour endowments this should, according to the Rybczynski theorem, result in a disproportionate increase in output. A strong deviation in the technology of this sector possibly explains this peculiarity. As we mentioned previously, Rybczynski's theorem relies on a typical H-O framework which our model can only approximate. In the case of the public service sector, a stronger deviation from Heckscher-Ohlin and thus from Rybczynski might have occurred.

Workers inside the EU perceive the migration phenomenon with mixed feelings. White collar workers experience a rather strong increase in their real wages (+1.3%) due to a rising demand whereas blue collar workers have to face a deterioration in wages (-0.8%) as a consequence of the positive supply shift. Opposition to free CEEC-EU migration is likely to arise from the latter group especially since blue collar workers are normally organised in trade unions. Surprisingly, the effects of immigration on EU wages surpass the effects of emigration in the CEEC. Capital owners encounter a modest rise in capital prices so that approval of integration on their part is likely.

The price performance of skilled labour, seemingly contradicting economic theory, requires an explanation. There are two forces working on the price of skilled labour: on the one side there is an increased supply of an endowment which exercises a downwards influence on the factor price. However, since we assume a production function where skilled and unskilled labour are perfect complements there is another source of influence on the final price. Due to the fact that there is a disproportionate increase in unskilled labour endowments (remember that unskilled labour rises by 0.2%, whereas skilled labour does so by only 0.1%) and since we assume a Leontief technology for the interaction between the two labour categories, on the other side, there is an overproportional demand for skilled labour. This latter effect outweighs the former so that eventually we end up with a rise in the price of skilled labour.

At the bottom of the tables we have added another variable displaying the wage divergence between the EU and the CEEC. The rise in the price of unskilled labour in the CEEC together with the fall in the EU leads to a reduction in wage divergence (i.e. convergence) of 0.1%. Due to the peculiar wage performance of skilled labour we notice an increase in its wage divergence by 0.1%. We believe that this dissimilar performance of blue and white collar wages is an extremely interesting and significant result.

The consequences for the macroeconomic variables are much more moderate as soon as we allow **return migration** to take place. This has been modelled in scenario *5(ii) /* TABLE 22(B). Effects on welfare, on production and on the demand for goods are tiny and about one third as large as they were in scenario 5(i).

Weyerbrock (1995) also estimates the impact of East-West migration on the EU using a CGE-model. She exogenously assumes immigration into the EU of 3.5 - 7 million workers from eastern Europe over a period of five years. Her calculations under a flexible wage regime, resemble our approach. In terms of estimation results there are also strong similarities:[113] the performance of real GDP, exports and imports follows a related pattern. Wages and capital returns, however, do not allow a comparison of both studies. Breuss and Tesche (1996) conduct another CGE-study on East-West migration although their emphasis lies on the case of Austria and Hungary. If the different size of immigration and emigration regions are taken into consideration, the results from their third experiment roughly relates to our findings.[114]

5.4.3.2 Simulated Effects of the Brain Drain / Brain Gain Phenomenon

Contrary to 5.4.3.1, this section discusses the simulation results of the *brain drain / brain gain* phenomenon. When we speak of brain drain, we assume a sort of migration where blue collar (unskilled) workers are immobile and only white collar (skilled) workers decide to move. We could, for instance, imagine a transition scenario where only skilled labour would be allowed to immigrate into the EU. The recent introduction of the so-called *Green card* into German immigration law[115] shows that the EU might be tempted to allow the immigration of white collar workers and to temporarily hinder or postpone any migration of blue collar workers.

In terms of factor endowments, this means that only the endowments of skilled labour alter in both the CEEC and the EU. Of course it is a rather extreme assumption that unskilled labour, on the one hand, will be completely immobile whereas skilled labour, on the other hand, will behave according to the estimated β-parameters. An extreme scenario, however, will describe some form of limit which may be used as a point of orientation.

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[113] See Weyerbrock (1995) p. 107 for the specification of her third experiment and p. 111 for estimation results.

[114] See Breuss and Tesche (1996), table 8, p. 19.

[115] Because of Germany's lack of computing experts, German immigration law introduced the *Green Card* on 1 August 2000. It is a special work permit for IT specialists from non-EU countries which entitles them to live and work in Germany for 5 years.

Simulated Brain Drain Effects for the CEEC:

The departure of skilled labour from the CEEC leads to macroeconomic effects which are summarised in TABLE 23(A).

Initially we focus on scenario *6(i)* which simulates **pure emigration** and ignores return migration. Just as in scenario 5(i), approximately 0.5% of the skilled labour force decides to leave the CEEC as the data on *Factor supply* suggest. In contrast to that and in accordance with our assumption, unskilled labour is immobile so that its factor supply remains constant at its benchmark level (± 0%). Real GDP, overall domestic output and aggregate demand decrease by 0.1%. Nominal and real prices only show a very small reaction to the brain drain. From an aggregate point of view, emigration of skilled labour constitutes a departure of consumers which must eventually end in a contraction of the economy. Due to the fact that the amount of emigration is considerably smaller than in scenario 5 (because unskilled labour does not move), it follows that the resulting effects on the macroeconomic variables will also be much smaller.

The reduced supply of skilled workers leads to a considerable increase in its price of 4.7%. Approval for the brain drain from this group is therefore possible. Since skilled and unskilled labour is demanded in fixed proportions (Leontief technology) there is, at the same time, an excess supply of unskilled labour which experiences a decrease in its price of 1.1%. This may lead to a strong opposition by trade unions and other groups representing unskilled workers. Capital owners are probably indifferent to the brain drain since the price of capital does not change at all.

The changing prices of production factors exert the degree of production costs which in turn influence sectoral product prices and competitiveness vis-à-vis foreign regions. Those industries which use skilled labour intensively face considerably higher factor costs whereas the industries using skilled labour extensively are affected to a much lesser degree. It is therefore not surprising and in accordance with Rybczynski's theorem that those industries which use skilled labour intensively should experience the strongest contractions. For instance, public service and the high tech sectors shrink by 1% and 0.3% respectively. In contrast to that, agriculture (+0.4%) and food & clothing (+0.2%), each being an industry which uses skilled labour extensively, even experience output growth. This differs from previous results in that we now observe clear sectoral winners and losers. Thus, from a sectoral perspective too, the brain drain is likely to be regarded extremely controversially within the CEEC. Strong intervention and pressure from various lobbying groups on government negotiations could be quite likely.

The changing competitiveness vis-à-vis the other international regions is well reflected by the sectoral export and import performance. Clearly, those sectors affected most by emigration will experience the strongest reduction of exports and an increase in imports.

TABLE 23(A) also displays the results from scenario 6(ii) analysing the effects from **net migration**. Since this scenario merely uses different and lower migration parameters all variables have the same sign as in scenario 6(i). Considering return migration, only 0.2% of all skilled employees leave the country. It turns out that net migration of skilled workers has negligible effects on the macroeconomic variables. Only factor prices of skilled and unskilled labour alter slightly, effects which are probably still large enough to create social tensions.

Simulated Brain Gain Effects for the EU:

The EU experiences the brain gain in an opposite manner as TABLE 23(B) illustrates.

In scenario 6(i), where we consider **pure immigration** into the EU, we observe an increase in skilled labour endowments by 0.1%. This arrival of additional consumers hardly has any effect on welfare. Neither do aggregate production, consumption and price variables react for the most part. The diverse sectors again respond differently to this increased factor supply. Whereas the sectors intensive in skilled-labour (public services, private services, high-tech) expand disproportionately, the extensive sectors (agriculture, minerals & energy , food & clothing) contract.

The increase in the supply of skilled labour by 0.1% induces a fall in white collar wages by 1.7%. Blue collar workers, however, benefit from the brain gain in the EU in that the demand for unskilled labour rises and so do their real wages by 0.9%. Contrary to the previous general migration scenario, trade unions will most likely welcome a transition period in which only skilled worker are allowed to move. Finally, there is wage convergence between the EU and the CEEC by 0.8% whereas unskilled labour experiences a further wage divergence of 0.3%.

All macroeconomic effects turn out to be extremely small as soon as we incorporate **return migration** of CEEC-migrants into our simulations. The results from scenario 6(ii) demonstrate that hardly any value deviates from zero. There are only minor effects in the price of government demand and certain deviations from benchmark values in factor prices.

Overall, it turns out to be surprising how small the positive and negative effects in the CEEC and particularly in the EU are. Comparing these results with the other integration policies which were modelled in previous sections (i.e. trade integration and capital transfers), migration proves to have negligible macroeconomic consequences. Nevertheless, labour market integration produces winners and losers. Each group is likely to exercise influence on the decision making process of politicians and governments in order to maximise the own benefits or minimise the drawbacks. We are not aware of any CGE studies having analysed the brain drain phenomenon in general and the brain drain in context of the eastern enlargement of the EU in particular. A comparison to other studies is therefore not possible at this point.

In view of such small simulation results we would like to stress once again that our model structure assuming CRTS and constant total factor productivity rates focuses on short-run effects only. In the medium to long run, a brain gain will probably enhance the growth prospects of the immigration region considerably.

5.4.3.3 Sensitivity Analysis

Three exogenous parameters are particularly important in the simulations of East-West migration. These are *(a)* the income elasticity of migration, β_1, which we estimated in EQ. 31 and which is the main determinant of the migration flows in our model, *(b)* the elasticity of substitution between skilled and unskilled labour (σ_{lc}) which we assumed to be zero, and *(c)* the income ratio of employers from the CEEC working in the EU. We initially assumed that CEEC employees would gain just as much as their EU colleagues, which means that the income ratio was fixed at a value of 100% (compare with section 3.7.3). They are subject to examination in the following sensitivity analyses:

	(a) Income parameter of migration:	*(b) Labour substitution elasticities:*	*(c) Income ratio of CEEC-workers in EU:*
Base model:	β_1= 0.39	σ_{lc} = 0 (Leontief)	100%
SA 8:	β_1= 0.546 (40% larger)	as in base model	as in base model
SA 9:	β_1= 0.234 (40% smaller)	as in base model	as in base model
SA 10:	as in base model	σ_{lc} = 0.5	as in base model
SA 11:	as in base model	σ_{lc} = 1 (Cobb-Douglas)	as in base model
SA 12:	as in base model	as in base model	80%
SA 13:	as in base model	as in base model	60%

All sensitivity results are compared with the base model's results from scenario 5(i) and scenario 6(i). We abstain from illustrating a comparison with scenarios 5(ii) and 6(ii) because the proportions of the deviations between the SA and the base model did not change.

One observation concerning all sensitivity analyses can be anticipated right away: partly there are substantial deviations in the values of some variables compared with the results of the base model. These deviations should, however, be interpreted with caution since the absolute impact of the simulations is rather small. For instance, if a variable's value climbs from 0.1 to 0.2 there is a 100% deviation from the base model, but the effect on the economy remains almost negligible. Thus some sensitivity analyses can be describe as sensitive compared with the base model but rather insensitive with respect to overall results.

Sensitivity Analysis Relative to Scenario 5:

A comparison between scenario 5(i) and SA 8 - 13 is provided in TABLE 24 (p. 149). SA 8 and SA 9 change the income parameter of migration, β_1, to values which are either 40% larger or 40% smaller than the original base value of 0.39. As can be seen in the table this alters the amount of migration of both types of labour. A 40% increase (SA 8) in the β_1-parameter increases the amount of migration and accordingly the effects on all other endogenous variables by more than 100% compared with the results of the base model.[116] Correspondingly, the 40% lower value of β_1 (SA 9) leads to a reduction in migration and the respective macroeconomic consequences by more than 60%. Thus we observe a rather strong degree of sensitivity of the income parameter of migration to actual simulation results. This implies that the appropriate value of this parameter should be chosen carefully in a CGE-analysis of this type. Since our value for β_1 has been derived from econometric estimates, we are confident that this methodology will withstand critical evaluation.

In a next step we have altered the value of the elasticity of substitution between skilled and unskilled labour. The base model value of zero has been replaced with a value of σ_{lc}=0.5 in SA 10 and a value of 1 (Cobb-Douglas relationship) in SA 11. Hence the possibility to replace skilled by unskilled labour in the production function and vice versa has been increased. It turns out that these changes cause rather strong effects on the factor prices of both labour categories. As the degree of substitutability rises, labour prices consequently fall more and more into line. Compared with the base model, SA 10 yields a wage increase of skilled labour in the CEEC which is almost 60% lower. In contrast to that, unskilled labour wages surpass the base value by almost 80%. In the EU, this difference is even more pronounced. For skilled labour there is a difference of almost 100% between SA 10 and the base model. For unskilled labour we observe a difference of almost 90%. SA 11 hardly intensifies this effect any further. These effects which are perfectly foreseeable using microeconomic theory could even be extended to a situation where substitution elasticities were increased infinitely (perfect substitution) so that both types of labour would eventually have exactly the same price. The other macroeconomic variables are not affected by this SA.

It turns out that the labour substitution elasticity is highly sensitive with respect to labour prices. This sensitivity, however, is only pronounced as long as we compare a parameter value of zero (base model) with a value of 0.5. In view of this evidence it becomes clear that our initial assumption of non-existing substitutability between skilled and unskilled labour is rather strong. Unfortunately, no theoretical or empirical work has studied this issue more intensively so that we are forced to construct our model based on pure presumptions. Future research may analyse this question in more depth. Our findings have to be careful with respect to the derived implications. After all, the question as to whether migration leads to a strong or weak pressure on wages is of quite some importance in policy recommendations.

Another rather hypothetical component of the model is the income ratio of CEEC-workers when migrating and working in the EU. As explained in 3.7.3, it is controversial whether a migrant will gain 60, 80 or 100% of his EU colleague's wage. In SA 12 we observe the outcome of our simulations under the assumption that CEEC-workers only gain 80% of the average EU wage. In SA 13 we further intensify this scenario and imagine the immigrant's wage to reach only 60%.

Naturally, in the CEEC no deviations from the base model take place as the table

[116] Rounding of results may lead to the impression that sensitivity effects are even larger.

displays. The income ratio is an issue which solely concerns the immigration country, i.e. the EU. There is hardly any reaction in labour supply in SA 12. More distinct are the effects on labour prices changing in exactly the same proportion as the income ratio. The consequences on the other macroeconomic variables are also noticeable. Lower payments for immigrant workers imply lower aggregate income of the representative agent with the resulting lower aggregate demand and consequently lower supply. Supply and demand quantities deviate from the results of the base model by 20% and 40% respectively. Thus an almost linear relationship between income ratios and macroeconomic effects is observable. On that basis any hypothesis on income ratios can be described as to be sensitive compared with the base model but rather insensitive with respect to overall results.

Sensitivity Analysis Relative to Scenario 6:

A further comparison between the base model and SA 8 - 13 is undertaken in TABLE 25. We now compare the results of the base model for the brain drain phenomenon of scenario 6(i) with sensitivity analyses.

SA 8 and SA 9 more or less duplicate our observations from the previous sensitivity analysis. The effects on labour prices reveal that the income parameter is very influential in relative as well as absolute terms.

The brain drain effect becomes a rather insignificant and trivial matter as soon as we deviate from our basic assumption of no substitutability between skilled and unskilled labour. This is undertaken in SA 10 and SA 11. Ignoring minor effects on other variables, we observe a significant deviation from base results for labour prices which, with an escalating degree of labour substitution, increasingly converge towards each other. It is logical that the elasticity of labour substitution becomes a crucial and particularly sensitive parameter in a scenario which simulates the brain drain effect.

Finally, changes in the income ratio of CEEC-workers in the EU (SA 12 and SA 13) have, compared to base results, proportional effects on all macroeconomic variables in the EU. The CEEC are barely affected by EU's income ratio. The income ratio is insignificant if we consider the variables in absolute terms.

TABLE 22: EFFECTS OF GENERAL LABOUR MIGRATION (SKILLED & UNSKILLED), SCENARIO 5 (% CHANGE FROM BENCHMARK)

(A) CEEC

		Scenario:	5(i)										5(ii)
			Emigration skilled & unskilled labour										Net migr.
	CEEC		Agriculture	Min. & Energy	Food & Clothing	Manufacturing	High tech	Priv. services	Transport serv.	Public services	Savings and investment	All sectors	All sectors
	Equivalent variation (real GDP)											-0,3	-0,1
	General price level											0,0	0,0
	Terms of trade											0,0	0,0
Supply Side	Output	quantity	-0,3	-0,2	-0,3	-0,3	-0,3	-0,3	-0,3	-0,4	-0,3	-0,3	-0,1
Supply Side	Domestic market	quantity	-0,3	-0,2	-0,3	-0,3	-0,3	-0,3	-0,3	-0,4	-0,3	-0,3	-0,1
		nominal price	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,2	0,0	0,0	0,0
		real price	-0,1	-0,1	0,0	0,0	0,0	0,1	0,0	0,2	0,0	0,0	0,0
	Exports	quantity	-0,3	-0,1	-0,3	-0,2	-0,3	-0,2	-0,2	-0,5	-	-0,2	-0,1
		nominal price	-0,1	0,0	0,0	0,0	0,0	0,2	0,1	0,0	-	0,0	0,0
		real price	-0,1	0,0	0,0	0,0	0,0	0,1	0,0	0,2	-	0,0	0,0
Demand Side	Imports	quantity	-0,1	-0,4	-0,1	-0,2	-0,2	-0,2	-0,2	0,1	-	-0,2	-0,1
		nominal price	-0,1	0,0	-0,1	0,0	0,0	0,0	0,0	0,1	-	0,0	0,0
		real price	-0,1	0,0	-0,1	0,0	0,0	0,0	0,0	0,1	-	0,0	0,0
	Intermediate demand	quantity	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-	-0,3	-0,1
		nominal price	-0,1	0,0	0,0	0,0	0,0	0,1	0,0	0,2	-	0,0	0,0
		real price	-0,1	0,0	0,0	0,0	0,0	0,1	0,0	0,2	-	0,0	0,0
	Private demand	quantity	-0,2	-0,2	-0,2	-0,2	-0,3	-0,3	-0,3	-0,5	-	-0,3	-0,1
		nominal price	-0,1	0,0	0,0	0,0	0,0	0,1	0,0	0,2	-	0,0	0,0
		real price	-0,1	0,0	0,0	0,0	0,0	0,1	0,0	0,2	-	0,0	0,0
	Government demand	quantity	-0,1	-0,1	-0,1	-0,2	-0,2	-0,2	-0,2	-0,4	-	-0,3	-0,1
		nominal price	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,2	-	0,1	0,0
		real price	0,0	-0,1	0,0	0,0	0,0	0,1	0,0	0,2	-	0,1	0,0
Factors of Production	Factor supply	skilled labour	-0,5	-0,5	-0,5	-0,4	-0,5	-0,5	-0,4	-0,5	-	-0,5	-0,2
		unskilled lab.	-0,5	-0,5	-0,5	-0,4	-0,5	-0,5	-0,4	-0,5	-	-0,5	-0,2
		capital	-0,1	-0,1	0,0	0,0	0,0	0,1	0,0	0,2	-	-	-
	Nominal factor prices	skilled labour										0,7	0,2
		unskilled lab.										0,1	0,0
		capital										-0,2	-0,1
	Real factor prices	skilled labour										0,7	0,2
		unskilled lab.										0,1	0,0
		capital										-0,2	-0,1
	Wage divergence betw. CEEC - EU	skilled labour										0,1	0,0
		unskilled lab.										-0,1	0,0

Source: Own calculations

(B) EU

	EU	Scenario:	5(i) Immigration skilled & unskilled labour: Agriculture	Min. & Energy	Food & Clothing	Manufacturing	High tech	Priv. services	Transport serv.	Public services	Savings and investment	All sectors	5(ii) Net migr.: All sectors
	Equivalent variation											0,1	0,0
	General price level											0,0	0,0
	Terms of trade											0,0	0,0
Supply Side	Output	quantity	0,4	0,1	0,2	0,1	0,1	0,0	0,1	0,0	0,1	0,1	0,0
	Domestic market	quantity	0,4	0,1	0,2	0,1	0,1	0,1	0,1	0,0	0,1	0,1	0,0
		nominal price	-0,2	0,0	-0,1	0,0	0,0	0,1	0,0	0,2	0,0	0,0	0,0
		real price	-0,2	0,0	-0,1	0,0	0,0	0,1	0,0	0,2	0,0	0,0	0,0
	Exports	quantity	0,5	0,1	0,3	0,1	0,1	0,0	0,1	-0,2	-	0,1	0,0
		nominal price	-0,2	0,0	-0,1	0,0	0,0	0,1	0,0	0,1	-	0,0	0,0
		real price	-0,2	0,0	-0,1	0,0	0,0	0,0	0,0	0,1	-	0,0	0,0
Demand Side	Imports	quantity	-0,1	0,0	0,1	0,1	0,1	0,2	0,1	0,4	-	0,1	0,0
		nominal price	-0,1	0,0	-0,1	0,0	0,0	0,0	0,0	0,1	-	0,0	0,0
		real price	-0,1	0,0	-0,1	0,0	0,0	0,0	0,0	0,1	-	0,0	0,0
	Intermediate demand	quantity	0,2	0,1	0,2	0,1	0,1	0,1	0,1	0,0	-	0,1	0,0
		nominal price	-0,2	0,0	-0,1	0,0	0,0	0,1	0,0	0,2	-	0,0	0,0
		real price	-0,2	0,0	-0,1	0,0	0,0	0,1	0,0	0,2	-	0,0	0,0
	Private demand	quantity	0,3	0,1	0,2	0,1	0,1	0,0	0,1	-0,1	-	0,1	0,0
		nominal price	-0,2	0,0	-0,1	0,0	0,0	0,1	0,0	0,2	-	0,0	0,0
		real price	-0,2	0,0	-0,1	0,0	0,0	0,1	0,0	0,2	-	0,0	0,0
	Government demand	quantity	0,4	0,3	0,3	0,3	0,3	0,2	0,3	0,0	-	0,1	0,0
		nominal price	-0,1	0,0	-0,1	0,0	0,0	0,1	0,0	0,2	-	0,2	0,1
		real price	-0,1	0,0	-0,1	0,0	0,0	0,1	0,0	0,2	-	0,2	0,1
Factors of Production	Factor supply	skilled labour	0,7	0,5	0,4	0,2	0,1	0,0	0,2	0,0	-	0,1	0,0
		unskilled lab.	0,7	0,5	0,4	0,2	0,1	0,0	0,2	0,0	-	0,2	0,1
		capital	-0,1	-0,1	0,0	-0,1	-0,1	0,1	0,0	0,2	-	-	-
	Nominal factor prices	skilled labour										1,3	0,5
		unskilled lab.										-0,8	-0,3
		capital										0,1	0,0
	Real factor prices	skilled labour										1,3	0,5
		unskilled lab.										-0,8	-0,3
		capital										0,1	0,0
	Wage divergence betw. CEEC - EU	skilled labour										0,1	0,0
		unskilled lab.										-0,1	0,0

Source: Own calculations

TABLE 23: EFFECTS OF BRAIN DRAIN / BRAIN GAIN MIGRATION, SCENARIO 6
(% CHANGE FROM BENCHMARK)

(A) CEEC

	CEEC	Scenario:	6(i) Emigration of skilled labour only (brain drain): Agriculture	Min. & Energy	Food & Clothing	Manufacturing	High tech	Priv. services	Transport serv.	Public services	Savings and investment	All sectors	6(ii) Net migr.: All sectors
	Equivalent variation (real GDP)											-0,1	0,0
	General price level											0,0	0,0
	Terms of trade											0,0	0,0
Supply Side	Output	quantity	0,4	0,0	0,2	0,0	-0,3	-0,2	0,0	-1,0	-0,1	0,0	0,0
	Domestic market	quantity	0,4	0,0	0,2	0,0	-0,3	-0,2	0,0	-0,9	-0,1	0,0	0,0
		nominal price	-0,3	0,1	-0,1	0,0	0,1	0,4	0,0	1,3	0,2	0,1	0,0
		real price	-0,3	0,0	-0,1	0,0	0,1	0,4	-0,1	1,3	0,2	0,1	0,0
	Exports	quantity	0,9	0,0	0,4	0,0	-0,4	-0,8	0,1	-2,9	-	-0,1	0,0
		nominal price	0,0	0,0	0,0	0,0	0,0	0,2	0,1	0,0	-	0,0	0,0
		real price	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,2	-	0,0	0,0
Demand Side	Imports	quantity	-1,3	0,0	-0,5	-0,1	0,0	1,6	-0,2	5,2	-	-0,1	0,0
		nominal price	0,1	0,0	0,1	0,0	0,0	0,0	0,0	-0,1	-	0,0	0,0
		real price	0,1	0,0	0,0	0,0	0,0	-0,1	0,0	-0,1	-	0,0	0,0
	Intermediate demand	quantity	0,2	-0,1	0,2	0,0	-0,2	-0,1	0,0	-0,2	-	0,0	0,0
		nominal price	-0,3	0,0	-0,1	0,0	0,0	0,4	0,0	1,3	-	0,1	0,1
		real price	-0,3	0,0	-0,1	0,0	0,0	0,4	0,0	1,2	-	0,0	0,0
	Private demand	quantity	0,2	-0,1	0,0	-0,1	-0,1	-0,4	0,0	-1,3	-	-0,1	0,0
		nominal price	-0,3	0,0	-0,1	0,0	0,0	0,4	0,0	1,3	-	0,0	0,0
		real price	-0,3	0,0	-0,1	0,0	0,0	0,4	0,0	1,3	-	0,0	0,0
	Government demand	quantity	0,8	0,4	0,6	0,5	0,4	0,1	0,5	-0,8	-	-0,1	0,0
		nominal price	-0,3	0,1	-0,1	0,0	0,0	0,4	0,0	1,3	-	0,5	0,2
		real price	-0,3	0,0	-0,1	0,0	0,0	0,4	0,0	1,3	-	0,5	0,2
Factors of Production	Factor supply	skilled labour	0,8	-0,1	0,4	0,1	-0,3	-0,6	0,1	-1,2	-	-0,5	-0,2
		unskilled lab.	0,8	-0,1	0,4	0,1	-0,3	-0,6	0,1	-1,2	-	0,0	0,0
		capital	-0,2	-0,1	0,1	-0,1	-0,3	0,3	-0,1	1,2	-	-	-
	Nominal factor prices	skilled labour										4,7	1,7
		unskilled lab.										-1,1	-0,4
		capital										0,0	0,0
	Real factor prices	skilled labour										4,7	1,7
		unskilled lab.										-1,1	-0,4
		capital										0,0	0,0
	Wage divergence betw. CEEC - EU	skilled labour										-0,8	-0,3
		unskilled lab.										0,3	0,1

Source: Own calculations

(B) EU

		Scenario:	6(i)										6(ii)
			Immigration of skilled labour only (brain gain)										Net migr.
	EU		Agriculture	Min. & Energy	Food & Clothing	Manufacturing	High tech	Priv. services	Transport serv.	Public services	Savings and investment	All sectors	All sectors
	Equivalent variation											0,0	0,0
	General price level											0,0	0,0
	Terms of trade											0,0	0,0
Supply Side	Output	quantity	-0,3	-0,1	-0,2	0,0	0,1	0,1	0,0	0,1	0,0	0,0	0,0
	Domestic market	quantity	-0,3	-0,1	-0,2	0,0	0,1	0,1	0,0	0,1	0,0	0,0	0,0
		nominal price	0,3	0,1	0,1	0,0	0,0	-0,1	0,0	-0,3	-0,1	-0,1	0,0
		real price	0,3	0,1	0,1	0,0	0,0	-0,1	0,0	-0,3	-0,1	0,0	0,0
	Exports	quantity	-0,5	-0,1	-0,2	0,0	0,1	0,1	0,0	0,4	-	0,0	0,0
		nominal price	0,2	0,1	0,1	0,0	0,0	-0,1	0,0	-0,2	-	0,0	0,0
		real price	0,2	0,1	0,1	0,0	0,0	-0,1	0,0	-0,2	-	0,0	0,0
Demand Side	Imports	quantity	0,3	0,2	0,1	0,0	0,0	-0,2	0,0	-0,5	-	0,0	0,0
		nominal price	0,1	0,0	0,1	0,0	0,0	-0,1	0,0	-0,1	-	0,0	0,0
		real price	0,1	0,0	0,1	0,0	0,0	0,0	0,0	-0,1	-	0,0	0,0
	Intermediate demand	quantity	-0,2	0,0	-0,1	0,0	0,0	0,0	0,0	0,1	-	0,0	0,0
		nominal price	0,3	0,1	0,1	0,0	0,0	-0,1	0,0	-0,3	-	0,0	0,0
		real price	0,3	0,1	0,1	0,0	0,0	-0,1	0,0	-0,3	-	0,0	0,0
	Private demand	quantity	-0,2	-0,1	-0,1	0,0	0,0	0,1	0,0	0,3	-	0,0	0,0
		nominal price	0,2	0,1	0,1	0,0	0,0	-0,1	0,0	-0,3	-	0,0	0,0
		real price	0,3	0,1	0,1	0,0	0,0	-0,1	0,0	-0,3	-	0,0	0,0
	Government demand	quantity	-0,4	-0,3	-0,3	-0,3	-0,2	-0,1	-0,2	0,1	-	0,0	0,0
		nominal price	0,2	0,1	0,1	0,0	0,0	-0,1	0,0	-0,3	-	-0,3	-0,1
		real price	0,2	0,1	0,1	0,0	0,0	-0,1	0,0	-0,3	-	-0,2	-0,1
Factors of Production	Factor supply	skilled labour	-0,6	-0,4	-0,3	0,0	0,1	0,2	0,0	0,2	-	0,1	0,0
		unskilled lab.	-0,6	-0,4	-0,3	0,0	0,1	0,2	0,0	0,2	-	0,0	0,0
		capital	0,1	0,1	0,0	0,1	0,1	-0,1	0,0	-0,3	-	-	-
	Nominal factor prices	skilled labour										-1,7	-0,6
		unskilled lab.										0,9	0,3
		capital										0,0	0,0
	Real factor prices	skilled labour										-1,7	-0,6
		unskilled lab.										0,9	0,3
		capital										0,0	0,0
	Wage divergence betw. CEEC - EU	skilled labour										-0,8	-0,3
		unskilled lab.										0,3	0,1

Source: Own calculations

TABLE 24: SENSITIVITY ANALYSES 8-13 CONCERNING SCENARIO 5 (% CHANGE FROM BENCHMARK)

CEEC			Base	SA8	SA9	SA10	SA11	SA12	SA13
	Equivalent variation		-0,3	-0,6	0,1	-0,3	-0,3	-0,3	-0,3
	General price level		0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Terms of trade		0,0	0,1	0,0	0,0	0,0	0,0	0,0
Supply Side	Output	quantity	-0,3	-0,7	0,1	-0,3	-0,3	-0,3	-0,3
	Domestic market	quantity	-0,3	-0,7	0,1	-0,3	-0,3	-0,3	-0,3
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Exports	quantity	-0,2	-0,6	0,1	-0,3	-0,3	-0,3	-0,3
		nominal price	0,0	0,1	0,0	0,0	0,0	0,0	0,0
Demand Side	Imports	quantity	-0,2	-0,5	0,1	-0,2	-0,2	-0,2	-0,2
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Intermediate demand	quantity	-0,3	-0,7	0,1	-0,3	-0,3	-0,3	-0,3
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Private demand	quantity	-0,3	-0,6	0,1	-0,3	-0,3	-0,3	-0,3
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Government demand	quantity	-0,3	-0,6	0,1	-0,3	-0,3	-0,3	-0,3
		nominal price	0,1	0,2	0,0	0,1	0,1	0,1	0,1
Factors	Factor supply	skilled labour	-0,5	-1,2	0,2	-0,5	-0,5	-0,5	-0,5
		unskilled labour	-0,5	-1,2	0,2	-0,5	-0,5	-0,5	-0,5
		capital	-	-	-	-	-	-	-
	Nominal factor prices	skilled labour	0,7	1,6	-0,3	0,3	0,3	0,7	0,6
		unskilled labour	0,1	0,3	-0,1	0,2	0,2	0,1	0,1
		capital	-0,2	-0,6	0,1	-0,2	-0,2	-0,2	-0,2
	Wage divergence betw. CEEC - EU	skilled labour	0,1	0,2	-0,1	0,0	0,0	0,0	0,0
		unskilled labour	-0,1	-0,3	0,1	0,0	0,0	-0,1	-0,1
EU	Equivalent variation		0,1	0,2	0,0	0,1	0,1	0,1	0,0
	General price level		0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Terms of trade		0,0	0,0	0,0	0,0	0,0	0,0	0,0
Supply Side	Output	quantity	0,1	0,2	0,0	0,1	0,1	0,1	0,1
	Domestic market	quantity	0,1	0,2	0,0	0,1	0,1	0,1	0,1
		nominal price	0,0	0,1	0,0	0,0	0,0	0,0	0,0
	Exports	quantity	0,1	0,3	-0,1	0,1	0,1	0,1	0,1
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Demand Side	Imports	quantity	0,1	0,2	0,0	0,1	0,1	0,1	0,1
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Intermediate demand	quantity	0,1	0,2	0,0	0,1	0,1	0,1	0,1
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Private demand	quantity	0,1	0,2	0,0	0,1	0,1	0,1	0,0
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Government demand	quantity	0,1	0,2	0,0	0,1	0,1	0,1	0,0
		nominal price	0,2	0,5	-0,1	0,0	0,0	0,1	0,1
Factors	Factor supply	skilled labour	0,1	0,2	0,0	0,1	0,1	0,1	0,0
		unskilled labour	0,2	0,4	-0,1	0,2	0,2	0,1	0,1
		capital	-	-	-	-	-	-	-
	Nominal factor prices	skilled labour	1,3	3,3	-0,7	0,0	0,0	1,0	0,8
		unskilled labour	-0,8	-2,0	0,4	-0,1	-0,1	-0,6	-0,5
		capital	0,1	0,3	-0,1	0,1	0,1	0,1	0,1

Source: Own calculations

TABLE 25: SENSITIVITY ANALYSES 8-13 CONCERNING SCENARIO 6 (% CHANGE FROM BENCHMARK)

CEEC			Base	SA8	SA9	SA10	SA11	SA12	SA13
	Equivalent variation		-0,1	-0,2	0,0	-0,1	-0,1	-0,1	-0,1
	General price level		0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Terms of trade		0,0	0,1	0,0	0,0	0,0	0,0	0,0
Supply Side	Output	quantity	0,0	-0,1	0,0	-0,1	-0,1	0,0	0,0
	Domestic market	quantity	0,0	-0,1	0,0	-0,1	-0,1	0,0	0,0
		nominal price	0,1	0,3	-0,1	0,0	0,0	0,1	0,1
	Exports	quantity	-0,1	-0,2	0,0	-0,1	-0,1	-0,1	-0,1
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Demand Side	Imports	quantity	-0,1	-0,2	0,0	-0,1	-0,1	-0,1	-0,1
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Intermediate demand	quantity	0,0	-0,1	0,0	-0,1	-0,1	0,0	0,0
		nominal price	0,1	0,4	-0,1	0,0	0,0	0,1	0,1
	Private demand	quantity	-0,1	-0,2	0,0	-0,1	-0,1	-0,1	-0,1
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Government demand	quantity	-0,1	-0,2	0,0	-0,1	-0,1	-0,1	-0,1
		nominal price	0,5	1,4	-0,3	0,1	0,1	0,6	0,6
Factors	Factor supply	skilled labour	-0,5	-1,2	0,2	-0,5	-0,5	-0,5	-0,5
		unskilled labour	0,0	0,0	0,0	0,0	0,0	0,0	0,0
		capital	-	-	-	-	-	-	-
	Nominal factor prices	skilled labour	4,7	12,0	-2,3	0,8	0,5	4,8	4,8
		unskilled labour	-1,1	-2,7	0,5	-0,1	0,0	-1,1	-1,1
		capital	0,0	0,1	0,0	0,0	0,0	0,0	0,0
	Wage divergence betw. CEEC - EU	skilled labour	-0,8	-2,1	0,4	-0,1	-0,1	-0,8	-0,7
		unskilled labour	0,3	0,7	-0,1	0,0	0,0	0,3	0,2
EU	Equivalent variation		0,0	0,1	0,0	0,0	0,0	0,0	0,0
	General price level		0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Terms of trade		0,0	0,0	0,0	0,0	0,0	0,0	0,0
Supply Side	Output	quantity	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Domestic market	quantity	0,0	0,0	0,0	0,0	0,0	0,0	0,0
		nominal price	-0,1	-0,1	0,0	0,0	0,0	0,0	0,0
	Exports	quantity	0,0	0,0	0,0	0,0	0,0	0,0	0,0
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Demand Side	Imports	quantity	0,0	0,0	0,0	0,0	0,0	0,0	0,0
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Intermediate demand	quantity	0,0	0,0	0,0	0,0	0,0	0,0	0,0
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Private demand	quantity	0,0	0,1	0,0	0,0	0,0	0,0	0,0
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Government demand	quantity	0,0	0,1	0,0	0,0	0,0	0,0	0,0
		nominal price	-0,3	-0,6	0,1	0,0	0,0	-0,2	-0,2
Factors	Factor supply	skilled labour	0,1	0,2	0,0	0,1	0,1	0,1	0,0
		unskilled labour	0,0	0,0	0,0	0,0	0,0	0,0	0,0
		capital	-	-	-	-	-	-	-
	Nominal factor prices	skilled labour	-1,7	-4,2	0,8	-0,1	-0,1	-1,3	-1,0
		unskilled labour	0,9	2,2	-0,4	0,0	0,0	0,7	0,5
		capital	0,0	-0,1	0,0	0,0	0,0	0,0	0,0

Source: Own calculations

5.5 Synthesis of Integration Elements: The Static All-Inclusive Scenario

In the previous sections of this chapter we have undertaken individual analyses of the most important integration components which would be likely to occur if the CEEC were to join the EU. In each simulation we have intentionally made use of the ceteris paribus condition. This means that except for the particular integration policy under study, all other political elements of an eastern enlargement of the EU remained unchanged at their pre-integration levels. The aim of this section now is to combine all individual integration components into one synthesising analysis. In this section we will remain in a purely static environment before the next section simulates integration using a recursive dynamic model over several time periods.

5.5.1 Scenarios

A synthesising analysis of CEEC' integration into the EU requires the incorporation of each of the previous individual integration elements. Thus, the following political elements are simultaneously contained in our model: (i) trade liberalisation, (ii) capital transfers from the EU to the CEEC and (iii) labour migration from the CEEC to the EU. In this "all-inclusive" simulation we will neglect some of the previously presented variations in the area of capital transfers and migration. Instead we will only concentrate on two main scenarios. The first one incorporates the more moderate assumptions with respect to CEEC' integration, the second one includes the more extreme hypotheses. In this way we can simulate some form of lower and upper boundary of a whole bunch of possible integration projections. In specific terms the two scenarios will contain:

Scenario 7: Moderate, static, all-inclusive scenario (synthesis)

- Trade Liberalisation: complete abolition of trade barriers (scenario 1)
- Capital Transfers: transfer of 25% (scenario 2)
- Labour Migration: net migration of skilled and unskilled labour (scenario 5 ii)

Scenario 8: Extreme, static, all-inclusive scenario (synthesis)

- Trade Liberalisation: complete abolition of trade barriers (scenario 1)
- Capital Transfers: transfer of 50% (scenario 3)
- Labour Migration: migration of skilled and unskilled labour (scenario 5 i)

5.5.2 Expectations

With the intention of anticipating the outcome of scenarios 7 and 8, we can make use of both, previously formulated expectations as well as foregoing simulations. The results of both synthesising scenarios should come close to the addition of individual effects. An overview of all previous simulation results is therefore provided in Table 26 (A+B) on p. 156 f.

The moderate integration scenario (**scenario** 7) is then expected to result in an overall increase in welfare and output in the CEEC. The abolition of trade barriers will yield moderate welfare and output effects whereas capital transfers will be strongly positive . Only net emigration from the CEEC may result in small negative consequences. We are also likely to see a similarly strong degree of trade creation as in scenario 1. With respect to production factors, prices of skilled labour will be strongly influenced in an upward direction by capital transfers (scenario 2), whereas unskilled labour prices will rise strongly as a result of both trade integration and capital transfers.

For the EU, outcomes can be expected to continue being very small. At the same time, it is difficult to say in advance if they will eventually turn out to be positive or negative. Welfare and output cannot be expected to show a strong reaction to trade integration and migration, although a positive influence should prevail. Only capital transfers will exercise a minimal negative effect. With respect to trade too, we may be confronted with ambiguous effects. Trade integration enhances trade whereas capital transfers reduce it. Prices for skilled labour will probably be positively influenced by immigration. Unskilled labour wages will probably fall due to capital transfers and immigration.

Expectations become more distinct as soon as we consider the extreme scenario (**scenario 8**). As TABLE 26(A) suggests, there will be very strong welfare, output and trade effects mostly influenced by the large amount of capital inflow. Prices for labour will rise whereas capital prices will fall substantially.

We should expect the EU to experience the extreme scenario as a decrease in welfare, output and probably also trade. The outflow of capital will be perceived negatively. The effect on skilled labour prices is difficult to foretell due to the negative influence exerted by capital outflow and the positive influence resulting from immigration. Unskilled labour prices should fall on aggregate, whereas capital prices should rise.

5.5.3 SIMULATION RESULTS

The simulation results of the all-inclusive scenarios 7 and 8 are illustrated in TABLE 27 (p. 158). We illustrate the economy wide effects and abstain from presenting their sectoral distribution.

5.5.3.1 The Moderate Integration Scenario

The simulation of the moderate integration scenario (scenario 7) results in welfare, supply and demand rises for the **CEEC**. As expected, most values are a composition of the effects which the individual policy measures (i.e. trade liberalisation, capital transfers and migration) have already caused. Hence, in order to determine the precise origin of effects, it is useful to consult the results from scenarios 1, 2 and 5(ii) displayed in TABLE 26(A). With respect to overall welfare, for instance, it turns out that the strongest effect comes from the inflow of capital from the EU. This already amounts to a welfare increase of 3.1%. An additional 0.9% increase can be attributed to the fall of all trade barriers. Lastly, the net outflow of labour reduces the other effects moderately until a final welfare rise of 3.8% is achieved.

We also observe a fall in the general price level (-1.9%) and an improvement in the terms of trade (+6%) which are mainly caused by the reduction of import barriers.

On the *supply side* there is an increase in domestic output of 3.2% originating mainly from the effects of capital inflows. The distribution of this output between the domestic and the export market, however, shows an interesting pattern which deviates from the pure aggregation of the three individual policy effects: Domestic supply increases disproportionately slowly by 1.9% only whereas we notice a disproportional rise in exports of 9.9%. Thus the combination of higher capital endowments with eliminated trade barriers and the resulting improvement in the terms of trade leads to a particularly strong stimulation of the export industries.

On the *demand side*, we can see rising imports (+11.4%) which are strongly influenced through trade integration and partly result from capital inflows. Private and government demand react proportionally to welfare, and increase by 3.8%.

The data on factor supplies reflects the changing endowments which come about due to net labour emigration and capital immigration. The moderate scenario simulates a departure of 0.2% of all skilled and unskilled employees and at the same time increases capital endowments by 9%. The effects on nominal factor prices are not so much a result of net labour emigration but rather of strong price effects originating from trade liberalisation and capital accumulation. For instance, the elimination of trade barriers, on the one hand, has a strong negative influence on skilled labour wages (compare with TABLE 26 A). Capital inflows, on the other hand, strongly affect wages in the opposite direction. The moderately positive effect resulting from skilled emigration then only has minor consequences on the final nominal price which increases by 2.1%. The performance of the price of unskilled labour (+5.4%) and capital (-4.6%) is consistent.

Finally, the effects on wage divergence between the CEEC and the EU reflect the changing performance of nominal labour wages. We observe a moderate convergence for skilled (-0.2%) and unskilled labour (-0.8%). From a comparison with scenario 5(i) (see TABLE 26) it becomes obvious that the degree of wage convergence is now strongly influenced by the number of capital transfers which we include in the simulations. This shows that capital transfers can also be an effective means of reducing wage disparities in the East and West, an observation which corresponds perfectly well with neoclassical theory.

The simulations of the moderate integration scenario lead to very small effects for the **EU**. It turns out that there is a weak negative effect on welfare, domestic production and on sales on the domestic market, which is due to the outflow of capital as part of the EU's regional and structural policy. Trade liberalisation improves the EU's terms of trade slightly and also enhances the export of goods. Net immigration from the CEEC increases the supply of skilled and unskilled labour by 0.03% and 0.05% respectively.[117] Capital outflows reduce capital endowments by 0.4%. Factor prices for skilled and unskilled labour perform contrastingly. A rising price for skilled labour (+0.2%) and

[117] Rounding causes these values to be displayed as 0,0% and 0,1% respectively in the table.

falling wages for unskilled labour (-0.3%) reflect the forces of both increased supply of labour and different demand structures resulting from Leontief technologies between both labour categories. Prices of capital rising as they do by 0.4% behave as expected.

5.5.3.2 The Extreme Integration Scenario

In contrast to scenario 7, scenario 8 represents a more extreme case of potential CEEC integration. Whereas trade liberalisation is modelled as previously, we now increase the amount of both the capital transfers from the EU to the CEEC and labour migration flows from the CEEC to the EU. Thus different and stronger assumptions about the quantity of factor flows characterise this scenario.

Increased capital endowments in the **CEEC** (+17.9%) are the main source of strongly positive welfare, supply and demand effects in this simulation. Real GDP even increases by a considerable 6.6%. Exports and imports each experience a rise of more than 10%. Private and government demand increase in the same proportion as welfare whereas intermediate inputs rise to a lesser extent. Larger emigration flows reduce labour endowments by 0.5%. The effect on factor prices is obvious. Rising labour and falling capital prices.

The extreme integration scenario has again hardly any effect on the **EU**. There is a slight decrease in welfare, production and demand. Trade is enhanced slightly. The strongest effects are on the factor markets. Supply of labour increases by 0.1% for skilled and 0.2% for unskilled labour whereas there is an outflow of capital of 0.8%. This has consequences for the factor prices, which increase for skilled labour and capital and fall for unskilled labour. There is wage convergence between the CEEC and the EU by 0.8% for skilled labour which is again mainly induced through the higher proportion of capital transfers, and 1.3% for unskilled labour.

Both, results from the moderate as well as the extreme scenario show that CEEC' integration effects are mainly capital driven. Neither trade integration nor labour migration are able to provoke upsurges which are even close to those created by capital transfers.

The CEEC happen to be the main beneficiaries of our scenarios. Strong approval for a quick and complete integration, particularly with the claim of full access to the EU's regional and structural policy measures is likely to evolve from our results. It should also be mentioned in this context, however, that not all parties within the CEEC are winners of integration. CEEC' capital owners, for instance, observe a strong deterioration in their capital prices, which might lead them to oppose the idea of larger capital inflows from the EU.

Although the consequences of full integration for the EU are very small in either scenario, it is probable that opposition to a quick EU-enlargement will come about. The outflow of capital being the main determinant of the EU's economic contraction could create some resistance against the form of integration as suggested by our simulations, particularly in those countries which are currently net receivers of the EU's regional and structural aid. A request for some form of transition period with respect to CEEC' participation in the regional and structural policy could be possible. The fact that any capital outflow is detrimental to the outflowing region is nothing new. In any discussion concerning this issue, it should therefore be pointed out that the consequences of transfer payments turn out to be extremely small for the EU-15.

Besides these aggregate economic developments, there are also individual EU-lobbying groups which might approve or reject an enlargement. Labour intensive producers benefiting most from immigration will, on the one side, argue in favour of CEEC' integration just as much as white collar workers and capital owners who perceive a rise in their factor prices. Producers of capital intensive goods and blue collar workers, on the other side, will strongly oppose the idea of capital transfers to the CEEC and labour market integration respectively. In particular trade unions representing unskilled workers will most probably make use of their lobbying power in order to prevent any quick EU-CEEC labour market integration. In these fields policy makers will be required to provide acceptable solutions.

TABLE 26: OVERVIEW OF SIMULATION RESULTS, SCENARIOS 1-6 (% CHANGE FROM BENCHMARK)

(A) CEEC

	CEEC	Scenario:	1 Trade	2 Transfer 25%	3 Transfer 50%	4 Transfer 75%	5(i) Gen. migration	5(ii) Gen. netmigration	6(i) Brain drain	6(ii) Net brain drain
	Equivalent variation (real GDP)		0,9	3,1	6,0	8,7	-0,3	-0,1	-0,1	0,0
	General price level		-1,8	0,0	0,0	-0,1	0,0	0,0	0,0	0,0
	Terms of trade		6,3	-0,3	-0,6	-0,9	0,0	0,0	0,0	0,0
Supply Side	Output	quantity	0,1	3,2	6,3	9,1	-0,3	-0,1	0,0	0,0
	Domestic market	quantity	-1,2	3,3	6,3	9,2	-0,3	-0,1	0,0	0,0
		nominal price	-1,3	-0,1	-0,2	-0,2	0,0	0,0	0,1	0,0
		real price	0,5	-0,1	-0,1	-0,2	0,0	0,0	0,1	0,0
	Exports	quantity	6,8	3,0	5,9	8,5	-0,2	-0,1	-0,1	0,0
		nominal price	2,9	-0,4	-0,7	-1,1	0,0	0,0	0,0	0,0
		real price	4,8	-0,4	-0,7	-1,0	0,0	0,0	0,0	0,0
Demand Side	Imports	quantity	8,6	2,7	5,2	7,6	-0,2	-0,1	-0,1	0,0
		nominal price	-5,2	0,0	-0,1	-0,1	0,0	0,0	0,0	0,0
		real price	-3,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Intermediate demand	quantity	0,2	3,2	6,3	9,1	-0,3	-0,1	0,0	0,0
		nominal price	-2,1	-0,1	-0,3	-0,4	0,0	0,0	0,1	0,1
		real price	-0,3	-0,1	-0,2	-0,3	0,0	0,0	0,0	0,0
	Private demand	quantity	0,9	3,1	6,0	8,7	-0,3	-0,1	-0,1	0,0
		nominal price	-1,8	0,0	0,0	-0,1	0,0	0,0	0,0	0,0
		real price	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Government demand	quantity	0,9	3,1	6,0	8,7	-0,3	-0,1	-0,1	0,0
		nominal price	-1,7	0,4	0,8	1,2	0,1	0,0	0,5	0,2
		real price	0,1	0,4	0,8	1,2	0,1	0,0	0,5	0,2
Factors of Production	Factor supply	skilled labour	-	-	-	-	-0,5	-0,2	-0,5	-0,2
		unskilled labour	-	-	-	-	-0,5	-0,2	0,0	0,0
		capital	-	9,0	17,9	26,7	-	-	-	-
	Nominal factor prices	skilled labour	-3,0	4,9	9,5	13,9	0,7	0,2	4,7	1,7
		unskilled labour	2,7	2,7	5,2	7,5	0,1	0,0	-1,1	-0,4
		capital	1,1	-5,6	-10,4	-14,5	-0,2	-0,1	0,0	0,0
	Real factor prices	skilled labour	-1,1	4,9	9,6	13,9	0,7	0,2	4,7	1,7
		unskilled labour	4,6	2,7	5,2	7,5	0,1	0,0	-1,1	-0,4
		capital	3,0	-5,5	-10,3	-14,5	-0,2	-0,1	0,0	0,0
	Wage divergence betw. CEEC - EU	skilled labour	-	-	-	-	0,1	0,0	-0,8	-0,3
		unskilled labour	-	-	-	-	-0,1	0,0	0,3	0,1

Source: Own calculations

(B) EU

	EU	Scenario:	1 Trade	2 Transfer 25%	3 Transfer 50%	4 Transfer 75%	5(i) Gen. migration	5(ii) Gen. netmigration	6(i) Brain drain	6(ii) Net brain drain
	Equivalent variation		0,0	-0,1	-0,3	-0,4	0,1	0,0	0,0	0,0
	General price level		0,0	0,0	0,1	0,1	0,0	0,0	0,0	0,0
	Terms of trade		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Supply Side	Output	quantity	0,0	-0,1	-0,2	-0,4	0,1	0,0	0,0	0,0
	Domestic market	quantity	0,0	-0,1	-0,3	-0,4	0,1	0,0	0,0	0,0
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	-0,1	0,0
		real price	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Exports	quantity	0,1	-0,1	-0,2	-0,3	0,1	0,0	0,0	0,0
		nominal price	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0
		real price	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Demand Side	Imports	quantity	0,1	-0,1	-0,2	-0,3	0,1	0,0	0,0	0,0
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
		real price	0,0	0,0	-0,1	-0,1	0,0	0,0	0,0	0,0
	Intermediate demand	quantity	0,0	-0,1	-0,2	-0,4	0,1	0,0	0,0	0,0
		nominal price	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
		real price	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Private demand	quantity	0,0	-0,1	-0,3	-0,4	0,1	0,0	0,0	0,0
		nominal price	0,0	0,0	0,1	0,1	0,0	0,0	0,0	0,0
		real price	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Government demand	quantity	0,0	-0,1	-0,2	-0,4	0,1	0,0	0,0	0,0
		nominal price	0,0	-0,1	-0,1	-0,2	0,2	0,1	-0,3	-0,1
		real price	0,0	-0,1	-0,2	-0,2	0,2	0,1	-0,2	-0,1
Factors of Production	Factor supply	skilled labour	-	-	-	-	0,1	0,0	0,1	0,0
		unskilled labour	-	-	-	-	0,2	0,1	0,0	0,0
		capital	-	-0,4	-0,8	-1,2	-	-	-	-
	Nominal factor prices	skilled labour	0,0	-0,3	-0,5	-0,8	1,3	0,5	-1,7	-0,6
		unskilled labour	0,0	0,0	-0,1	-0,1	-0,8	-0,3	0,9	0,3
		capital	0,0	0,3	0,6	0,9	0,1	0,0	0,0	0,0
	Real factor prices	skilled labour	0,0	-0,3	-0,6	-0,9	1,3	0,5	-1,7	-0,6
		unskilled labour	0,0	-0,1	-0,1	-0,2	-0,8	-0,3	0,9	0,3
		capital	0,0	0,3	0,5	0,8	0,1	0,0	0,0	0,0
	Wage divergence betw. CEEC - EU	skilled labour	-	-	-	-	0,1	0,0	-0,8	-0,3
		unskilled labour	-	-	-	-	-0,1	0,0	0,3	0,1

Source: Own calculations

TABLE 27: EFFECTS OF COMPLETE INTEGRATION (STATIC SYNTHESIS), SCENARIOS 7 & 8 (% CHANGE FROM BENCHMARK)

			Scenario 7 (moderate)		Scenario 8 (extreme)	
			CEEC	EU	CEEC	EU
			All sectors	All sectors	All sectors	All sectors
	Equivalent variation (real GDP)		3,8	-0,1	6,6	-0,2
	General price level		-1,9	0,0	-1,9	0,1
	Terms of trade		6,0	0,1	5,7	0,1
Supply Side	Output	quantity	3,2	-0,1	6,0	-0,2
	Domestic market	quantity	1,9	-0,1	4,7	-0,2
		nominal price	-1,4	0,1	-1,5	0,1
		real price	0,5	0,0	0,4	0,0
	Exports	quantity	9,9	0,1	12,7	0,0
		nominal price	2,5	0,1	2,1	0,1
		real price	4,4	0,0	4,1	0,0
Demand Side	Imports	quantity	11,4	0,0	14,0	0,0
		nominal price	-5,2	0,0	-5,2	0,0
		real price	-3,4	-0,1	-3,4	-0,1
	Intermediate demand	quantity	3,3	-0,1	6,1	-0,1
		nominal price	-1,5	0,0	-1,4	0,0
		real price	-0,4	0,0	-0,5	0,0
	Private demand	quantity	3,8	-0,1	6,6	-0,2
		nominal price	-1,9	0,0	-1,9	0,1
		real price	0,0	0,0	0,0	0,0
	Government demand	quantity	3,8	-0,1	6,6	-0,2
		nominal price	-1,3	0,0	-0,8	0,1
		real price	0,6	0,0	1,1	0,0
Factors of Production	Factor supply	skilled labour	-0,2	0,0	-0,5	0,1
		unskilled labour	-0,2	0,1	-0,5	0,2
		capital	9,0	-0,4	17,9	-0,8
	Nominal factor prices	skilled labour	2,1	0,2	7,1	0,8
		unskilled labour	5,4	-0,3	8,0	-0,8
		capital	-4,6	0,4	-9,6	0,7
	Real factor prices	skilled labour	4,0	0,2	9,2	0,7
		unskilled labour	7,4	-0,3	10,1	-0,9
		capital	-2,8	0,3	-7,9	0,7
	Wage divergence betw. CEEC - EU	skilled labour	-0,2		-0,8	
		unskilled labour	-0,8		-1,3	

Source: Own calculations

5.6 Synthesis of Integration Elements: The Recursive Dynamic All-Inclusive Scenario

The recursive dynamic simulation resembles the static simulations in many aspects: it includes the *"all-inclusive"* analysis meaning that trade liberalisation, capital transfers and labour migration are studied simultaneously. A recursive dynamic approach is particularly convenient for the analysis of migration because the intertemporal feature of the migration decision can be modelled more realistically: the previous period's income differential being the main migration determining variable endogenously alters each loop anew, thereby determining the next period's amount of migration. There is thus an indirect, two-way causality between income differentials and migration.

What is also new in the recursive dynamic scenario is the incorporation of intertemporal capital formation in the context of the savings and investment decision of economic agents (recall section 3.6.3). Thus, the approach includes the domestically produced, periodical increase of capital endowments.

5.6.1 Scenarios

Scenario 9, which will be simulated in this section, incorporates two things: firstly, it includes all types of *integration elements* which would come about in the course of an EU eastern enlargement. In this respect, we decided to model the recursive dynamic scenario equivalently to the moderate, all-inclusive projection undertaken in scenario 7. These enlargement elements are additionally complemented by the intertemporal *capital formation process* which is assumed to come about irrespective of EU-CEEC integration.

The model is being run over a time horizon of three periods. In our case, each period is assumed to last approximately one year.[118] In each period we undertake the following simulations:

Scenario 9: Recursive dynamic, all-inclusive scenario (synthesis)

- Trade Liberalisation: complete abolition of trade barriers (scenario 1)
- Capital Transfers: transfer of 25% (scenario 2)
- Labour Migration: net migration of skilled and unskilled labour (scenario 5 ii)

5.6.2 Expectations

The formulation of expectations can be divided into the two types of elements implicitly included in this scenario: On the one side, the *integration elements* can be anticipated analogously to the expectations formulated in the context of scenario 7. They need not be repeated here. The *capital formation element*, on the other side, which leads to a periodical increase in capital endowments within each individual region, leaves space for additional anticipations. Since our model is mostly based on neoclassical

[118] Recall section 3.10.1.

assumptions, the capital formation process can be expected to roughly follow Solow's (1956) neoclassical growth theory. There, decreasing returns on capital, which imply falling marginal productivity, lead to an ever-decreasing amount of net investment over time. This process only ends when the steady state has eventually been reached where net investment is zero, so that gross investment equals the depreciation of capital.

Depending on the macroeconomic propensity to invest and on the exogenously given depreciation rate, any rise in net capital endowments can be expected to improve production possibilities enhancing overall output, income and consumption. In short, any form of capital formation leads to overall growth.

The overall effects of scenario 9 should depend on which of the two elements, integration vs. capital formation, predominates. In the CEEC the integrative elements, particularly the capital transfers from the EU, will already bring strong macroeconomic consequences (as seen in scenario 7). Further effects from CEEC' own capital formation will then be noticeable but not decisive. In the EU, in contrast, integration is hardly noticed so that the capital formation element should be superior in its consequences.

5.6.3 Simulation Results

Simulation results of scenario 9 are illustrated in Table 28 on p. 164. It displays the aggregate results for every period in each of the two regions. No sectoral breakdown has been undertaken. Each period's results must be seen relative to the previous period.

5.6.3.1 Simulated Recursive Dynamic Effects for the CEEC

As Table 28 shows, the CEEC experience strong positive effects. An increase in capital endowments of over 10% in period 1 and more than 9% in periods 2 and 3 seem to be the main factor determining strongly positive welfare, output and demand effects. In this scenario capital endowments are composed of capital transfers in the context of EU's structural and regional policy (as in scenario 7) and CEEC' own capital formation. The negative reaction of capital prices, falling by a real 4-6% depending on the period, is the logical consequence of increased supply.

The increase in capital endowments in periods 2 and 3 slows down slightly, a performance which clearly reflects CEEC' convergence to its long-run steady state where net investment becomes zero. If we continued our recursive dynamic experiment including additional loops we should at some point theoretically reach CEEC' steady state where no further growth of capital endowments takes place.

The supply of skilled and unskilled labour decreases in all three periods by 0.2%. This value corresponds to the rate of net emigration which we already encountered in scenario 5(ii). It is interesting to notice that the amount of emigration only decreases minimally despite continuous wage convergence of labour between the CEEC and the EU (an exception is period 1 where there is even some evidence of wage divergence for skilled labour). This is due to the fact that the degree of wage convergence is rather small and that the migrant stock in the EU, which exerts a positive influence on migration, rises. This counteracts the influence of the income parameter (compare with

EQ. 23).
The performance of labour wages represents a mixture of previous individual policy simulations. We observe an increase in the wages of skilled and unskilled labour which comes from (i) the effects of trade liberalisation, (ii) the departure of labour (to a small proportion) and (iii) the increase in capital endowments (to a large proportion). Whereas trade liberalisation induces a strong negative effect on skilled and a positive effect on unskilled labour, the increase in capital endowments leads to a rise in both types of labour prices. Finally, emigration has another minor positive effect (see again TABLE 26 for the overview).

The CEEC experience an overall welfare increase of 4.5% in period 1 which is larger than the effect we have seen during the relatively similar scenario 7. Naturally, intertemporal capital formation is responsible for this difference and it accounts for 0.7 percentage points (20-25%) of the positive effect on welfare alone. Clearly, capital formation boosts the production of commodities which enhance aggregate producers' income and overall wealth. In other words, investment results in economic growth.

The results suggest that economic effects in the CEEC moderately wane the more the model is repeatedly run. In period 1 the effects on welfare, supply, trade, and demand are positive and larger compared to those effects in period 2 and period 3. This is comprehensible since the effect of a reduction in trade barriers only appears in the first period. In periods 2 and 3 no further trade liberalisation is undertaken so that direct consequences from this policy simulation no longer take place. The export and import quantities reflect this link especially. In period 1 they reach values of more than 10% reflecting the trade integration effect whereas in periods 2 and 3 their performance is much lower and mainly welfare driven. A comparison with scenario 1 provides useful insight into the degree of effects coming solely from trade liberalisation. As TABLE 26(A) shows, trade liberalisation by itself accounts for approximately 0.9 percentage points in the CEEC. Thus, a difference in effects between period 1 and period 2 of at least 0.9 percentage points is rational.
Besides this one-off trade effect in the first period, the decreasing marginal productivity of capital which is an imperative consequence of investment in subsequent periods also enhances this abating effect.

As in previous simulations, we observe that welfare on the one hand and private as well as government demand on the other hand react to exactly the same degree. This is natural since the model assumes an exogenous marginal propensity to consume and a constant government share in total output.

5.6.3.2 Simulated Recursive Dynamic Effects for the EU

With respect to the EU, the recursive dynamic scenario exposes moderately positive effects.
Capital endowments increase by about 4% in period 1 and slightly less in periods 2 and

3 and are mainly determined by the intertemporal capital formation process. The capital transfers to the CEEC are already included in this value.

As in the case of the CEEC, the periodical amount of capital formation in the EU also "slows down". Again, we must see this pattern in the context of neoclassical growth theory, where decreasing returns to capital and a constant propensity to invest must logically result in a gradual convergence of net investment towards zero (steady state). Capital prices behave as expected and decrease by a real 2.5% roughly. It is interesting to observe that the EU experiences positive net investment in the first place because this means that it has not reached its steady state yet and is still in the process of convergence. We might have expected a developed region to be at or close to its steady state with net investment being very small or even amounting to zero. A possible explanation could lie in the long-term steady state growth path which developed economies tend to have. This dynamic path is determined by factors such as population growth, labour participation etc. and defines an investment factor which results in positive net investment even after a steady state has been reached. The information on the benchmark amount of investment in our SAM could then contain such a dynamic factor without actually being able to identify it as being of dynamic nature.

Net immigration of labour from the CEEC leads to a very small increase in labour endowments within the EU. The positive effects on skilled labour are indeed so small that they do not even appear in TABLE 28. Only unskilled labour endowments show a positive reaction of a moderate 0.1% in periods 1 and 2 and converge towards zero in period 3. The strong, positive reaction of white collar wages (+4.2% in period 1 and slightly less thereafter) is then surely only marginally due to the change in labour endowments or the other integration elements (compare also with TABLE 26). It is mainly a response to the strong increase in the EU's capital endowments. Interestingly, the wage for unskilled labour does not show a strong reaction in scenario 9. Although it increases (in contrast to most previous scenarios), its positive real value of 0.1% remains a very small deviation compared to the benchmark.

Overall, the EU experiences some moderately positive welfare in each period, with output and demand effects accounting for a welfare increase of about 1.2% in each loop anew. Comparing these results with the calculations from scenario 7, it becomes obvious that it is intertemporal capital formation within the EU that is responsible for this positive tendency. This implies that the actual consequences resulting from the EU-enlargement continue to remain negligible.

Similarly to what we observed in the case of the CEEC, period 1 demonstrates the strongest macroeconomic effects. Again this is firstly due to the moderate but positive consequences arising from the abolition of all trade barriers prior to period 1. Subsequent periods do not benefit from trade liberalisation any further so that a dropping off is understandable. Secondly, the aforementioned decreasing marginal productivity of capital contributes to this effect.

However, the net positive welfare effect for the EU is a very important result since EU citizens would hardly approve an eastern enlargement if their overall welfare decreased. The minimal reduction of net welfare due to enlargement would probably still be tolerated.

5.6.3.3 Sensitivity Analysis

The question arises as to what degree the intertemporal capital accumulation which particularly characterises the recursive dynamic scenario influences the results of our simulations. This answer can be given by running the recursive dynamic model with the element of intertemporal capital formation excluded. Although this is nonsense in terms of economic logic because capital formation is an essential component of the economic cycle, it appears sensible since it can show the recursive dynamic results of economic integration in isolation.

SA 14: Recursive dynamic model without capital formation

TABLE 29 displays the results from SA 14. In the **CEEC** capital endowments turn out to be roughly 2 percentage points smaller compared with scenario 9. Obviously there are no differences with respect to the change in labour endowments. Nominal and real factor prices alter in line with lower capital endowments. Also the effects on welfare, output and domestic demand are minor without exception. All in all, intertemporal capital formation enlarges endowments and resulting macroeconomic consequences by about 20-25%.

In the **EU** where all integration effects are extremely small anyway, intertemporal capital formation appears to play a much bigger role. Capital endowments become negative, nominal and real factor prices deviate considerably from those in scenario 9 and welfare, output and demand effects again show a small but negative tendency. Hence, simply due to EU's own capital formation process, which has nothing to do with an EU-enlargement, scenario 9 provides positive welfare results for the EU.

TABLE 28: SIMULATION RESULTS OF THE RECURSIVE DYNAMIC APPROACH, SCENARIO 9 (% CHANGE FROM PREVIOUS PERIOD)

			CEEC			EU		
			Period 1	Period 2	Period 3	Period 1	Period 2	Period 3
	Equivalent variation (real GDP)		4,5	3,3	3,0	1,3	1,3	1,2
	General price level		-2,1	-0,2	-0,2	-0,4	-0,4	-0,4
	Terms of trade		6,1	-0,2	-0,2	0,0	0,0	0,0
Supply Side	Output	quantity	3,8	3,4	3,1	1,3	1,2	1,2
	Domestic market	quantity	2,4	3,4	3,1	1,3	1,3	1,2
		nominal price	-1,6	-0,3	-0,3	-0,2	-0,2	-0,2
		real price	0,5	0,0	0,0	0,2	0,2	0,2
	Exports	quantity	10,7	3,4	3,1	1,3	1,2	1,1
		nominal price	2,3	-0,6	-0,5	-0,2	-0,2	-0,2
		real price	4,4	-0,3	-0,3	0,2	0,2	0,2
Demand Side	Imports	quantity	12,4	3,2	2,9	1,3	1,2	1,1
		nominal price	-5,5	-0,3	-0,3	-0,3	-0,2	-0,2
		real price	-3,5	-0,1	-0,1	0,1	0,1	0,1
	Intermediate demand	quantity	3,9	3,4	3,1	1,3	1,2	1,2
		nominal price	-1,7	-0,1	-0,1	-0,3	-0,3	-0,2
		real price	-0,4	-0,1	-0,1	0,1	0,1	0,1
	Private demand	quantity	4,5	3,3	3,0	1,3	1,3	1,2
		nominal price	-2,1	-0,2	-0,2	-0,4	-0,4	-0,4
		real price	0,0	0,0	0,0	0,0	0,0	0,0
	Government demand	quantity	4,5	3,3	3,0	1,3	1,3	1,2
		nominal price	-1,3	0,4	0,3	0,6	0,6	0,5
		real price	0,8	0,6	0,5	1,0	1,0	0,9
Factors of Production	Factor supply	skilled labour	-0,2	-0,2	-0,2	0,0	0,0	0,0
		unskilled labour	-0,2	-0,2	-0,2	0,1	0,1	0,0
		capital	10,7	9,9	9,1	4,1	3,8	3,6
	Nominal factor prices	skilled labour	3,3	5,9	5,4	3,8	3,4	3,2
		unskilled labour	5,7	2,7	2,5	-0,3	-0,3	-0,3
		capital	-5,7	-6,3	-5,8	-2,9	-2,8	-2,7
	Real factor prices	skilled labour	5,5	6,1	5,6	4,2	3,8	3,6
		unskilled labour	7,9	3,0	2,7	0,1	0,1	0,1
		capital	-3,7	-6,1	-5,6	-2,6	-2,4	-2,3
	Wage divergence betw. CEEC - EU	skilled labour	0,1	-0,3	-0,3	0,1	-0,3	-0,3
		unskilled labour	-0,9	-0,5	-0,5	-0,9	-0,5	-0,5

Source: Own calculations

TABLE 29: SENSITIVITY ANALYSIS 14, EXCLUDING CAPITAL FORMATION (% CHANGE FROM PREVIOUS PERIOD)

			CEEC Period 1	CEEC Period 2	CEEC Period 3	EU Period 1	EU Period 2	EU Period 3
	Equivalent variation (real GDP)		3,8	2,7	2,5	-0,1	-0,1	-0,1
	General price level		-1,9	0,0	0,0	0,0	0,0	0,0
	Terms of trade		6,0	-0,3	-0,3	0,1	0,0	0,0
Supply Side	Output	quantity	3,2	2,8	2,6	-0,1	-0,1	-0,1
	Domestic market	quantity	1,9	2,9	2,7	-0,1	-0,1	-0,1
		nominal price	-1,4	-0,1	-0,1	0,1	0,0	0,0
		real price	0,5	-0,1	0,0	0,0	0,0	0,0
	Exports	quantity	9,9	2,7	2,5	0,1	-0,1	-0,1
		nominal price	2,5	-0,4	-0,3	0,1	0,0	0,0
		real price	4,4	-0,3	-0,3	0,0	0,0	0,0
Demand Side	Imports	quantity	11,4	2,4	2,2	0,0	-0,1	-0,1
		nominal price	-5,2	0,0	0,0	0,0	0,0	0,0
		real price	-3,4	0,0	0,0	-0,1	0,0	0,0
	Intermediate demand	quantity	3,3	2,8	2,6	-0,1	-0,1	-0,1
		nominal price	-1,5	0,1	0,1	0,0	0,0	0,0
		real price	-0,4	-0,1	-0,1	0,0	0,0	0,0
	Private demand	quantity	3,8	2,7	2,5	-0,1	-0,1	-0,1
		nominal price	-1,9	0,0	0,0	0,0	0,0	0,0
		real price	0,0	0,0	0,0	0,0	0,0	0,0
	Government demand	quantity	3,8	2,7	2,5	-0,1	-0,1	-0,1
		nominal price	-1,3	0,4	0,4	0,0	0,0	0,0
		real price	0,6	0,4	0,4	0,0	0,0	0,0
Factors of Production	Factor supply	skilled labour	-0,2	-0,2	-0,2	0,0	0,0	0,0
		unskilled labour	-0,2	-0,2	-0,2	0,1	0,1	0,1
		capital	9,0	8,2	7,6	-0,4	-0,4	-0,4
	Nominal factor prices	skilled labour	2,1	4,7	4,4	0,2	0,1	0,1
		unskilled labour	5,4	2,5	2,3	-0,3	-0,3	-0,3
		capital	-4,6	-5,2	-4,8	0,4	0,3	0,3
	Real factor prices	skilled labour	4,0	4,8	4,4	0,2	0,1	0,1
		unskilled labour	7,4	2,5	2,3	-0,3	-0,3	-0,3
		capital	-2,8	-5,2	-4,8	0,3	0,3	0,3
	Wage divergence betw. CEEC - EU	skilled labour	-0,2	-0,6	-0,6	-0,2	-0,6	-0,6
		unskilled labour	-0,8	-0,4	-0,4	-0,8	-0,4	-0,4

Source: Own calculations

5.7 WHERE DO WE STAND? COMPARISON WITH OTHER STUDIES

Due to the high degree of political relevance of the topic and the rising popularity of the general equilibrium methodology, several studies were undertaken in the past which also analysed the question of CEE integration using a CGE model. In view of other analyses, the question arises as to where we stand with our results. The aim of this section therefore is to first provide an overview of these recent analyses so that we will be able to identify differences and similarities between ours and other studies. Classification could be based on a number of factors. Our overview is structured according to publication date and does not claim to have taken account of all existing studies in this field.[119]

Overview of Other Studies:

Hinojosa-Ojeda et al. (1992) model Hungarian integration using the so-called Hapsburg model, a 7-sector, 4-region (Hungary, Austria, the EC, ROW), perfect competition, constant returns to scale CGE model. The model has been benchmarked to the late 1980s. Instead of the Armington assumption, trade is modelled according to the Almost Ideal Demand System. The authors simulate seven different Hungarian liberalisation scenarios which range from Ruble trade elimination through Austria-Hungary integration to full EC integration. The diverse scenarios differ in an increasing degree of harmonisation of taxes and tariffs. All scenarios are run under two model variants. In the first variant, all factors are sectorally mobile which is interpreted as the restructuring process in Hungary. In the second, factors are sectorally immobile. International factor mobility is not considered. It transpires that increased integration is welfare-enhancing and trade-creating for Hungary particularly if factors are assumed to be sectorally mobile. Domestic restructuring is therefore strongly emphasised. The effects for Austria and the EC are very weak.[120]

Breuss and Tesche (1994) also concentrate on questions of trade integration and policy harmonisation between Austria and Hungary using a static 14-sector, 3-region (Austria, Hungary, ROW) model which resembles that of Hinojosa-Ojeda et al. The model is based on 1990 data. The authors simulate three main policy scenarios: firstly, trade liberalisation - unilaterally, bilaterally and globally is analysed. All kinds of liberalisation appear to have positive welfare and output effects for Hungary and Austria. Real welfare gains for Austria range from +0.006% to +0.087% whereas for Hungary they vary between -3.7% and +0.345%. Secondly, factor movements of either capital or labour between both regions are simulated. It is assumed that 2.5% of Austrian capital moves to Hungary which leads to welfare losses in Austria of 1.5% and to welfare gains in Hungary of 1.1%. Alternatively, 2.5% of Hungarian labour is assumed to migrate to Austria. This yields welfare gains in Austria of 2.6% and losses in Hungary of 1.5%. Thirdly, policy harmonisation between both countries is modelled

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[119] Interesting literature overviews are also contained in Keuschnigg and Kohler (1998) and Breuss (1998).

[120] For detailed results see Hinojosa-Ojeda et al. (1992), tables 8 and 9.

by equalising net indirect taxes. As a result, Austria and Hungary both experience welfare rises of 2.9% and 1.3% respectively.[121] All in all, the authors evaluate Hungary's integration positively.

Weyerbrock (1995) focuses on the issue of East-West Migration in Europe using a 14-sector, 6-region (amongst these, the EC, the CEEC and the former Soviet Union), perfect competition, constant returns to scale CGE model. The data was derived from the data base of a previous World Bank/OECD model which benchmarks the model to the mid 1980s. International regions are linked through trade flows using the Armington assumption. Migration is permitted to take place between the CEEC and the EC. All in all, five different migration experiments are simulated: (i) immigration under a fixed wage regime, (ii) immigration and growth under a fixed wage regime, (iii) immigration under a flexible wage regime, (iv) immigration and growth under a flexible wage regime, (v) immigration with wage adjustments. In each experiment, Weyerbrock differentiates between two different migration scenarios. Immigration into the EC is assumed to amount to either 3.5 or 7 million workers from the former Soviet Union and the CEEC. Growth is modelled as an increase in the EC capital stock of 3.192% and the EC labour force of 0.072%. Additionally, each experiment further differentiates between intersectoral capital mobility and immobility. All results are reported for the EC only: immigration has overall positive welfare effects for the EC although there is some variation depending on the experiment undertaken. The positive effects on real GDP relative to the base run range from +0.15% to 4.02%.[122] The author notes that large scale immigration does not lead to the devastating effects which many Europeans fear and has hardly any macroeconomic effects. Growth in the EC and a flexible wage regime even out some of the effects caused by immigration and ease the adjustment problems. Since flexible wage regimes are politically unfeasible, Weyerbrock proposes a policy of small wage cuts. "To sum up, [...] Immigration is economically beneficial in the long-run. In the short-, and medium-run, growth in the EC capital stock contributes to easing immigration-related adjustment problems."[123]

The subject of East-West migration is also analysed in a study by Breuss and Tesche (1996). They apply the same CGE-model and dataset as in Breuss and Tesche (1994) but focus only on two regions (Austria and Hungary). Their interest lies in the effects of Austrian immigration from Hungary and the CEEC respectively. The amount of Austrian immigration is assumed to amount to 10'000 migrants from Hungary and 100'000 from eastern Europe over a period of five years. In their simulations, the same policy experiments as in Weyerbrock (1995) are being undertaken (see above). Hungary experiences almost the same degree of welfare loss in each of the experiments. Irrespective of whether capital is assumed to be sectorally mobile or not and whether wages are modelled to be flexible or rigid, the loss to Hungarian welfare (compensating variation) lies between -0.72% and -0.82%. In contrast to that, Austria's welfare gains vary considerably between the different experiments ranging from +0.06% to +3%.

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121 See Breuss and Tesche (1994), tables 2-5.

122 For a detailed overview of results see Weyerbrock (1995), tables 6-10.

123 Weyerbrock (1996), p. 116.

Welfare gains increase with the amount of immigration which has been assumed. Also the modelling of growth obviously exercises positive welfare effects. Wage flexibility proves to have a positive impact on welfare in those scenarios without growth and a negative impact in the scenarios modelled inclusive of growth. Finally, capital mobility/immobility appears to have no stronger effect on welfare.[124] Overall, macro effects of immigration are minimal and, provided that labour markets are flexible, can be positive for Austria.

Brown et al. (1997) study the effects of integration using a static 29-sector, 8-region (amongst these, Czechoslovakia, Hungary, Poland, EU-North, EU-South, EU-EFTA), monopolistic competition, increasing returns to scale model. The model is benchmarked to 1992. Trade is modelled according to the Armington assumption, labour supply is fixed. With their simulations, the authors capture the trade and rationalisation component of EU-CEEC integration. Issues such as factor mobility, capital accumulation and budgetary costs are not considered. The four policy experiments are: (A) bilateral removal of all tariffs and NTB among the CEEC, (B) elimination of tariffs between EU and CEEC, (C) removal of non-sensitive NTB and (D) removal of all NTB. The creation of the CEE-free trade area increases welfare in the CEEC to a small extent (0.4 - 0.5%) and reduces welfare in all other international regions by an insignificant amount. The establishment of the EU-CEEC free trade area (scenario B) increases welfare in the CEEC (3 - 4%) and in the EU, although the gains for the latter are still very small (0.1 - 0.2%). Finally, the removal of non-sensitive NTB and of all NTB provides the largest welfare gains for the CEEC. Their gains amount to 4 - 7%. The EU's welfare benefits can still be regarded as rather small with magnitudes of 0.1 - 0.3%.[125] The gains in the EU are distributed unevenly with the EU-North and the EU-EFTA region benefiting more than the EU-South region. "This reflects the fact that the EU-South includes the poorest parts of the EU, which therefore are likely to compete most directly with the CEE countries in the EU markets for especially labor-intensive goods."[126]

Baldwin et al. (1997) model CEEC' integration in the EU using a static 13-sector, 9-region CGE-model where the CEEC7 (Czech Rep., Slovakia, Poland, Hungary, Slovenia, Bulgaria, Romania) and the EU15 are each aggregated to one region. The model is based on the GTAP3 dataset incorporating scale economies and imperfect competition in seven of the sectors. The Armington assumption is applied, regional labour is fixed (no migration) and capital stocks are endogenously modelled in each region. The authors simulate two main policy scenarios: a conservative scenario focuses on single market access and common external tariffs between the CEEC and the EU. Single market access is modelled as a 10% reduction in the real costs of trade. Another, less conservative estimate additionally assumes that membership promotes CEEC investment by considerably lowering their risk-premia to Portuguese values. The

[124] See Breuss and Tesche (1996), tables 6-10.
[125] Compare with Brown et al. (1997), table 2.5.
[126] Brown et al. (1997), p. 43.

conservative scenario yields real income gains of 1.5% for the CEEC7 and 0.2% for the EU15 whereas the less conservative scenario boosts real income by 18.8% and 0.2% respectively.[127] Sensitivity analyses prove that the results are fairly robust. The budget costs of integration for the EU are also calculated and set off against the benefits. The authors argue that "eastern enlargement will be a phenomenally good bargain for the incumbent EU15. Sweeping aside questions about the timing of the benefits and budget costs, and the list of countries in the first enlargement, the net costs - transfer less benefits - should be somewhere between zero and ECU 8 billion. Even the upper boundary of this range is something like 0.01% of the EU15's GDP."[128] For the CEEC economies, membership is estimated to be enormously beneficial, amounting to 23 - 50 billion ECU including transfer payments.

A number of CGE-studies are not only based on the GTAP dataset, they have also been undertaken using the so-called GTAP model.[129] Most of these studies belong to the area of agricultural economics. For instance, Hertel et al. (1997) evaluate the potential impact of the eastern enlargement, focusing particularly on the agricultural sectors. On the basis of the 1992 GTAP3 dataset, they employ a monopolistic competition version of the standard GTAP model incorporating ten sectors and nine aggregated regions (amongst others CEEC7, EU12, EU3) into the analysis. The authors simulate four main policy scenarios:[130] in a first experiment, the formation of a customs union with CEEC' participation/contribution to a EU-budget is modelled. With a welfare gain of 3.4 billion ECU p.a., the CEEC turn out to be the main beneficiary from integration. EU's welfare is positive too although with plus 937 million ECU p.a. much smaller. A second experiment additionally studies the catch-up process in CEEC' agriculture by influencing total factor productivity. This positive technological shock leads to annual welfare gains in the CEEC and the EU of 10 billion and 1.7 billion ECU. The third experiment analyses CEEC accession with agriculture left out of the agreement. As a result, transfer payments from Brussels to the CEEC cease. The EU now gains more than the CEEC with 1.2 billion ECU against 780 million ECU p.a. Finally, the fourth experiment combines the eastern enlargement with the reform of the CAP consisting of a 50% cut of the EU's border protection and output subsidies for agriculture. There are strong efficiency gains particularly for the EU gaining 17 billion ECU p.a. The CEEC enter a less distorted customs union and benefit to the tune of 2.8 billion ECU p.a.

The same dataset and model but with a different sectoral aggregation is used in a CGE analysis by Brockmeier et al. (1998a). Two main policy scenarios are simulated: the first scenario models CEEC' accession to the single market combined with a CAP reform. In this respect it roughly resembles experiments two and four in Hertel et al. (1997). Additionally, however, the authors assume sectoral labour immobility as well as rigidity in the supply of agricultural land to alternative uses. With a gain of 12 billion

[127] Compare with Baldwin et al. (1997), tables 3 and 4.
[128] Baldwin et al. (1997), section 5.1., p. 168.
[129] See Hertel (1997) for a description of the model.
[130] For detailed information on the experiments see Hertel et al. (1997), table 4. Welfare results are reported in table 10.

ECU p.a. mainly stemming from the agricultural reform, the EU is the main beneficiary of this policy. CEEC' welfare rises by about 7.8 billion ECU p.a. The second scenario relaxes the assumption of labour rigidity so that labour is assumed to react fully to sectoral wage differences within each region. The welfare gains in the EU and the CEEC now amount to 15 billion and 7.9 billion ECU p.a. respectively.[131]

Frandsen et al. (1998) also apply an adjusted GTAP model in combination with the GTAP3 dataset. In a 14-sector, 7-region (amongst these: EU15, CEEC7), perfect competition, constant returns to scale framework they model the instruments of the CAP and analyse the outcomes of CEEC' integration. In four different scenarios, the authors simulate: (i) projections of the world economy to the year 2005 without integration, (ii) formation of a EU-CEEC common market and extension of the CAP to the CEEC, (iii) a CAP reform without integration and (iv) formation of an EU-CEEC common market and extension of the reformed CAP to the CEEC. Integration scenario (ii) yields a very moderate welfare loss of -0.1% for the EU and a welfare gain of 7.3% for the CEEC whereas scenario (iv) leads to -0.1% and +2.3% respectively.[132]

Keuschnigg and Kohler (1998) address the question of enlargement effects using a dynamic 18-sector, single region CGE-model evaluating the short and long-run costs and benefits for Austria. The model has been benchmarked to 1992. Each sector produces differentiated goods under the assumption of monopolistic competition with constant returns to scale. The dynamics incorporate the accumulation of capital through forward-looking agents and overlapping generations. Capital is assumed to be sector specific in the short-run. Labour is differentiated into skilled and unskilled labour which is intersectorally mobile. International migration is not considered. The assumption of rational agents combined with dynamics allows evaluation of the complete adjustment path resulting from the eastern enlargement. Thus, policy experiments are simulated as the calculation of a new and different long-run, steady state growth-path. The eastern enlargement of the EU is assumed to consist of two elements: the first element is trade liberalisation which is modelled as a complete tariff elimination between Austria and the CEEC, a reduction in real trade costs from 5% to 0% of transactions value, a reduction in import prices for eastern farm products of 23%, and a fall in import prices for eastern food products of 5%. The second element incorporates the implications for the EU's budget or in other words the costs of enlargement. It is either modelled as an increase in Austria's contribution payments to the EU's budget or alternatively as a fall in agricultural funds which Austria receives. Both ways of budget implications are compared in the simulations. In this context, the authors also differentiate between an enlargement of either five or ten CEEC altering the assumptions about these budgetary costs. The authors calculate that an eastern enlargement by five CEEC results in an aggregate welfare gain equivalent to 0.576% of benchmark GDP if it is financed through raising contribution rates. If enlargement is financed through a cut in agricultural funds, the welfare gain amounts to 0.777% of benchmark GDP. The more ambitious enlargement scenario of admitting ten CEEC even results in welfare rises of

131 Compare with Brockmeier et al. (1998a), table 11.
132 Compare with Frandsen et al. (1998), table 14.

0.534% and 0.864% of benchmark GDP respectively.[133] "These results suggest, with a safe error margin, that eastern enlargement of the EU is in Austria's own economic interest, rather than being a costly adventure that is necessary to ensure further economic progress and peaceful reform in the transition economies".[134]

Where Do We Stand?

TABLE 30 summarises the studies presented above. For the sake of brevity we have greatly simplified the implemented model structure, policy experiments and outcomes. Modelling results are divided into four categories of welfare consequences for the EU and the CEEC respectively: these are *weak*, *moderate*, *visible* and *strong* welfare effects. The effects on other variables are not included in the table. Our own estimates are summarised in the last column of the table.

If we ignore the individual focus of the studies for a moment, there are certain similarities which appear to stand out across most analyses summarised in the table. In the row which summarises the welfare effects for the EU, for instance, the word *"weak"* is disproportionally over-represented. Most studies, irrespective of the size of the regions, the data source, the model or even the policy experiment, come to the conclusion that CEE integration only affects the EU region(s) contemplated rather weakly. In this respect, our own results seem to be well in line with those of other studies. Now and then, the other calculations suggest moderate and even visible welfare effects which can be explained with simulated EU-reforms (e.g. a CAP reform analysed by Hertel et al. 1997 and Brockmeier et al. 1998a) or with general assumptions about growth; both policy experiments which are not necessarily a result of CEE integration (e.g. Weyerbrock 1995 as well as Breuss and Tesche 1996). Most studies further judge that integration will have a weakly *positive* effect on the EU. This observation cannot entirely be confirmed by our own calculations since we obtained ambiguous welfare effects depending on our individual scenarios. Thus, differing policy experiments explain such contrasting welfare effects. Although our results from trade integration and East-West migration are more or less in line with the observations of other studies, it is mainly our simulation of a capital outflow (an experiment not undertaken by others) which also generates negative welfare effects in the EU.

The welfare effects on the CEEC follow a slightly different pattern. A rough comparison of the different CGE-studies reveals that integration effects are perceived to be relatively stronger but at the same time also more uneven. Looking at the row in TABLE 30 describing the welfare effects for the CEEC, it becomes obvious that all welfare categories between *weak* and *strong* can be found. Thus, the reaction of the CEEC to the different integration experiments is much more volatile. However, apart from Breuss and Tesche (1996) and our own East-West migration scenario, all CGE-studies confirm that integration is a positive issue for the CEEC.

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[133] Compare with Keuschnigg and Kohler (1998), table 4.

[134] Keuschnigg and Kohler (1998), p. 28.

From these first, unspecific observations it becomes obvious that a direct and general comparison of all these studies is not easy. The models differ rather strongly in the data source, the sectoral and regional aggregation, the modelling of the economy, the economic and political focus and, most of all, the policy experiments. In a way this task resembles comparing apples with pears. A few studies, however, bear a stronger resemblance in terms of regional focus and policy experiments with some of our individual scenarios. The papers by Brown et al. (1997) and Baldwin et al. (1997) show some correspondence with our scenario 1 concerning trade liberalisation. And Weyerbrock's (1995) simulations can roughly be compared to our scenario 5 concerning general East-West migration. In contrast to that, our scenarios 2-4 focusing on the transfer of regional and structural funds do not find a direct counterpart in other studies. The "burden" of enlargement for the EU in terms of budgetary costs has been discussed in Baldwin et al. (1997 :149f) but it has not been explicitly modelled using a CGE model. Scenario 6, simulating the brain drain effect as well as our synthesising all-inclusive scenarios, also presents too many differences to allow for a simple comparison with the other CGE-studies analysing CEE integration.

The previously described scenario D by Brown et al. (1997 :42) roughly resembles scenario 1 in our analysis. However, they obtain much higher welfare effects for the CEEC in their calculations than we do in ours. How can such a difference be explained? Firstly, there is distinction with respect to the precise policy experiment undertaken in both studies. Whereas Brown et al. analyse some advanced form of free trade area (not modelling a common external tariff rate vis-à-vis the ROW), we study the effects from the creation of a customs union. Thus, it is possible that the CEEC experience trade diversion and welfare reduction along with the establishment of protectionist barriers vis-à-vis the ROW in the course of their membership in a common customs union. Secondly, also with respect to the model structure, we observe differences between both studies. In contrast to our model, Brown et al. use an IRTS, monopolistic competition model. The assumption of larger enterprises which this form implies is likely to result in improved realisation of cost-reducing and welfare-enhancing economies of scale.

The real income changes for the CEEC and the EU in the conservative scenario by Baldwin et al. (1997 :138) come fairly close to our own calculations. This is an interesting observation since, contrary to our approach, Baldwin et al. firstly model single market access by the CEEC as a 10% reduction in the real costs of trade and, secondly, assume IRTS and imperfect competition. Thus differing assumptions concerning the modelling of trade integration and slightly contrasting model structures yield similar welfare consequences. The second less conservative scenario by Baldwin et al. lowering risk premia for investments in the CEEC finds no equivalent in our policy experiments and can therefore not be compared.

With respect to the analysis of migration effects, a closer comparison to Weyerbrock (1995 :107) might be appropriate. After all, her model resembles ours in the sense that she uses a perfect competition, constant returns to scale structure with a similar regional aggregation of the EC. In her third experiment she studies the effects of immigration of 3.5 and 7 million migrants from CEE into the EC under a flexible wage regime, assuming intersectoral factor mobility. The assumption of this amount of net migration greatly surpasses our migration experiments by factors of almost five and twenty respectively. Additionally, Weyerbrock defines a much longer time horizon than we do. Her migration scenario is assumed to take place over a time period of 5 years in contrast to ours which studies annual migration flows. It is then not surprising that in contrast to our results, Weyerbrock's positive welfare effects for the EU are also much higher in each simulation run. Rough, back-to-the-envelope estimates, during which we adapted our migration assumptions to a five-year period and an additional estimate of approximate welfare effects, showed that simulation results from both studies resemble each other strongly. Of course, this cannot count as a profound test of the comparability of our model. Certainly, the migration experiments conducted by Weyerbrock start from scenarios that differ too greatly to answer this question conclusively.

Overall, a comparison between different CGE studies seems to be a difficult issue. The diversity of several decisive factors such as data, model structure and most importantly policy experiments and assumptions hinder the one-to-one comparability. However, a general look at the simulation results of other CGE studies dealing with the issue of CEE integration seems to suggest that our outcomes are more or less in line with those of other researchers.

TABLE 30: OVERVIEW OF STUDIES CONCERNING CEE INTEGRATION AND CGE-MODELLING

	Hinojosa-Ojeda et al. (1992)	Breuss & Tesche (1994)	Weyerbrock (1995)	Breuss & Tesche (1996)
Number of aggregate sectors	7	14	14	14
Number of aggregate regions	4	3	6	2
Which EU regions?	Austria, EC	Austria	EC	Austria
Which CEEC regions?	Hungary	Hungary	CEEC, Soviet Union	Hungary
Which dataset used?	different sources	different sources	OECD & different sources	different sources
Benchmark year	late 1980s	1990	mid 1980s	1990
Which model?	Hapsburg model	own model / extension	extension of other model	own model / extension
Static / Dynamic	static	static	static	static
CRTS / IRTS	CRTS	CRTS	CRTS	CRTS
Perfect / imperf. competition	perfect	perfect	perfect	perfect
Armington/AIDS	AIDS	AIDS	Armington	AIDS
Policy experiments	increasing steps of trade integration	(i) trade liberalisation (ii) factor mobility (iii) policy harmonisation	East-West migrat., growth, different wage regimes, mobile / immobile capital	East-West migrat., growth, different wage regimes, mobile / immobile capital
Welfare effects for EU regions	weak +/-	(i) weak + (ii) weak +/- (iii) visible +	weak to visible +	weak to visible +
Welfare effects for CEEC regions	visible	(i) weak +/- (ii) weak +/- (iii) moderate +	not illustrated	moderate -
CONTINUATION OF TABLE BELOW				

Note: Welfare effects are categorised into: weak, moderate, visible, strong. + indicates positive, - indicates negative, +/- indicates ambiguous / negligible welfare effects.

TABLE 30 (CONT.)

	Brown et al. (1997)	Baldwin et al. (1997)	Hertel et al. (1997)	Brockmeier et al. (1998a)
Number of aggregate sectors	29	13	10	13
Number of aggregate regions	8	9	9	9
Which EU regions?	EU-north, EU-south, EU-EFTA	EU 15	EU 12, EU 3	EU 12, EU 3
Which CEEC regions?	Czechoslovakia, Hungary, Poland	CEEC 7	CEEC 7	CEEC 7
Dataset used	different sources	GTAP 3	GTAP 3	GTAP 3
Benchmark year	1992	1992	1992	1992
Which model?	University of Michigan model	own model / extension	GTAP model	GTAP model
Static / dynamic	static	static	static	static
CRTS / IRTS	IRTS	IRTS	CRTS	CRTS
Perfect / imperf. competition	monopolistic competition	imperfect	monopolistic competition	monopolistic competition
Armington/AIDS	Armington	Armington	Armington	Armington
Policy experiments	(i) free trade among CEEC (ii) EU-CEEC free trade (iii+iv) abolition of nonsens. NTB	(i) single market access (ii) investment promotion	(i) customs union (ii) CEE catch-up (iii) accession without agricult. (iv) accession + CAP reform	(i) accession with CAP reform + sectoral labour immobility (ii) as (i) with labour mobility
Welfare effects for EU regions	(i) +/- (ii) weak + (iii+iv) weak +	(i) weak + (ii) weak +	(i) weak + (ii) weak + (iii) weak + (iv) visible +	(i) moderate + (ii) visible +
Welfare effects for CEEC regions	(i) weak + (ii) visible + (iii+iv) visible to strong +	(i) moderate + (ii) strong +	(i) moderate + (ii) visible + (iii) weak + (iv) moderate +	(i) visible + (ii) visible +
CONTINUATION OF TABLE BELOW				

Note: Welfare effects are categorised into: weak, moderate, visible, strong. + indicates positive, - indicates negative, +/- indicates ambiguous / negligible welfare effects.

TABLE 30 (CONT.)

	Frandsen et al. (1998)	Keuschnigg & Kohler (1998)	Own estimates (for comparison)
Number of aggregate sectors	14	18	9
Number of aggregate regions	7	1	3
Which EU regions?	EU 15	Austria	EU 15
Which CEEC regions?	CEEC 7		CEEC
Dataset used	GATP 3	not specified	GTAP 4
Benchmark year	1992	1992	1995
Which model?	adjusted GTAP model	own model	GTAP in GAMS model (edited)
Static / dynamic	static	dynamic	static / recursive dynamic
CRTS / IRTS	CRTS	CRTS	CRTS
Perfect / imperf. competition	perfect	monopolistic competition	perfect
Armington/AIDS	Armington	Armington	Armington
Policy experiments	(i) integration pre CAP reform (ii) integration post CAP reform	Trade liberalisation + budgetary costs: (i) accession of 5 CEEC (ii) accession of 10 CEEC	(i) trade liberalisation (ii) capital transfers (iii) migration (iv) synthesis of i-iii
Welfare effects for EU regions	(i) weak - (ii) weak -	(i) weak + (ii) weak +	(i) +/- (ii) weak - (iii) weak + (iv) weak -
Welfare effects for CEEC regions	(i) visible + (ii) moderate +	not modelled	(i) moderate + (ii) visible to strong + (iii) weak - (iv) visible to strong +

Note: Welfare effects are categorised into: weak, moderate, visible, strong. + indicates positive,- indicates negative, +/- indicates ambiguous / negligible welfare effects.

5.8 SUMMARY

This chapter has dealt with the simulation of actual policy scenarios which would arise in the case of eastern enlargement of the EU. In this context we have focused on the three key elements of economic integration. These were: (i) the complete liberalisation of trade, (ii) capital transfers and (iii) labour migration. Using the GTAP4 dataset, we firstly simulated each integration element individually by making use of the ceteris paribus assumption. Afterwards we modelled a synthesis of all three elements simulating two all-inclusive, static and scenario one recursive dynamic scenario.

The **trade integration** scenario has moderate and positive effects for the CEEC and negligible effects for the EU. The former experience strong trade creation with an improvement in their terms of trade, falling domestic prices and a moderate welfare increase. Blue collar workers' wages and capital prices rise strongly whereas white collar workers' wages deteriorate. The sectoral distribution clearly shows that agriculture and food belong to the winning sectors and minerals & energy and manufacturing are on the losing side. In the EU, in contrast, not much happens. There is weak indication of some trade creation and minimally falling welfare. The agricultural sector contracts the most.

In view of these results, full trade liberalisation seems to be advisable since it is a first step towards an overall growth-enhancing policy in the CEEC. Of course, this does not imply an improvement for every participant. Some sectors and players in the CEEC (and in the EU) have to get used to the idea that reduced protection will also threaten their domestic rents. This, however, is part of the "game" of liberalisation.

Capital transfers in the form of structural or regional aid for the CEEC are an effective tool of development policy, particularly since capital turns out to be the growth restricting factor in that region. In the moderate scenario the CEEC already benefit greatly because increased capital endowments boost production and income enhancing overall welfare strongly. In accordance with the Rybczynski theorem, however, it is mainly capital intensive sectors in the CEEC which benefit from these transfers. Labour intensive industries do not improve much. Naturally, in the EU every outflow of capital is perceived negatively. We believe that the degree of welfare loss is still within the bounds of the tolerable. The EU must be aware of the fact that CEEC' integration does imply a moderate redistribution of resources. Due to our regional aggregation we are not able to provide a statement as to how these costs of enlargement will be distributed among the EU-member states.

The simulation of **labour migration** provides some extremely interesting results. We differentiated between *general migration* implying the mobility of skilled and unskilled workers and the *brain drain* phenomenon meaning migration of skilled workers only.

General migration is seen to have only small macroeconomic consequences on welfare, production and demand. The degree of effects depends on the amount of return migration, i.e. the degree of net migration. The CEEC encounter the exit of a fraction of their labour force as the departure of consumers and producers causing a moderate contraction of the economy. The labour intensive sectors in particular suffer the most under emigration. Whereas wages of the remaining workers increase in real terms, capital prices deteriorate. Thus, besides the migrants themselves who will probably be the strongest beneficiaries of migration, those people staying behind are not necessarily the losers from migration. The EU perceives immigration in an overall expansionary form. Depending on the skill level of workers, however, there is either approval or rejection of labour mobility. Whereas white collar workers see their wages rising, blue collar workers observe them falling. Since the degree of corporatism of the latter is rather distinctive, refusal to a policy of free labour mobility is likely to be expressed strongly.

The effect of the *brain drain* has gained particular relevance in view of the recent introduction of the *Green card* in Germany (see footnote 115). It can no longer be ruled out that in a potential transition period only white collar workers will be allowed to move whereas blue collar workers will not. Our simulations suggest that in the CEEC macroeconomic welfare, production and demand effects are even smaller compared to those consequences in the context of the general migration scenario. Those sectors relying heavily on skilled workers experience the strongest contraction. Although in our static simulation this does not cause a greater macroeconomic problem, in a dynamic environment it could constitute a severe danger for the CEEC. Skilled workers are normally employed in sectors which contribute a great deal to long-term growth. Their disproportionate contraction can then put a region's future growth perspectives at risk. Whereas the remaining white collar workers in the CEEC face strongly rising wages as a consequence of the brain drain, blue collar workers have to accept a deterioration. Resulting social conflicts may therefore be likely.

In the EU, the brain gain is mostly perceived positively. Firstly, there is a disproportionate expansion of those sectors employing white collar workers intensively. The long-term growth perspectives of the EU, although not covered in our simulations, do therefore implicitly improve. Although wages of white collar workers decrease, it is unlikely that this will cause stronger social or political conflicts because the degree of unionisation of white collar workers is simply too small. Blue collar workers, in contrast, will explicitly welcome the brain gain since their wages are being pulled up.

In the **static synthesis** of all three integration elements, the CEEC appear to be the outstanding beneficiaries. Strong trade creation, a boost in output, demand and welfare and wage increases for skilled and unskilled labour make complete and fast EU enlargement an attractive scenario for the CEEC. Only capital owners see a deterioration in capital prices. It turns out that capital transfers from the EU are *the* main welfare-determining factor in these simulations against which the positive effects from trade integration fade into insignificance (not to mention the negative welfare effects resulting from emigration). The EU may view CEEC' integration more critically. Although inside the EU there are sectoral winners and losers, we observe a minimal decrease in overall welfare. It turns out that the positive effects from labour immigration are not large enough to counterbalance the negative effects from capital emigration. Thus the EU enlargement in our static environment is only of benefit to one region.

However, it should not be forgotten in this context that enhancing economic growth and therefore also political stability in the CEEC must be the major interest of the EU. The very small economic costs which the EU has to bear can be justified on these grounds.

In the **recursive dynamic** simulation we incorporate periodical capital formation into the analysis. The dynamics of migration over several periods is also studied. All simulation effects can be divided into *integration consequences* and *capital formation consequences*. Integration effects in the recursive dynamic approach do not differ greatly from the static approach presented above. With ongoing periods, effects from trade integration obviously abate. The capital formation process in turn enhances the positive macroeconomic effects to some degree. In the recursive dynamic scenario even the EU experiences moderate positive welfare, output and demand effects. Hence, the slightly negative macroeconomic effects from integration do not prevent the overall positive dynamic performance of the EU. This is a very important implication since EU-citizens might otherwise be averse to the idea of integration. Over the different periods there is also moderate wage convergence between the EU and the CEEC. It is, however, not large enough to actually influence the degree of migration.

The different sensitivity analyses which we conducted throughout this chapter suggest that changes in the exogenous trade elasticities mainly influence export and import quantities. Altered Armington substitution elasticities do not show greater effects on simulation results. Although these elasticity values do not influence the model's results too strongly, some empirical work aimed at better determination of the correct values could be useful. A different modelling of investment turns out to have some effects on welfare, demand and factor prices. The amount of emigration and the effects on the other macroeconomic variables rely strongly on the income parameter of migration, β_1. Econometric estimation of this parameter, however, allows some confidence so that we do not see a reason for altering it. Furthermore, the labour substitution elasticity, σ_{lc}, has proved to be decisive for the degree of change in wages. The value of zero for the base model is likely to be a typical short-run value. We can only stress again that further research in this field to determine the exact value of this parameter more precisely would nevertheless be helpful.

Besides the static effects of the eastern enlargement, additional long-run, dynamic effects are also likely to come about. Other empirical studies have shown that their influence can be quite substantial. Our results should therefore be seen as a typical short-run evaluation of potential East-West integration.

6 CONCLUSION

Eastern enlargement of the European Union will definitely come. Both, the treaty on European Union as well as politicians in East and West leave no doubt about this fact. The course has been set clearly for an integration of the central and eastern European Countries. However, the current negotiations between the European Commission and the governments of the CEEC cannot yet say anything about the timing and the conditions on which accession should take place. Nevertheless – or should we perhaps say for that reason – policymakers and their advisers on both sides of Europe are obliged to form expectations about the costs and benefits of integration. This study aims to a make moderate contribution to this discussion by undertaking an empirical, general equilibrium assessment of different integration scenarios of central and eastern Europe, placing particular emphasis on the issue of East-West migration.

6.1 OVERVIEW

Chapter one introduced the reader to the political question, containing the description of the problem and this study's objective. Considering deficiencies of purely theoretical or partial equilibrium studies we decided to apply a computable general equilibrium analysis of CEE integration. Specifically it was our **aim** to state:

(i) what the extent of migration between the CEEC and the EU would be once free mobility was permitted, and

(ii) which macroeconomic effects would result from far-reaching forms of integration such as full trade liberalisation, capital transfers and labour migration between both regions.

Chapter two acquainted the reader with the concept, the approaches and some of the technical details of general equilibrium analysis. The GE approach has often been criticised for the abstractions and assumptions this methodology is based on: perfectly organised markets which ensure the determination of equilibria with completely flexible prices have been blamed as much as the large degree of exogeneity of parameter values and elasticities. Still, the advantages of this approach carry weight: besides the fact that it allows the consequences of policy changes to be traced throughout the entire economy, appraising changes on resource allocation and assessing the winners and losers, CGE models can well analyse structural changes and do not require time series data as many econometric estimates do. The last point in particular plays an important role since work with the CEEC still implies some limitations in this respect. There are several approaches to the practical implementation of CGE models of which the Mixed Complementarity approach has been used in this study. The model was programmed in MPSGE, a model and function generator particularly designed for general equilibrium problems.

Chapter three provided a detailed description of the computable general equilibrium model which has been used and which is based on the so-called *GTAP-in-GAMS* model. It is a comparative, recursive dynamic, open economy model with nine production sectors and three aggregated international regions: the EU, the CEEC and the ROW. Production occurs according to a nested production function at constant returns to scale. Each sector and region uses different technologies due to varying calibrated shift and share parameters. Prices and quantities on the goods markets are assumed to be fully flexible in order to clear the markets. Factor markets are initially characterised by fixed endowments as well as perfect factor mobility inside a region but international immobility. Factor prices are also fully flexible. Demand is characterised by households maximising utility subject to a budget constraint. Wealth is measured using a Representative Agent who earns income through private and public sources. Expenditure occurs for private and public consumption and investment. The government share in total output is assumed to be constant. International regions are linked through trade in goods. Imports and exports are modelled according to the Armington assumption which assumes that domestic and foreign goods are imperfect substitutes. Tariffs and NTB hinder free trade in the benchmark equilibrium. Real investment takes place according to an exogenously provided marginal propensity to save. In the recursive dynamic run, current period's investment is assumed to lead to real capital formation with an increase in next period's capital endowments. Purely dynamic effects are neglected. The current account surplus or deficit ensures that the model clears. Labour is divided into skilled and unskilled labour, which are assumed to be non-substitutable. We apply our own aggregation of version 4 of the GTAP dataset which benchmarks the model to the year 1995.

Chapter four undertook a quantification of the potential of CEEC-EU migration which would exist if the CEEC were permitted the free mobility of labour. The main aim of this chapter was the econometric estimation of migration parameters, which we were then inserted into the CGE-model in order to simulate free labour mobility between the CEEC and the EU. Thus, instead of exogenously assuming the required migration parameter, we derived it through quantitative methods. In doing so, we made use of the method of extrapolation by studying migration flows in the context of the southern EC enlargement and, under the assumption of resemblance, transferring the estimated parameters to the potential eastern EU enlargement. This hypothetical South - East analogy can be seen controversially. It is, however, the most suitable and similar example of economic integration which exists for the present question. We estimated a pooled time series, cross-sectional model of bilateral, unrestricted migration flows between southern and northern EC-member states. The rate of migration was assumed to be dependent on the previous period's wage differentials, the previous period's relative unemployment rate, the past period's stock of migrants and the distance between both countries. The estimated function parameters were then combined with the prevailing EU and CEEC values of the independent variables. This way it was possible to answer the first of our two main questions:

(i) Our calculations suggest an annual **migration potential** to the EU of 270'000 - 340'000 citizens from the CEEC. Under consideration of return migration of CEEC citizens, i.e. **net migration**, the results suggest that approximately 100'000 migrants would move from CEE into the EU on a net basis each year provided that there exists free mobility of labour. We believe that our results initially overestimate the amount of return migration: as long as the CEEC have not built up a comparable migrant stock to the SEC in the EU, return migration is likely to be smaller. Our two econometric estimates of gross and net migration can then be interpreted as upper and lower boundaries of potential net immigration from the CEEC. Since we applied a simple econometric model, results should be regarded as an approximate assessment. At the same time, it should be stressed that our results are quite comparable with those of other studies.

Chapter five contained the simulation and evaluation of integration scenarios using the CGE-model. Three experiments in eastern enlargement of the EU were undertaken:

1. Trade liberalisation through the creation of a customs union by completely abolishing tariffs and NTB between the EU and the CEEC and imposing a common external tariff vis-à-vis the ROW.
2. Different scenarios of capital transfers from the EU to the CEEC in the context of the EU's regional and structural policy.
3. Labour migration from East to West which was modelled according to the migration parameters estimated in Chapter 4. Both labour categories were assumed to possess the same migration propensities. Workers who migrate were believed to earn the same level of income as their domestic colleagues.

In a first set of experiments we calculated the individual effects of trade liberalisation, capital transfers and labour migration. This was done to simulate different forms of partial integration and to be able to break down and explain the simulation results from the second set of experiments: there we combined all integration elements into an all-inclusive, static and a recursive dynamic model with the aim of simulating full integration of the CEEC in the EU. The following simulation results were obtained, which allow us to provide an answer to the second main question:

(ii) Depending on the policy experiment we obtained the following results:

Trade liberalisation by itself has overall moderate positive welfare effects on the CEEC. Most sectors experience trade creation due to lower import and export prices. Clear winners of trade liberalisation in the CEEC are blue collar workers and capital owners who experience a real increase in their wages and capital prices, with the agricultural and the food & clothing sectors expanding the most. Losers are white collar workers whose real wages fall, and the manufacturing and the minerals & energy sectors, which contract the most. In the EU all effects are negligible.

Capital transfers from the EU into the CEEC were modelled as the transfer of capital endowments in the context of the EU's structural and regional aid. Our results suggest that capital is *the* growth-impeding factor in the CEEC. Depending on the degree of relocation of capital, we therefore observe strong to very strong positive welfare effects for the CEEC. Clear winners of transfer payments in the CEEC are skilled and unskilled workers whose real wages strongly rise and basically all sectors. The capital intensive sectors, however, benefit the most. Losers are clearly CEEC' capital owners encountering a strong fall in capital prices. In the EU there are small to moderate negative welfare effects. On the winning side within the EU are the capital owners whose real capital prices increase. Workers whose wages deteriorate and all capital intensive sectors, which contract disproportionately, are on the losing side.

Labour migration from the CEEC into the EU which we modelled according to the parameter values obtained from our econometric estimates in Chapter 4 provided partly differing results, depending on whether we simulated general migration (i.e. skilled and unskilled labour) or the brain drain phenomenon (i.e. skilled labour only).

Common to all forms of labour migration is the small welfare reducing effect on the CEEC and a negligible positive welfare effect on the EU. These consequences appear to be slightly larger or smaller, depending on whether gross or net migration is simulated. Furthermore, migration induces particularly strong contractions (expansions) of labour intensive sectors in the CEEC (the EU) as predicted by the Rybczynski theorem.

The simulations concerning *general migration*, i.e. migration of skilled and unskilled labour, lead to the interesting observation that blue collar (white collar) wages converge (diverge) between the CEEC and the EU. The assumption of non-substitutability in particular provokes this peculiar performance. In the CEEC, winners of general migration are both labour categories since their real wages increase. Losers are the capital owners and basically all sectors because they face an economic contraction, with the labour-intensive sectors being affected most. In the EU, beneficiaries of general immigration are skilled workers and capital owners (real factor prices increase) and the labour-intensive industries, whose production expands disproportionately. Losers are unskilled workers whose real wages decrease. The migrants themselves can, however, be regarded as benefiting the most from migration since their wages are assumed to adapt to western standards.

The *brain drain* does not cause large macroeconomic effects. In the CEEC, winners of the brain drain are mostly skilled workers because their wages rise strongly. The sectors relying strongly on blue collar workers (e.g. agriculture and food & clothing) also benefit since wages for unskilled labour fall. Obviously, unskilled workers and those industries relying on skilled labour can then be regarded as being the losers of the brain drain. Despite no welfare effect in the EU, we observe blue collar workers being clear winners of the brain gain. Their real wages rise. Losers are the skilled workers whose wages deteriorate.

The **all-inclusive, static simulations** reveal that the sum of integration scenarios strongly benefits the CEEC. Strongest beneficiaries are the capital intensive industries because they expand production disproportionately and skilled and unskilled workers whose wages rise sharply. Capital owners in the CEEC suffer from a fall in capital prices and can be regarded as being the losers of complete integration. The EU, in contrast, has to accept a very small welfare decrease resulting mainly from the outflow of capital in the context of West-East capital transfers. Nevertheless, the EU's white collar workers and capital owners benefit from CEEC-integration since their real wages and capital prices increase. Blue collar workers, in contrast, are on the losing side since their real wages fall. All in all, the static synthesis turned out to be a fairly close addition of individual integration simulations.

In the **all-inclusive, recursive dynamic simulations**, each region's own capital formation was taken into consideration inducing an increase in capital endowments. It is then not surprising that both the CEEC as well as the EU show clear positive welfare effects, the former much more strongly than the latter, since the additional positive effects from integration are clearly perceptible. The winners and losers in the CEEC are identical to those in the all-inclusive, static simulations. In the EU we observe that both labour categories can now be regarded as beneficiaries whereas capital owners have to suffer from a deterioration in real capital prices and must be seen as the losers.

Summarising our observations it is possible to make the following **central statements**:

- The amount of net immigration from the CEEC into the EU in case of free labour mobility will be rather moderate.
- In terms of welfare, further economic integration will mainly benefit the CEEC. Negative effects in the EU will be negligible although the distribution of costs among the EU-member states may cause problems.
- Independent of overall welfare consequences, integration produces winners and losers within each region.
- Capital transfers from the EU into the CEEC will cause the largest positive welfare effects in the CEEC compared with other forms of integration such as full trade liberalisation or labour migration.

6.2 POLICY IMPLICATIONS

Based on our simulation results we can derive the subsequent **economic policy implications**. In this context the reader must remember that all policy implications can only be seen in the context of the model's abstractions and assumptions. Thus, our policy experiments can only provide a rather theoretical and restricted view of a much more complex issue:

1. Due to the outstanding role of capital transfers in the CEEC' economic performance, it seems advisable to include this region in the EU's structural and

regional policy measures. Considering the admittedly hypothetical amount of capital transferred to the CEEC, negative effects for the EU as a whole are tolerably small.

Our results do not say anything about the distributional effects of these costs among the current EU member states. The model implicitly assumes that capital is evenly withdrawn from the EU region and handed over to the CEEC. Contrary to this modelling, it seems likely that EU's contemporary net recipients of structural and regional aid will suffer the most from a redirection of these means. The realisation of an extended regional policy which also incorporates the CEEC may therefore imply some opposition from Greece, Ireland, Portugal and Spain. Questions of how to share out the economic costs of enlargement must therefore be tackled first. Besides, our study ignores all forms of transfers in connection with the EU's Common Agricultural Policy, an issue which also needs to be solved prior to EU enlargement. Thus, before CEEC' accession can take place, a budgetary reform for the EU is inevitable.

2. The formation of a customs union between the CEEC and the EU with a full abolition of tariffs and NTB is desirable since it enhances overall welfare in the CEEC and is likely to provoke a more optimal reallocation of resources. Politicians from CEE should therefore negotiate a quick and extensive abolition of all remaining tariffs and NTB.

   It must, however, be borne in mind that some sectors will experience a contraction due to increased competition from the West whereas other sectors will expand. Inter sectoral shifts of labour and capital will be the consequence. Contrary to our model's theoretical assumptions, cross sectoral factor mobility within the economy is not perfect. Workers, for example, who have worked in the agricultural sector for many years can not simply sign on for a different job in the high tech industry. Neither can tractors can be reconstructed to produce stereo equipment. Thus there is some demand for structural policy from the state side to cushion these negative externalities of liberalisation. A policy which enhances labour mobility within a country would be welcome. The state could, for instance, finance some form of retraining, help with removal costs and promote the rearrangement of employment by other means.

   For the EU, trade relations with the CEEC are too small for the formation of a customs union to have a stronger impact. It should be pointed out that we did not make allowances for the special role of so-called sensitive sectors. The disproportionately negative effect in the agricultural sector reminds us of this fact. EU politicians are therefore well advised to anticipate such negative consequences in sensitive areas. Just as the CEEC are obliged to make their economies fit for competition in a future single market according to the Copenhagen criteria, the EU should be obliged to do the same in their sensitive sectors. Agriculture, steel, coal and mining are still too strongly protected to be able to compete with low-cost producers in CEE the so that politically induced reforms are urgently required.

3. As our results suggest, East-West migration of skilled and unskilled labour (general migration) provokes a moderate reduction in unskilled labour wages in the EU. Even though this fall is not great, it is likely to create political tensions with EU's

unskilled workers, or rather with their representatives, i.e. the trade unions. In contrast to the theoretical assumptions of our model, wages are commonly characterised by a downwards rigidity. If wages are not able to clear the labour market, it must be the unemployment rate which alters instead. This implies that immigration might eventually cause unemployment.

The alternatives which politicians have in order to solve this problem are unfortunately rather limited. On one hand, it seems very impracticable to convince workers and unions quickly that they should accept a deterioration in wages for the sake of European integration. The power of employee institutions is simply too strong. On the other hand, EU politicians fear nothing more than even higher unemployment rates. This leaves us with a policy consisting of a double strategy. Firstly, general migration would need to be restricted until relative wages between both regions could be brought more into line. After all, it seems as if the main migration determinant is wage differences. In the absence of migration, wage convergence could be achieved through trade and capital mobility. Remember from our simulations that capital transfers have proved to induce wage convergence as well. Thus, we argue in favour of a transition period where labour mobility is temporarily restricted. Secondly, the EU labour market would have to be gradually prepared for external competition. In terms of our model this would mainly imply greater wage flexibility, a task which must be carried out by politicians, employers and employees alike. Reduction in the amount of regional pay agreements and a change of wage policy towards firm specific wage contracts could possibly increase the wage flexibility. Whether trade unions will join in this game will remain an interesting question.

As in the case of capital transfers, our model does not consider the country specific impact of migration. Those states which are likely to experience the largest relative amount of immigration from the CEEC, such as Germany and Austria, have not been modelled individually but instead are included in the aggregated EU region. Individual macroeconomic consequences could then develop differently to the results what is suggested by our simulation results.

4. As we saw, the brain drain phenomenon also generates negative wage effects. Both, white collar workers in the EU as well as blue collar workers in the CEEC suffer from the consequences of migration of the skilled.

   It is likely that the degree of organisation in corporate institutions such as trade unions will decrease with the skill level of workers. Corporatism in turn implies stronger wage bargaining power. Thus, there seems to be a negative correlation between skill level and bargaining power. For this reason, it is quite probable that the acceptance of a wage decrease of skilled workers in the EU will be fairly high. No bigger political tensions would have to be expected here.

   In contrast to that, blue collar workers in the CEEC will strongly oppose any form of brain drain. Although their bargaining power is possibly rather pronounced, it will not be of much use. After all, one cannot prevent the departure of a skilled colleague if there is prospect of higher income and better working conditions for him else where. Besides the wage consequences for unskilled workers, a brain drain can also be particularly harmful for the long-run development and growth perspectives of the CEE economies. Thus, in the overall interest of the CEEC this form of migration should be prevented.

How could that be done? It is certainly not possible for politicians in the CEEC to restrict the amount of push migration by, for example, prohibiting skilled workers emigrating. This would imply creating a successor to the iron curtain system. Instead, CEE politicians should be active with respect to two political measures. Firstly, they should foster the economic and legal environment in their home countries in order to attract investment, thereby creating interesting working conditions for their own white collar workers. An attractive tax and social security ambience combined with certainty of the law would surely induce quite a few firms to move from the high-wage EU into the low-wage CEEC. After all, production could just as well take place in the CEE since European free trade agreements ensure the access to the huge European market. Secondly, CEE politicians would be well advised to persuade their EU-colleagues that projects such as the Green card in Germany and other special working permits for experts in other countries are not necessarily in the interest of the CEE. Admittedly, this is not an easy task since the EU member states have just started to learn that skilled workers from abroad can be very beneficial to their economies. Additionally, voters in the CEEC would not be particularly amused if their governments hindered their own development prospects. Still, from the viewpoint of the East, on option would be the implementation of some form of transition period restricting free migratory movements of white collar workers as long as income differences are as pronounced as they currently are. Alternatively, we could also imagine a transition period in which free mobility would be permitted but migrants would only obtain work permits for a restricted time period. This would increase the degree of return migration to the CEEC and therefore reduce the net outflow of workers.

Summarising our policy suggestions, it is possible to make the following **central statements**:

- Capital transfers seem to be an effective development tool for the CEEC, particularly since the negative effects for the EU are rather limited. The inclusion of the CEEC into EU's regional policy is advisable. The distribution of costs among the EU-member states is, however, not considered.
- The abolition of all tariffs and NTB should be undertaken together with political steps to cushion adjustment effects.
- General migration is likely to create political tensions in the EU so that in the EU's interest, a transition period could be advisable.
- The brain drain phenomenon will harm the CEEC so that in the CEEC' own interest, a transition period would also be welcome.

6.3 Limitations of Our Approach and Suggestions For Research

The reader must be fully aware that our research on EU-CEEC integration only provides a restricted view of the topic since we leave several factors out of account. Their incorporation into future research seems sensible in order to elaborate on the predictive value of CGE analyses.

As mentioned, our regional aggregation implies that all effects are evenly distributed within each country block. Questions as to how costs and benefits are distributed among the various member states cannot be answered with our approach. The analysis of these aspects from the field of political economy may, however, be of particular interest to those countries which are likely to gain or lose disproportionately within a regional block. In the case of the EU, for instance, the current net beneficiaries of EU's structural and regional aid, i.e. Greece, Ireland, Portugal and Spain are likely to suffer most from a redirection of these financial means to the future members in CEE. Likewise, Germany and Austria are likely to be affected most by all forms of immigration from the CEEC due to their special geographical position. Therefore, regional disaggregation could contribute a great deal to policy advice at the state level. There are two forms in which future research could address this issue: either, future CGE-studies could use more disaggregated data than the one provided by the GTAP4 dataset, or the results for aggregated regions would have to be split according to some form of distribution key among the individual countries.[135]

Our model is based on the assumption of CRTS and perfect competition. In many economic sectors where we experience mergers and acquisitions this may be a too simplistic view. A closer consideration of the peculiar economic structure in the CEEC as well as the EU incorporating imperfect competition and increasing returns to scale in certain sectors would therefore possibly improve the model's predictions.

With respect to trade integration it would be interesting to analyse the dynamic effects of liberalisation, such as the formation of economies of scale, dynamic competition and innovation effects. The consideration of a certain degree of immobility of production factors within each region would also make sense: As we saw, trade integration generates sectoral allocation effects which in our model did not create a problem because we assumed perfect mobility within a region. A more realistic description of cross-sectoral factor mobility could then provide interesting and new insights.

The issue of private international capital mobility has been neglected in this study. In a way we have touched on this topic by assuming several different scenarios of capital transfers from West to East. A more detailed analysis of capital mobility between the EU and the CEEC would be interesting. A dynamic, forward looking model might in this respect be more appropriate where capital investors make allowances for differing capital returns, adjustment costs and risk premia in their investment decision.

There is also scope for further refinement with respect to labour migration. Firstly, an empirical analysis of substitutability between skilled and unskilled labour would be helpful since this parameter proved to have quite an impact on wage performance in our

[135] Baldwin et al. (1997 :148) provide an idea of how such "back-of-the-envelope calculations" could be undertaken.

sensitivity analyses. Secondly, a greater diversification of different skill categories would be interesting. Phenomena like the brain drain effect of very specialised workers (e.g. computer specialists) and scientists could be modelled more precisely. Thirdly, the incorporation of remittances of migrants can be recommended. Several economists argue that the importance of remittances for CEEC' supply of capital has often been underestimated. Fourthly, also the consideration of human capital development would also be very interesting, incorporating a dynamic component into the model. Migrants who work in the EU for some time obviously attain special training on the job which, after their return, might be of importance to the development of their domestic economies. Finally, dynamics could also be included by modelling the migration decision in a similar way to the behaviour of capital investors. As the *Human Capital approach* suggests, migration can be understood as a forward looking investment decision of an agent who compares expected financial net profits in different regions. Instead of adaptive or myopic expectations as in our approach, the potential migrant should, in a dynamic CGE-model, then have rational expectations.

The time horizon of our model could not be determined completely satisfactorily. Whereas the assumption of price flexibility suggests a long-run adjustment time, the application of a static model and of annual migration flows tends to advocate a short-run horizon. A more precise answer to this question, however, is particularly interesting and important for economic policy advice. After all, politicians need to know whether the predicted effects will come about in two, five or ten years.

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APPENDIX

Our CGE model was programmed using MPSGE, a model and function generator which allows the user to define the model in a non-algebraic way. Some readers may, however, be interested in an algebraic description of the model. In this appendix we therefore describe the model algebraically closely following the explanation and formulation of Rutherford (1998b : 3-8) to whom we would like to refer to in this context.

THE ALGEBRAIC FORMULATION OF OUR BASE MODEL

Deviating from Rutherford's (1998b) basic GTAP-in-GAMS model we incorporated (i) non-substitutability between skilled and unskilled labour, (ii) a constant government share in total output and (iii) a constant marginal propensity to save.

Initially, production technology and producer choices will be presented. Then, the structure of private and public demand as well as bilateral trade will be illustrated. Finally, the income balance, the market clearance and the zero-profit condition will be shown.

The definition of sets (subscripts), superscripts, parameters and variables is outlined in tables A1 - A3 following the algebraic formulation.

1. Production:

Production differentiates between domestic and export markets according to an elasticity of transformation:

$$Y_{ir} = \left[\alpha_{ir}^{Y} D_{ir}^{1+1/\eta} + \beta_{ir}^{Y} X_{ir}^{1+1/\eta}\right]^{1/(1+1/\eta)} \qquad \text{(A1)}$$

There is perfect competition. For a given output value, supplies to the domestic and the export market are given by:

$$D_{ir} = Y_{ir}\, a_{ir}^{D}\left(p_{ir}^{D}, p_{ir}^{X}\right) \quad \text{and} \qquad \text{(A2)}$$

$$X_{ir} = Y_{ir}\, a_{ir}^{X}\left(p_{ir}^{D}, p_{ir}^{X}\right). \qquad \text{(A3)}$$

Unit demand and supply functions are displayed in reduced form, e.g. $a_{ir}^{X} = (p_{ir}^{D}, p_{ir}^{X})$.

Production occurs using primary factors of production and intermediate inputs.

Intermediate inputs are proportional to production which implies that intermediate input coefficients are fixed and unresponsive to price:

$$ID_{ir} = \sum_j Y_{jr} a_{ijr} \ . \tag{A4}$$

Intermediate demand is a composite of imported and domestic goods which are imperfectly substitutable (Armington assumption):

$$ID_{ir} = \left[\alpha_{ir}^{ID} DI_{ir}^{\sigma_{DM}} + \beta_{ir}^{ID} MI_{ir}^{\sigma_{DM}}\right]^{1/\sigma_{DM}} \tag{A5}$$

Primary factors (land, capital, labour) enter production activity according to a Cobb-Douglas production function. Given factor prices and factor taxes, producers minimise unit costs so that factor demand is:

$$\min \sum_f p_{fr}^F \left(1 + t_{fir}^F\right) FD_{fir} \quad \text{s.t.} \quad \left(LND_{ir}^{\theta_{ir}^{LND}} K_{ir}^{\theta_{ir}^K} L_{ir}^{\theta_{ir}^L}\right)\psi_{ir} = Y_{ir} \tag{A6}$$

Labour consists of skilled and unskilled labour and enters production in fixed ratios:

$$L_{ir} = \left[\delta_{ir}^{lc} SKL_{ir}^{1-\sigma_{lc}} + \left(1 - \delta_{ir}^{lc}\right) LAB_{ir}^{1-\sigma_{lc}}\right]^{1/(1-\sigma_{lc})} \text{ with } \sigma_{lc} = 0 \tag{A7}$$

Factor demand can be expressed as the product of an activity level and the compensated demand function which depends on factor prices and factor taxes:

$$FD_{fir} = Y_{ir}\, a_{fir}^F \left(p_r^F, t_{ir}^F\right) \tag{A8}$$

2. Public and Private Demand:

A representative agent determines final demand in each region by choosing non-negative values of investment, consumer demand and public demand. He maximises utility according to a Cobb-Douglas utility function subject to a budget constraint. His budget is determined by equation A17:

$$U_r = \theta_r^I \log\left(I_r\right) \cdot \sum_i \theta_{ir}^C \log(CD_{ir}) \cdot \sum_i \theta_{ir}^G \log(GD_{ir}) \tag{A9}$$

Investment output is determined by a savings and investment good (capital good) which is produced using imported and domestic goods according to equation A5. Primary production factors are not used in the production of this savings and investment good.

Public provision of goods is a Cobb-Douglas aggregation of commodities:

$$G_r = \Gamma_r \prod_i GD_{ir}^{\theta_{ir}^G} \tag{A10}$$

Public sector demand is a composite of imported and domestic goods which are imperfectly substitutable (Armington assumption):

$$GD_{ir} = \left[\alpha_{ir}^G DG_{ir}^{\sigma_{DM}} + \beta_{ir}^G MG_{ir}^{\sigma_{DM}}\right]^{1/\sigma_{DM}} \tag{A11}$$

Consumer demand is a composite of imported and domestic goods which are imperfectly substitutable (Armington assumption):

$$CD_{ir} = \left[\alpha_{ir}^C DC_{ir}^{\sigma_{DM}} + \beta_{ir}^C MC_{ir}^{\sigma_{DM}}\right]^{1/\sigma_{DM}} \tag{A12}$$

3. Bilateral trade:

Imports are differentiated into intermediate demand, public sector demand and consumer demand. While the aggregate import share may differ between these three functions, each of theses shares have the same regional composition within the import aggregate. A CES aggregation across imports from different regions *s* forms the total import composite:

$$MI_{ir} + MG_{ir} + MC_{ir} = \left[\sum_s \alpha_{isr}^M M_{isr}^{\sigma_{MM}}\right]^{1/\sigma_{MM}} \tag{A13}$$

Two types of taxes (export taxes & tariffs) and transportation costs apply on bilateral trade. Real transport costs are proportional to trade:

$$T_{irs} = \tau_{irs} M_{irs} \tag{A14}$$

and are defined by a Cobb-Douglas aggregate of international transport inputs supplied by different countries:

$$\sum_{irs} T_{irs} = \psi_T \prod_{i,r} TD_{ir}^{\theta_{ir}^T} \tag{A15}$$

Trade flows are determined by cost-minimising choice, given the *fob* export price from region r, the export tax rate, and the import tariff rate. The demand for bilateral imports then is:

$$M_{irs} = M_{is} \; a^{M}_{irs}\left(p^{X}_{ir}, t^{X}_{irs}, p^{T}, t^{M}_{irs}\right) \qquad \text{(A16)}$$

4. Income Balance:

Expenditure of the representative agent (i.e. the budget constraint) is determined by total disposable income which is the sum of factor earnings, tax revenue and the current account balance:

$$\begin{aligned}
Exp_r = & \sum\nolimits_f p^F_{fr} F_{fr} && \text{factor income} \\
& + \sum\nolimits_i t^Y_{ir}\left(p^D_{ir} D_{ir} + p^X_{ir} X_{ir}\right) && \text{indirect taxes} \\
& + \sum\nolimits_{ij} t^{ID}_{ijr} p^{ID}_{ir} Y_{jr} a_{ijr} && \text{taxes on intermediate goods} \\
& + \sum\nolimits_{fi} t^F_{fir} p^F_{fr} FD_{fir} && \text{factor tax revenue} \\
& + \sum\nolimits_i t^G_{ir} p^{GD}_{ir} GD_{ir} && \text{public tax revenue} \qquad \text{(A17)} \\
& + \sum\nolimits_i t^C_{ir} p^{CD}_{ir} CD_{ir} && \text{consumption tax revenue} \\
& + \sum\nolimits_{is} t^X_{irs} p^X_{ir} M_{irs} && \text{export tax revenue} \\
& + \sum\nolimits_{is} t^M_{isr}\left(p^X_{is} M_{isr}\left(1 + t^X_{isr}\right) p^T T_{isr}\right) && \text{tariff revenue} \\
& \pm p^C_n B_r && \text{current account balance}
\end{aligned}$$

The current account balance involves the amount of foreign borrowing or lending of each region. It is determined by the difference between the value of imports and exports:

$$B_r = \sum_i p^M_{ir} M_{ir} - \sum_i p^X_{ir} X_{ir} \qquad \text{(A18)}$$

5. Market Clearance:

The market clearance condition applies to:

Domestic output:

Domestic output equals demand for intermediate inputs, public sector demand, consumer demand and domestic investment:

$$D_{ir} = DI_{ir} + DG_{ir} + DC_{ir} + I_{ir}$$
$$= ID_{ir}a_{ir}^{D,I} + GD_{ir}a_{ir}^{D,G} + CD_{ir}a_{ir}^{D,C} + I_{ir} \quad \text{(A19)}$$

where a represent the unit demand functions for domestic inputs which are functions of domestic and import prices.

Imports:

Supply of imports must equal import demand for intermediate, public, private consumption:

$$M_{ir} = MI_{ir} + MG_{ir} + MC_{ir}$$
$$= ID_{ir}a_{ir}^{M,I} + GD_{ir}a_{ir}^{M,G} + CD_{ir}a_{ir}^{M,C} \quad \text{(A20)}$$

where a represent the unit demand functions for imported inputs which are functions of domestic and import prices.

Exports:

Export supply equals import demand across trading partners plus demand for transport:

$$X_{ir} = \sum_s M_{irs} + TD_{ir}$$
$$= \sum_s M_{is}a_{irs}^{M} + T\,a_{ir}^{T} \quad \text{(A21)}$$

Armington Aggregate Supply:

The supply of Armington goods must equal intermediate (ID_{ir}), public (GD_{ir}) and private demand (CD_{ir}). This has already been specified in A5, A11 and A12.

Primary Factors:

Factor endowments must equal factor demand:

$$F_{fr} = \sum_i Y_{ir}a_{fir}^{F} \quad \text{(A22)}$$

6. Zero Profit:

Production:

Under constant returns to scale technology, competitive producers earn zero profits. Thus, the value of output minus indirect taxes equals the production costs, i.e. primary factor inputs and intermediate inputs.

$$\left(p_{ir}^{D}, a_{ir}^{D} + p_{ir}^{X}, a_{ir}^{X}\right)\left(1 - t_{ir}^{Y}\right) = \sum_{f} a_{fir}^{F} p_{fr}^{F}\left(1 + t_{fir}^{F}\right) + \sum_{j} a_{jir} p_{jr}^{ID}\left(1 + t_{jir}^{ID}\right) \tag{A23}$$

Imports:

The zero profit condition also applies to trade activities. The value of imports at the domestic *cif* price therefore equals the *fob* price gross of export tax, the transport margin and the tariff:

$$p_{ir}^{M} = \sum_{s} a_{irs}^{M}\left[p_{is}^{X}\left(1 + t_{isr}^{X}\right) + \tau_{irs} p^{T}\right]\left(1 + t_{isr}^{M}\right) \tag{A24}$$

Intermediate, Public and Private Demand:

The zero-profit condition must also hold for the composite good (Armington) used for intermediate demand, public sector demand and private demand:

$$p_{ir}^{I} = c\left(p_{ir}^{D}, p_{ir}^{M}, \alpha_{ir}^{I}, \beta_{ir}^{I}\right) \tag{A25}$$

$$p_{ir}^{G} = c\left(p_{ir}^{D}, p_{ir}^{M}, \alpha_{ir}^{G}, \beta_{ir}^{G}\right) \tag{A26}$$

$$p_{ir}^{C} = c\left(p_{ir}^{D}, p_{ir}^{M}, \alpha_{ir}^{C}, \beta_{ir}^{C}\right) \tag{A27}$$

in which

$$\begin{aligned} c\left(p^{D}, p^{M}, \alpha, \beta\right) &\equiv \min_{D,M} \; p^{D} D + p^{M} M \qquad \text{s.t.} \qquad \left(\alpha D^{\sigma_{DM}} + \beta M^{\sigma_{DM}}\right)^{1/\sigma_{DM}} = 1 \\ &= \left(\alpha^{\sigma} p_{D}^{1-\sigma_{DM}} + \beta^{\sigma} p_{M}^{1-\sigma_{DM}}\right)^{1/1-\sigma} \end{aligned} \tag{A28}$$

is the unit cost function defined by the constant-elasticity-of-substitution aggregate of domestic and imported inputs.

TABLE A1: DEFINITION OF SETS

Sets	Explanation
i, j	sectors and goods (j is used as alias)
f	factors of production
r, s	regions (s is used as alias)
n	numeraire
lc	labour category

TABLE A2: DEFINITION OF SUPERSCRIPTS

Superscripts	Explanation
C	consumer
CD	consumer demand
D	domestic
F	factor
G	government
GD	government demand
ID	intermediate demand
M	import
T	transport
X	export
Y	output
I	investment
ID	intermediate demand
K	capital
LND	land
L	labour

TABLE A3: DEFINITION OF PARAMETERS AND VARIABLES

Variable / Parameter	Explanation	Endogen. / Exogen.*
α	distribution parameter	calibr.
β	distribution parameter	calibr.
δ	share parameter	calibr.
Γ	public sector shift parameter	calibr.
η	elasticity of transformation between production for domestic and export market (fixed to a value of 2)	exog.
μ	depreciation rate	exog.
θ	calibrated benchmark share parameter of value added, gov. demand (G), consumer demand (C) and transport (T).	calibr.
σ_{DM}	Armington elasticity of substitution (fixed to a value of 4)	exog.
σ_{lc}	labour elasticity of substitution (fixed to a value of 0)	exog.
σ_{MM}	import elasticity of substitution (fixed to a value of 8)	exog.
τ	calibrated benchmark share parameter of unit transport cost coefficient	calibr.

TABLE A3 (CONT.):

ψ	shift parameter	calibr.
a	unit demand or supply function in reduced form	funct.
AD	aggregate demand for intermediate inputs	endog.
B	current account balance (capital flows)	endog.
c	unit cost function in reduced form	funct.
CD	Armington consumer demand	endog.
D	domestic output	endog.
DC	consumer demand for domestic goods	endog.
DG	government demand for domestic goods	endog.
DI	intermediate demand for domestic goods	endog.
Exp	regional expenditure	endog.
F	factor supply	bench.
FD	factor demand	endog.
G	public provision	endog.
GD	Armington government demand	endog.
I	investment	endog.
ID	total intermediate demand	endog.
K	demand for capital	endog.
L	demand for aggregate labour	endog.
LAB	demand for unskilled labour	endog.
LND	demand for land	endog.
M	import composite	endog.
MC	consumer demand for imports	endog.
MG	government demand for imports	endog.
MI	intermediate demand for imports	endog.
p	price	endog.
rk_0	gross rate of return to capital	calibr.
s	marginal propensity to save	calibr.
S	Domestic savings	endog.
SKL	demand for skilled labour	endog.
t	tax rate or tariff rate	bench.
T	transport	endog.
TD	demand for transport services	endog.
U	utility of the representative agent	endog.
X	exports	endog.
Y	activity level	endog.

Note: * Exogenous parameters are determined by benchmark data (bench.), through calibration (calibr.) or they are fixed through plausibility considerations.

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