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Proceedings of OeNB Workshops

New Regional Economics in Central European Economies: The Future of CENTROPE

March 30 to 31, 2006

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Contents

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Editorial

Norbert Schuh
Oesterreichische Nationalbank

Philip Schuster
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The Oesterreichische Nationalbank (OeNB) and the Institute for Advanced Studies (IHS) organized the workshop "New Regional Economics in Central European Economies: The Future of the CENTROPE Region". This get-together on the future of the Central European Region (CENTROPE) was hosted by the OeNB on March 30 and 31st.

The role and functions of central banks in general depend strongly on the state of surrounding banking and financial markets and on the dimensions and dynamics of the overall economic environment. As a result of growing economic globalization and regionalization observed since the late 1980s and as a consequence of the European Single Market and the Economic and Monetary Union (EMU), national borders will, no doubt, lose further in significance. Regional economic issues will therefore gain in importance and come to play an increasing role in the policy debates of central banks. Complementing global, European and national perspectives, the regional point of view has come to represent a new aspect of central bank analysis.

During the past two decades we have experienced as well a renaissance of spatial economic issues in the field of social science and economics. Above all, this is due to the aforementioned acceleration of worldwide regionalization and globalization processes. This trend has brought forth a host of sometimes contradictory spatial economic theories and empirical studies.

Therefore the OeNB and the IHS deemed it necessary to review the state of art of regional economics in its application for the region surrounding Vienna and Bratislava, called CENTROPE or Central European Region. The recent expansion of the European Union places CENTROPE at the centre of a potentially new core area, where the region connecting Berlin with the Adriatic intersects with the Danube basin.

The workshop was organized into two sessions. The first session "New Regions in Europe: New Regional Economics?", which dealt with the theoretical issues of (new) regional economics was chaired by Professor Polasek of the IHS. The second session analyzed CENTROPE from different angles and was chaired by Director Achleitner from the OeNB.

Session 1 started with an introduction to geographical economics by *Charles van Marrewijk* (Erasmus University of Rotterdam). He raised the main question of how to explain the observable uneven distribution of economic activity and introduced Zipf's Law and gravity models that find regularities in distribution and interaction. Gravity models, based on the findings of Isaac Newton in the field of physics, are used to determine economic interaction by taking distance into account.

Next, the influences on the distribution of economic activity were analyzed and divided into a political, a physical, and a social or a cultural dimension. Political borders include customs, immigration regulations, taxation, etc., whereas physical borders lead to higher transportation costs due to natural barriers. Cultural separation subverts the mutual trust necessary for interaction. Subsequently, he presented three core models in the New Economic Geography literature that combines micro foundation with a geographical structure[1]. These models provide a framework to analyze interaction between geography and economy and can endogenously explain the location and size of economic activity. The three models are Krugman, Krugman-Venables-Puga, and Forslid-Ottaviano and all yield similar core-periphery results. In the framework of the Krugman model simple migration dynamics and the importance of the starting point were shown. The example of a pancake economy was used to analyze the effects of infrastructure projects on the size of agglomerations.

Finally, *Charles van Marrewijk* introduced a new method, called GI-estimator, to find new interaction regularity by using the Balassa index, which measures comparative advantage in a specific sector. He finds that the estimators characterizing distribution of economic activity differ significantly for the CENTROPE countries.

In the second lecture, *Manfred Fischer* (Vienna University of Economics and Business Administration) presented his spatial econometric paper on pan-European regional income growth and club-convergence. As growth regression convergence models that tended to dominate in this field cannot sufficiently capture the complex process of regional convergence, *Manfred Fischer* suggested using a two club alternative method. The two clubs were grouped using Getis and Ord's local clustering technique, where spatial regime A includes most NUTS 2 regions in Western Europe and regime B covers regions of Portugal, the southwest of Spain, the south of Italy and Eastern Europe including parts of Austria. Now the two club-convergence model was tested first with independent and homosekdastic errors yielding a faster convergence within club A than B. Estimations using a spatially

[1] A general geographical economics model with congestion from *Charles van Marrewijk* can be found in this volume.

autocorrelated error specification resulted in a higher convergence speed in club B than A. This suggests that spatial error dependence introduces an important bias that would lead to deceptive conclusions if it is neglected.

Steven Brakman (University of Groningen) gave the third lecture. He presented his paper on free-ness of trade and agglomeration in the regions of the EU. Based on the New Economic Geography model by Puga the equilibrium wage equation was estimated for the NUTS 2 regions of the EU in order to determine two parameters, namely the substitution elasticity and the distance parameter. They were used to calculate the so called free-ness of trade parameter which represents the degree of economic integration. Given this variable its influence on the degree of agglomeration was analyzed. The main findings suggest that agglomeration forces have little spatial reach in the EU. The reach of these forces was calculated and ranges between 87.3 and 161 km. The agglomeration forces can therefore be considered to be localized. Finally, *Steven Brakman* stressed that there still exist considerable limitations of empirical research in New Economic Geography.

The last lecture of the day was given by *Dirk Stelder* (University of Groningen). He tries to fill one of the main gaps in New Economic Geography by introducing realistic geographical space. His grid model is based on the basic multiregional model by Krugman consisting of an immobile sector called agriculture and a sector that is not geographically fixed and referred to as manufacturing. Modifications were made by using a discrete grid of equidistant locations that was altered to fit the actual geographical shape of a country. Assuming that the endowment with labor is equally distributed on every dot at the beginning one can simulate the influence of geographical space on economic agglomeration by taking altitude into account. *Dirk Stelder* showed maps that illustrated how well actual cities could be predicted by the model and how these predictions changed with other model specifications, e.g. allowing for sea transport.

The field of application includes simulating the effect of economic integration or infrastructural changes on agglomerations. Considering economic integration, e.g. the abolition of the Iron Curtain, his preliminary results suggest that this leads to domestic concentration. He admitted that one drawback of his ongoing work was that the model was not able to explain the development of satellite cities. His main conclusions were that not only geography but also history and integration have to be taken into account when trying to understand the appearances of agglomerations.

In the first lecture of the second session, *Gerhard Palme* (Austrian Institute of Economic Research – WIFO) and *Martin Feldkircher* (IHS) set the stage for the second empirical part on CENTROPE by giving an overview on the characteristics of the Central European Region. Their analysis was divided into a national and regional section. The national part concentrated on the competitiveness and its determinants, whereas the regional section emphasized the structural and partly the functional characteristics of CENTROPE.

The main findings are the following: Central Europe constitutes a relatively wealthy and dynamic region which is fully integrated into the economy of the European Union. Exports from the four countries grew much faster than from the EU-15. The thus improved current account indicates the competitiveness of the region. The high share of foreign direct investment shows as well the attractiveness of the four Central European countries.

But CENTROPE is not yet a "structural region" which causes it to be clearly differentiated from the region around it in Central Europe. It is also not a homogenous region, nor a "functional region" that is held together by close economic relationships. It is in fact a diversified region with large inner-regional differences. But this very fact could give rise to their competitive advantage. The authors characterize CENTROPE as an intermediate zone, surrounded by two different growth clusters. The dynamic regions of the new EU Member States can be characterized by high growth rates, while in the high purchasing power areas of the west lower rates dominate. Therefore, CENTROPE has a locational advantage for products or components that are in demand in the Western markets with their sophisticated preferences and high levels of purchasing power, as well as in the dynamic Eastern markets. This advantage of location can lead to rising internal economies of scale or to lower transaction costs.

In order to realize this potential economic policy has to cope with infrastructural deficiencies which particularly hinder the division of labor within CENTROPE. *Palme* and *Feldkircher* show in this respect a gap with regard to "modern" location factors. If CENTROPE is to develop into a region with intensive economic integration, then these infrastructure bottlenecks need to be eliminated as they particularly hamper the division of labor within CENTROPE. These deficiencies can be observed especially in schooling at higher qualification levels, transport and communication infrastructure, the high quality development of local infrastructure within the individual countries as well as the interconnection between these countries.

Although the authors identify the agglomerations of Vienna and Bratislava as the core region of CENTROPE they think that in order to reach the critical mass for economic dynamism cooperation should not be limited to Vienna and Bratislava. Therefore, cities like Brno and Györ but also the capital cities Budapest and Prague should be included in the network.

Additionally, *Martin Feldkircher* provides a spatial econometric analysis for the regional convergence within the EU-25 in this volume. The study of *Martin Feldkircher* investigates absolute convergence within the EU-25 for the time period 1995–2002. He shows that growth performance and convergence depend crucially on the development of a region's surrounding. The detected spatial autocorrelation is of substantive form indicating that ordinary least squares estimates would be biased. The obtained results point to a yearly convergence rate of 0.7%–0.9%. Several robustness checks are carried out: First, he examines whether the functional relationship of the convergence equation is stable over space, and secondly, he investigates the sensitivity of the estimation results on the specified weight matrix, before identifying the source of spatial dependence.

The following lecture by *Robert Stehrer* (Vienna Institute for International Economic Studies – wiiw), after giving an overview on the growth differential between Eastern and Western Europe, estimates the growth potential for the CENTROPE countries. By following the new growth approach he concludes that the longer-term perspectives for continued economic growth and structural change in Hungary, Slovakia and the Czech Republic are good and that interesting perspectives for regional agglomeration effects – including Austria – can be expected.

His estimations for the growth differentials versus the EU-15 range between 0.8% and 1.4% for the Czech Republic, 1.2% and 2% for Hungary, and 1.5% and 2.5% for Slovakia. This implies a catching-up of 7.6 percentage points of per capita GDP to 62.7% of the Austrian level for the Czech Republic in the base scenario using 1999 PPP. For Hungary and Slovakia the corresponding improvements would be respectively 10 percentage points to 56% and 11.3 percentage points to 52.8% of the Austrian level.

Using constant 2004 PPP instead of 1999 PPP the three countries' positions vis-à-vis Austria are higher by 2–5 percentage points. These "improvements", representing the effects of favorable changes in the structure of prices and quantities produced/consumed in the catching-up countries, must be expected to continue in the future as well. It seems quite reasonable to expect the structural changes to produce effects of at least similar size over the period twice as long: 2004–2015.

By analyzing the implications for investment and foreign trade, foreign direct investment, productivity growth and employment the structural characteristics of the catching-up-process of the three Central European states are worked out.

In the following contribution *Peter Huber* (WIFO) and *Peter Mayerhofer* (WIFO) focused on the characteristics and consequences of structural change in the CENTROPE region. This region is a particularly interesting case study of integration since it comprises some of the most advanced regions of both the new and old Member States and may thus reflect the structural effects of EU integration particularly well, since CENTROPE is characterized by internal structural disparities that may be considered as typical for the enlarged EU. Moreover CENTROPE is in a favorable position relative to other cross border regions, due to its strong urban core and to a lack of problems of mono-industrialization and extremely peripheral agricultural areas. The diversity of specialities and locational advantages could lead to functional specialization in border crossing producer networks.

The second part of session 2 dealt with sector specific issues. *Norbert Schuh* (OeNB) started with a short literature overview of the link between the financial system and economic growth.

An important corollary of the finance-led theory is the fact that agglomeration effects and scale economies play an important role in the development of financial markets. Financial deepening coincides with increased complexity in the financial system. In a more complex financial system, however, scale effects play an important role. The new Member States are a clear example of this fact. As the financial markets in the individual countries are too small, the benefits of the scale effects can an only be realized by foreign subsidiaries and branches.

Norbert Schuh concludes that the Austrian banks have been fulfilling their role as a central sector for the development of a growth cluster in the CENTROPE region in an exemplary manner by heavily investing in CENTROPE and beyond.

By modeling the banknote migration in the CENTROPE region, *Anton Schautzer* (OeNB) then touched an important question related to the recent EU enlargement and the impending euro area enlargement concerning the euro cash logistics.

According to the analysis made in this study, about one third of the migration between the Czech Republic, Hungary, Austria and Slovakia takes place within the CENTROPE region. About four fifths of the total cash flows between Austria and its neighboring countries are inflows to Austria.

As new Member States will most likely join the euro area soon, the administration of cash distribution will become more complex. Against this background the ECB evaluated an alternative to the current concept of cash circulation. The proposed concept is based on a hub-and-spoke system, where excess stocks would be delivered to an assigned hub and then transported to the national central banks (NCBs) that require banknotes.

The significance of the region, the strategic position of the Bratislava-Vienna axis in the European framework and the characteristics of the banknote migration lead to a specific challenge for the OeNB related to euro cash logistics. The unique situation of the proximity of two capital cities provides the opportunity of a close cooperation between Austria and Slovakia.

In the euro area it is necessary to supply cash efficiently and to meet the requirements of the stakeholders (especially NCBs, cash transport organizations and commercial banks). The OeNB has identified the changing environment. Preparations have already been made in order to meet the conditions of an efficient cash distribution and to cope with the future challenges of the euro area enlargement. In any case a hub for banknotes and coins in CENTROPE would be a beneficial approach for an efficient management of euro cash.

In the last lecture of the day, *Wolfgang Polasek* (IHS) presented his work on estimating the sensitivity of the regional growth forecast in the year 2002 resulting from changes in the travel time (TT) matrix. A dynamic panel model with spatial effects was used, where the spatial dimension enters the explanatory variables in different ways. The spatial dimension is based on geographical distance between 227 regions in Central Europe and the travel time matrix based on average train travel times. The regressor variables are constructed by the average past growth rates, where the travel times are used as weights, the average travel times across all regions, the gravity potential variables based on gross domestic product (GDP) per capita, employment, productivity and population and dummy variables and other socio-demographic variables.

The main findings suggest that for the majority of the regions the relative differences in growth for the year 2020 are rather small if the accessibility is improved. But there are differences in the number of regions that will benefit from improved train networks. GDP, employment, and population forecasts respond differently.

Finally, we add as background information a report by *Delia Meth-Cohn* (Economist Intelligence Unit – EIU) which evaluates the Central European Region from an international business perspective. The main results of the report are the following: The size and scope of regional headquarters has shrunk over the years as local subsidiaries took on more management and support responsibilities. Now most Vienna-based hubs are small, high-level, strategic management units.

From an international business perspective, the real opportunity for Vienna is not in servicing a narrowly defined CENTROPE region, but in providing high-level support for a much wider region. CENTROPE is just too small to be an internationally relevant region. Moreover, the changing business realities threaten to make the traditional Vienna hub irrelevant, with operations easily assumed by more autonomous local subsidiaries and/or European headquarters.

But the *EIU* stresses also positive developments. Several large international companies already use their Vienna hubs to cover Russia, Turkey, the Middle East and Africa. More recently, companies have started using Vienna to take responsibility for western Central Europe, including Austria, Switzerland and even Germany.

The workshop was concluded by a panel discussion that was chaired by Director Felderer (IHS).

The Future of the Central European Region: CENTROPE

Welcome Address

Peter Achleitner

Oesterreichische Nationalbank

Ladies and Gentlemen:

It is a great pleasure to welcome you to this workshop which was coorganized by the Institute for Advanced Studies (IHS) and the Oesterreichische Nationalbank (OeNB).

Since the late 1980s, we have been witnessing a growing economic globalization and regionalization process. As a result of it, spatial economic issues have regained importance in the fields of politics, social sciences and economics. "Lost and found" is the metaphor economist Paul Krugman[1] uses to aptly describe this renaissance of regional issues.

As a result of this trend, whole new branches of – sometimes contradictory – spatial economic theories have been formed and numerous empirical studies[2] have been written by the academic world. Especially the concept of New Economic Geography has stirred a debate within the economic community.[3] This concept tries to answer the core questions[4] of regional and urban economics: Why is economic activity usually concentrated in a certain geographical area? How has the spatial distribution of economic activity evolved, and how can it be expected to develop in the future?

The central idea of this approach is that production patterns result from the interaction between centripetal and centrifugal forces. Furthermore, the concept of New Economic Geography suggests that economic integration does not necessarily lead to a convergence of per-capita income or an even distribution of economic

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[1] Krugman (1995).
[2] Brakman, Garretsen and van Marrewijk (2001).
[3] Ottaviano and Thisse (2004).
[4] Simonis (2002), Neary (2001).

activity in the long run. Instead, this agglomeration theory argues that core-periphery patterns may persist and even intensify despite economic integration.

Not surprisingly, the increased interest in geography is mainly attributable to the process of EU integration and enlargement, as it is the perfect case study[5] for such research activities. Will the old European spatial division of labor persist or will we witness the emergence of a new European economic geography? How does integration impact on the distribution of industries? Will we see a development similar to that of the U.S. economy in the past century?[6] Will the EU and the European and Monetary Union (EMU) foster the formation of a “bunch of grapes” in Europe? This image describes the focus on regional convergence and polycentrism by the European Commission and many European national governments in their regional policy programs. It mirrors the European Community’s commitment to economic and social cohesion as laid down in the preamble to the Treaty of Rome.

The enlargement of the EU to 25 Member States has created an economic area inhabited by 450 million people. As a consequence of the Single Market and EMU, national borders will doubtlessly further lose significance, thus opening up a number of opportunities in particular for the Central European countries. The formation of a transnational economic region in the heart of Europe may cause the European economic core area to expand toward the east, along the former East-West border (“Iron Curtain”), to the “new economic powerhouse” of Europe.[7]

The Central European Region (CENTROPE) is currently situated outside the European economic core area, which spans from southern England via Belgium, the Rhine-Ruhr, Rhine-Main and Main-Neckar areas to Switzerland, western Austria and northern Italy. This so-called “blue banana”, which has existed since the 13th century, is characterized by very high per-capita income and a high density of urban areas.

Many analysts argue that, as a result of European integration, the blue banana has been complemented by a so-called “sun belt” or “golden banana”, extending from Valencia via Barcelona and the Provence to northern Italy. The creation of a thriving Central European Region (and subsequently of a “Danube Basin Region”) may well expand the European economic core area.

CENTROPE, which comprises the neighboring border regions of Austria, the Czech Republic, Hungary and Slovakia, once was a major transport hub where the river Danube intersected with the ancient amber road. CENTROPE shared a common history for many centuries before it was split up by the political events after World War II. “Lost and found” seems, once again, a fitting metaphor for this phenomenon.

[5] Resmini (2003).
[6] Martin (2001).
[7] Business Week (2005).

At the core of the Central European Region – CENTROPE – are the two capital cities of Vienna and Bratislava. Taken together, these cities have a population of almost three million, thus ranking among the largest conurbations in Europe. Nowhere else in the Western world are two capitals (and consequently also two national central banks) located so close to each other (55 km as the crow flies).

The EU's eastward expansion may revive the vast economic, scientific and cultural potential of this region. It encompasses 48 cities with around 10,000 inhabitants and includes a number of transregional cities. Its total population comes to approximately 7 million.

Numerous projects and initiatives have been launched to help realize the region's enormous potential: The term "Central European Region" (Europa Region Mitte) was coined in connection with an initiative launched by the Federation of Austrian Industries in 1997. The CENTROPE project, which promotes economic development in the Central European Region, was initiated by regional politicians. The "BAER – Building a European Region" project, which is carried out within the framework of the EU's Interreg III A program, was designed to implement several steps that are necessary for establishing CENTROPE as a transnational region. The Direct Investment Agency Net (DIANE) is an initiative to attract international investors to CENTROPE, undertaken by the regional investment promotion organizations of the Austrian provinces of Lower Austria, Burgenland and Vienna as well as the federal investment organization Austrian Business Agency and various sister institutions in the Czech Republic, Hungary and Slovakia.

Despite the increased interest in regional issues, our knowledge of specialization patterns and agglomeration phenomena in Europe in general[8] and especially in CENTROPE is still limited. Obviously, there are good reasons to explore the implications of the future development in greater detail.

There are at least two valid reasons why a national central bank should be interested to know more about regional issues:

- A central bank's role, function and size depend (at least to a certain extent) on its geographical location – e.g. the dimensions of the surrounding banking and financial markets have a strong impact on the complexity of the central bank's operational and analytical structures.
- The research interest in the impact of geographical issues on monetary and financial stability in a multinational, multicultural and multilingual Europe is increasing.[9]

For these reasons, the OeNB has launched a research program in 2004. The primary goals of this project are

- assessing CENTROPE's economic outlook,
- filling some of the diagnosed research gaps and

[8] Brülhart (2001).
[9] Berger, Ehrmann and Fratzscher (2006).

- promoting institutional cooperation within the region.

The project comprised the following aspects:

- organizing lead discussions and lectures with national experts,
- holding interviews with national and international experts,
- commissioning research papers from national experts,
- organizing this workshop and
- publishing its results.

The workshop program, as I am sure you will agree, is both exciting and attractive. This afternoon, we will concentrate on theoretical issues in regional economics. Tomorrow morning, we will focus on CENTROPE. The first five (out of six) presentations will highlight the outcome of the OeNB's project. We will finish our workshop with a panel discussion.

Before I hand the floor over to Professor Polasek from the Institute for Advanced Studies, who will chair the afternoon session, let me express special thanks to all those who have accepted our invitation to act as speakers or discussants. I would also like to thank the organizers of the workshop for their excellent preparation work, especially our joint organizer, the Institute for Advanced Studies.

I wish you a stimulating and interesting workshop.

Thank you very much.

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Geographical Economics Model with Congestion

Charles van Marrewijk[1]

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Abstract

We derive and discuss a general, but simple geographical economics model with congestion, allowing us to explain the economic viability of small and large locations. The model generalizes some previous work and lends itself to analyzing the impact of public policy in terms of infrastructure changes. We show analytically that scale effects (total size of the economy) and changes in the cost structure (fixed and marginal costs) are important from a welfare perspective, but largely irrelevant from an economic dynamics perspective.

Keywords: Geographical economics, congestion, externalities
JEL code: F, O, R

1. Introduction

Economic activity is very unevenly distributed across the globe. On the one hand, there are large empty spaces in the world, such as the Sahara desert, where few people live and virtually no economic value is produced. On the other hand, there are large, congested, and crowded places, such as Tokyo, where millions of people live and a substantial proportion of Japan's GDP is produced. As emphasized by Hinloopen and van Marrewijk (2005), there is a "fractal" dimension to this uneven distribution, which holds at different levels of aggregation (global, continental, at the country level, the regional level, and the city level) and for different types of economic activity (population and production, possibly corrected for purchasing

[1] Parts of an earlier version were presented at the Institute for Advanced Studies/Oesterreichische Nationalbank workshop "New Regional Economics in Central European Economies". I am grateful to the workshop participants, Steven Brakman, Harry Garretsen, and Wolfgang Polasek for useful comments and suggestions. Please send all correspondence to:
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power parity). Moreover, they argue that there is a strong empirical regularity regarding the distribution of economic activity (Zipf's Law or the Rank-Size Rule) and the interaction between economic centers (the gravity equation). Hinloopen and van Marrewijk (2005, pp. 26–27) conclude: "In short, we can summarize the distribution of economic activity in five stylized facts:

- There is an uneven distribution regardless of the type of economic activity.
- There is an uneven distribution regardless of the geographic level of aggregation.
- There is an uneven distribution regardless of the economic level of aggregation.
- There is a remarkable regularity in the spatial distribution of economic activity.
- There is a remarkable regularity in the interaction between economic centers."

Countless aspects of human inter-personal interaction and human interaction with the global environment influence the above mentioned distribution of economic activity and the empirical regularities. The political boundaries of countries, for example, influence goods and services flows, as well as migration and capital flows. Similarly, regarding physical boundaries (mountains and rivers) and social, cultural, and religious boundaries. The objective of the "New Economic Geography" or "geographical economics" literature initiated by Paul Krugman (1991), see below, is to provide a simple, coherent framework in which to analyze the various factors that influence the distribution of economic activity. As such, this approach can be fruitfully applied to analyze important policy issues and better explain empirical observations. Some excellent examples were presented at the 2006 workshop "New Regional Economics in Central European Economies," organized in Vienna, Austria, by the Institute for Advanced Studies and the Oesterreichische Nationalbank. Brakman, Garretsen, and Schram (in this volume), for example, provided a break analysis at the sector level, Stelder (in this volume) discussed a model with much more detailed geographical information, Mayerhofer and Huber (in this volume) included details of the regional economic structure in their discussion, Palme and Feldkircher (in this volume) focused on some policy implications, and Polasek (in this volume) paid attention to dynamics and economic growth aspects. To better understand all these approaches, requires a solid understanding of a basic, but general and rather flexible geographical economics model that allows for congestion and positive externalities and the locational level. The remainder of this paper explains the analytical details of such a model.

2. Theoretical Developments

Geographical economics has come a long way since the by now classic contribution of Krugman (1991) who, by combining new trade theory with factor mobility, was able to explain some endogenous aspects of the distribution of economic activity across space in a simple model through a tug-of-war of the powers of agglomeration and spreading. Shortly afterwards, an alternative explanation of these types of forces based on intermediate goods deliveries was provided by Krugman and Venables (1995). The similar structure and results promted Neary (2001) to dub this the second core model. The most important results and conclusions of these approaches were summarized in Fujita, Krugman, and Venables (1999). At the turn of the century yet another core model popped up, see Forslid and Ottaviano (2003). The big advantage of their approach, which is based on different types of inputs for the fixed and variable costs of production, is the fact that it is analytically solvable. This made it most useful to analyze public policy issues, see for example Andersson and Forslid (2003), Baldwin and Krugman (2004), and the path-breaking work of Baldwin et al. (2003). An important problem with the literature is the 'bang-bang' nature of agglomeration. Either economic activity spreads (evenly) across space, or it agglomerates in a few (equally sized) large cities. This poses empirical problems because there are many cities of different sizes throughout the world. Brakman et al. (1996) overcome this discrepancy through a model incorporating congestion costs, which ensures that the powers of agglomeration and spreading are more easily balanced, allowing for many cities of different sizes. Brakman et al. (1999) use this approach to explain the empirically observed city-size distribution across space (rank-size rule/Zipf's Law). This paper provides a brief description and the main derivations of an improved and more elegant general geographical economics model with congestion.[2]

3. Demand

Spending on Food and Manufactures

The economy has two goods sectors, manufactures M and food F. Although "manufactures" consist of many different varieties, we can define an exact price index to represent them as a group, as will be explained below. We call this price index of manufactures I. If a consumer earns an income Y (from working either in the food sector or the manufacturing sector) she has to decide how much of this income is spent on food and how much on manufactures. The solution to this problem depends on the preferences of the consumer, assumed to be of the Cobb-Douglas specification given in equation (1) for all consumers, where F represents food consumption and M represents consumption of manufactures.

(1) $$U = F^{1-\delta} M^{\delta}; \quad 0 < \delta < 1$$

[2] An earlier version of this paper is the basis of parts in Brakman, Garretsen, and Van Marrewijk (2001).

Obviously, any income spent on food cannot simultaneously be spent on manufactures, that is the consumer must satisfy the budget constraint in equation (2).

(2) $$F + I \cdot M = Y$$

Note the absence of the price of food in this equation. This is a result of choosing food as the numéraire, which implies that income Y is measured in terms of food. Thus, only the price index of manufactures I occurs in equation (2). To decide on the optimal allocation of income over the purchase of food and manufactures the consumer now has to solve a simple optimization problem, namely maximize utility given in equation (1), subject to the budget constraint of equation (2). The solution to this problem is:

(3) $$F = (1-\delta)Y; \qquad IM = \delta Y$$

As equation (3) shows it is optimal for the consumer to spent a fraction (1-δ) of income on food, and a fraction δ of income on manufactures. We will henceforth refer to the parameter δ given in equation (1) as the fraction of income spend on manufactures.

Technical Note 1: Derivation of Equation (3)

To maximize equation (1) subject to the budget constraint (2) we define the Lagrangean Γ, using the multiplier κ:

$$\Gamma = F^{1-\delta}M^{\delta} + \kappa\left[Y - (F + IM)\right]$$

Differentiating Γ with respect to F and M gives the first order conditions:

$$(1-\delta)F^{-\delta}M^{\delta} = \kappa; \qquad \delta F^{1-\delta}M^{\delta-1} = \kappa I$$

Taking the ratio of the first order conditions gives:

$$\frac{\delta F^{1-\delta}M^{\delta-1}}{(1-\delta)F^{-\delta}M^{\delta}} = \frac{\kappa I}{\kappa}; \qquad or \quad IM = \frac{\delta}{1-\delta}F$$

Substituting the latter in the budget equation gives:

$$Y = F + IM = F + \frac{\delta}{1-\delta}F; \qquad or \quad F = (1-\delta)Y$$

Which indicates that the share (1-δ) of income is spend on food, and thus the share δ on manufactures, as given in equation (3).

Spending on Manufacturing Varieties

Now that we have determined that the share δ of income is spend on manufactured goods, we still have to decide how this spending is allocated among the different varieties of manufactures. In essence, we have to optimally allocate spending over the consumption of a number of goods which can be consumed. This problem can only be solved if we specify how the preferences for the aggregate consumption of manufactures M depends on the consumption of particular varieties of manufactures. Let ci be the level of consumption of a particular variety i of manufactures, and let N be the total number of available varieties. The Dixit-Stiglitz (1977) approach uses:

(4)
$$M = \left(\sum_{i=1}^{N} c_i^{\rho} \right)^{1/\rho} ; \quad 0 < \rho < 1$$

Note that the consumption of all varieties enter equation (4) symmetrically. This greatly simplifies the analysis in the sequel. The parameter ρ represents the love-of-variety effect of consumers. If ρ = 1 equation (4) simplifies to M = Σi ci and variety as such does not matter for utility (100 units of one variety gives the same utility as 1 unit of 100 varieties). Products are then perfect substitutes (1 unit less of one variety can exactly be compensated by 1 unit more of another variety). We therefore need ρ < 1 to ensure that the product varieties are imperfect substitutes. In addition, we need ρ > 0 to ensure that the individual varieties are substitutes (and not complements) for each other, which enables price setting behavior based on monopoly power. How does the consumer allocate spending on manufactures over the various varieties? Let pi be the price of variety i for i = 1,…,N. Naturally, funds pici spend on variety i cannot be spend simultaneously on variety j, as given in the budget constraint for manufactures:

(5)
$$\sum_{i=1}^{N} p_i c_i = \delta Y$$

In order to derive a consumer's demand, we must now solve a somewhat more complicated optimization problem, namely maximize utility derived from the consumption of manufactures given in equation (4), subject to the budget constraint of equation (5). The solution to this problem is given in equations (6) and (7):

(6)
$$c_j = p_j^{-\varepsilon} \left[I^{\varepsilon - 1} \delta Y \right], \quad where \quad I \equiv \left[\sum_{i=1}^{N} p_i^{1-\varepsilon} \right]^{1/(1-\varepsilon)} \quad for \quad j = 1,.., N$$

(7) $$M = \delta Y / I, \quad and \quad \varepsilon \equiv \frac{1}{1-\rho}$$

Technical Note 2: Derivation of Equations (6) and (7)

We proceed as in Technical Note 1. To maximize equation (4) subject to the budget constraint (5) we define the Lagrangean Γ, using the multiplier κ:

$$\Gamma = \left[\sum_{i=1}^{N} c_i^{\rho}\right]^{(1/\rho)} + \kappa\left[\delta Y - \sum_{i=1}^{N} p_i c_i\right]$$

Differentiating Γ with respect to cj and equating to 0 gives the first order conditions:

$$\left[\sum_{i=1}^{N} c_i^{\rho}\right]^{(1/\rho)-1} c_j^{\rho-1} = \kappa p_j, \quad for \quad j = 1,.., N$$

Take the ratio of these first order conditions with respect to variety 1, note that the first term on the left hand side cancels (as does the term κ on the right hand side), and define $\varepsilon \equiv 1/(1-\rho)$ as discussed in the main text. Then:

$$\frac{c_j^{\rho-1}}{c_1^{\rho-1}} = \frac{p_j}{p_1} \quad or \quad c_j = p_j^{-\varepsilon} p_1^{\varepsilon} c_1 \quad for \quad j = 1,.., N$$

Substituting these relations in the budget equation (5) gives:

$$\sum_{j=1}^{N} p_j c_j = \sum_{j=1}^{N} p_j \left[p_j^{-\varepsilon} p_1^{\varepsilon} c_1\right] = p_1^{\varepsilon} c_1 \sum_{j=1}^{N} p_j^{1-\varepsilon} = p_1^{\varepsilon} c_1 I^{1-\varepsilon} = \delta Y, \quad or \quad c_1 = p_1^{-\varepsilon} I^{\varepsilon-1} \delta Y$$

Where use has been made of the definition of I defined in equation (6) of the main text. This explains the demand for variety 1 as given in equation (6). The demand for the other varieties is derived analogously. The question remains why the price index I was defined as given in equation (6). To answer this question we have to substitute the derived demand for all varieties in equation (4), and note along the way that $-\varepsilon\rho = 1-\varepsilon$ and $1/\rho = -\varepsilon/(1-\varepsilon)$:

$$M = \left(\sum_{i=1}^{N} c_i^{\rho}\right)^{1/\rho} = \left(\sum_{i=1}^{N} \left(p_i^{-\varepsilon} I^{\varepsilon-1} \delta Y\right)^{\rho}\right)^{1/\rho} = \delta Y I^{\varepsilon-1}\left(\sum_{i=1}^{N} p_i^{-\varepsilon\rho}\right)^{1/\rho} = \delta Y I^{\varepsilon-1}\left(\sum_{i=1}^{N} p_i^{1-\varepsilon}\right)^{-\varepsilon/(1-\varepsilon)}$$

Using the definition of the price index I from equation (7) this simplifies to:

$$M = \delta Y I^{\varepsilon-1}\left(\sum_{i=1}^{N} p_i^{1-\varepsilon}\right)^{-\varepsilon/(1-\varepsilon)} = \delta Y I^{\varepsilon-1} I^{-\varepsilon} = \delta Y / I$$

To finish our discussion of the demand structure of the model we want to note that we could derive the exact price index for the allocation of income between food and manufactures. As the reader may wish to verify, the result would be:

$1^{1-\delta} I^{\delta} = I^{\delta}$, where the "1" on the left hand side represents the price of food, which is set equal to 1 as it is the numéraire. Thus, the consumer's utility increases if, and only if, Y / I^{δ} rises, that is if the income level rises faster than the exact price index I^{δ}. We can thus define *real income y* as an exact representation of a consumer's preferences, see equation (8). Similarly, if the wage rate is *W*, we can define the *real wage w* also using the exact price index, see again equation (8). Moreover, if an individual consumer only has wage income, that is if $Y = W$, then the individual real income *y* is equal to the real wage *w*.

(8) $$\textit{real income}: \quad y = YI^{-\delta}; \qquad \textit{real wage}: \quad w = WI^{-\delta}$$

4. Supply

Production Structure

We start the analysis of the supply side of the model with a description of the production structure for food and manufactures. Food production is characterized by constant returns to scale and is produced under conditions of perfect competition. Workers in this industry are assumed to be immobile. As mentioned above, the food sector is therefore the natural candidate to be used as the numéraire. Given the total labor force L, a fraction (1-γ) is assumed to work in the food sector. The labor force in the manufacturing industry is therefore γL. Production in the food sector, F, equals, by choice of units, food employment:

(9) $$F = (1-\gamma)L; \qquad 0 < \gamma < 1$$

Since farm workers are paid the value of marginal product this choice of units implies that the wage for the farm workers is 1, because food is the numéraire.
Production in the manufacturing sector is characterized by internal economies of scale, which means that there is imperfect competition in this sector. The varieties in the manufacturing industry are symmetric and are produced with the same technology. Note that at this point we already introduce an element of location. Internal economies of scale means that each variety is produced by a single firm; the firm with the largest sales can always outbid a potential competitor. Once we introduce more locations each firm has to decide where to produce. The economies of scale are modeled in the simplest way possible, namely through a fixed cost component and a variable cost component. The production structure can be easily adapted to introduce congestion costs. The main idea is that the congestion costs that each firm faces depend on the overall size of the location of production. The size of city r is measured by the total number of manufacturing firms Nr in that

city. Congestion costs are thus not industry or firm specific, but solely a function of the size of the city as a whole.

(10) $$l_{ir} = N_r^{\tau/(1-\tau)}(\alpha + \beta x_{ir}); \qquad -1 < \tau < 1$$

Where lir is the amount of labor required in city r to produce xir units of a variety, and the parameter τ represents external economies of scale. There are no location-specific external economies of scale if $\tau = 0$. There are positive location-specific external economies if $-1 < \tau < 0$. Such a specification could be used to model, for example, learning-by-doing spillovers. For our present purposes, the case of negative location-specific external economies arising from congestion are relevant, in which case $0 < \tau < 1$.

Price Setting and Zero Profits

Each manufacturing firm produces a unique variety under internal returns to scale. This implies that the firm has monopoly power, which it will use to maximize its profits. We will therefore have to determine the price setting behavior of each firm. The Dixit-Stiglitz monopolistic competition model makes two assumptions in this respect. First, it is assumed that each firm takes the price setting behavior of other firms as given, that is if firm 1 changes its price it will assume that the prices of the other N-1 varieties will remain the same. Second, it is assumed that the firm ignores the effect of changing its own price on the price index I of manufactures. For ease of notation we will drop the sub index i for the firm, retaining a subindex r for the region. Note that a firm which produces xr units of output in region r using the production function in equation (10) will earn profits πr given in equation (11) if the wage rate it has to pay is Wr.

(11) $$\pi_r = p_r x_r - W_r N_r^{\tau/1-\tau}(\alpha + \beta x_r)$$

Naturally, the firm will have to sell the units of output xr it is producing, that is these sales must be consistent with the demand for a variety of manufactures derived above. Although this demand was derived for an arbitrary consumer, the most important feature of the demand for a variety, namely the constant price elasticity of demand ε, also holds when we combine the demand from many consumers with the same preference structure. If the demand x for a variety has a constant price elasticity of demand ε, maximization of the profits given in equation (11) leads to a very simple optimal pricing rule, known as mark-up pricing, as given in equation (12) and derived in Technical Note 3.

(12) $$p_r(1-1/\varepsilon) = \beta W_r N_r^{\tau/(1-\tau)} \qquad (or \quad p_r = \beta W_r N_r^{\tau/(1-\tau)}/\rho \quad)$$

Technical Note 3: Derivation of Equation (12)

The demand xr for a variety can be written as $x_r = \text{con} \cdot p_r^{-\varepsilon}$, where "con" is some constant. Substituting this in the profit function gives:

$$\pi_r = \text{con} \cdot p_r^{1-\varepsilon} - W_r N_r^{\tau/(1-\tau)}(\alpha + \beta \,\text{con} \cdot p_r^{-\varepsilon})$$

Profits are now a function of the firm's price only. Differentiating with respect to the price p and equating to 0 gives the first order condition:

$$(1-\varepsilon)\text{con} \cdot p_r^{-\varepsilon} + \varepsilon\, W_r N_r^{\tau/(1-\tau)} \beta \,\text{con} \cdot p_r^{-\varepsilon-1} = 0$$

Canceling the term $\text{con} \cdot p_r^{-\varepsilon}$ and rearranging gives equation (12).

Now that we have determined the optimal price a firm will charge to maximize profits we can actually calculate those profits (if we know the constant in Technical Note 3). This is where another important feature of monopolistic competition comes in. If profits are positive (sometimes referred to as excess profits) it is apparently very attractive to set up shop in the manufacturing sector. One would then expect that new firms enter the market and start to produce a different variety. This implies, of course, that the consumer will allocate her spending over more varieties of manufactures. Since all varieties are substitutes for one another, the entry of new firms in the manufacturing sector implies that profits for the existing firms will fall. This process of entry of new firms will continue until profits in the manufacturing sector are driven to zero. A reverse process, with firms leaving the manufacturing sector, would operate if profits were negative. Monopolistic competition in the manufacturing sector therefore imposes as an equilibrium condition that profits are zero. If we do that in equation (11) we can calculate the scale at which a firm producing a variety in the manufacturing sector will operate, equation (13), how much labor is needed to produce this amount of output, equation (14), and how many varieties N are produced in the economy as a function of the available labor in the manufacturing sector, equation (15). See Technical Note 4.

Technical Note 4: Derivation of Equations (13)–(15)

Put profits in equation (11) equal to zero and use the pricing rule from equation (12):

$$p_r x_r - W_r N_r^{\tau/1-\tau}(\alpha + \beta x_r) = 0; \qquad p_r x_r = W_r N_r^{\tau/1-\tau}(\alpha + \beta x_r)$$

$$\frac{\varepsilon}{\varepsilon - 1}\beta W_r N_r^{\tau/(1-\tau)} = W_r N_r^{\tau/1-\tau}(\alpha + \beta x_r); \qquad x_r = \frac{\alpha(\varepsilon - 1)}{\beta} \equiv x$$

This explains equation (13). Now use the production function (10) to calculate the amount of labor required to produce this much output:

$$l_{ir} = N_r^{\tau/(1-\tau)}(\alpha + \beta x) = N_r^{\tau/(1-\tau)}\left(\alpha + \beta\frac{\alpha(\varepsilon - 1)}{\beta}\right) = N_r^{\tau/(1-\tau)}\alpha\varepsilon$$

This explains equation (14). Finally, equation (15), determining the number of varieties N produced, simply follows by dividing the total number of manufacturing workers by the number of workers needed to produce 1 variety.

(13) $$x = \frac{\alpha(\varepsilon - 1)}{\beta}$$

(14) $$l_r = N_r^{\tau/(1-\tau)}\alpha\varepsilon$$

(15) $$N_r = \gamma L_r / l_r = \gamma L / N_r^{\tau/(1-\tau)}\alpha\varepsilon \quad ; \qquad N_r = \left(\gamma L_r / \alpha\varepsilon \quad\right)^{1-\tau}$$

5. Transport Costs and Multiple Locations

The parameter T denotes the number of goods that need to be shipped to ensure that 1 unit of a variety of manufactures arrives per unit of distance, while Trs is defined as the number of goods that need to be shipped from region r to ensure that 1 unit arrives in region s. We will assume that this is proportional to the distance between regions r and s. If we let Drs denote the distance between region r and region s (which is 0 if r = s), we therefore assume that:

(16) $$T_{rs} = T^{D_{rs}}, \quad \textit{note:} \quad T_{rs} = T_{sr}, \quad \textit{and} \quad T_{rr} = T^0 = 1$$

These definitions ease notation in the equations below and allow us to distinguish between changes in the parameter T, that is a general change in (transport) technology applying to all regions, and changes in the "distance" Drs between regions, which may result from a policy change, such as tariff changes, a cultural treaty, or new infrastructure.

Now that we have introduced transport costs it becomes important to know where the economic agents are located. We therefore have to (i) specify a notation to show how labor is distributed over the regions, and (ii) investigate what the consequences are for some of the demand and supply equations discussed above. To start with point (i), we have already introduced the parameter γ to denote the fraction of the labor force in the manufacturing sector, such that 1-γ is the fraction of labor in the food sector. We now assume that of the laborers in the food sector a fraction ϕi is located in region i, and of the laborers in the manufacturing sector a fraction λi is located in region i.

Point (ii) involves more work. We will concentrate on region 1. Similar remarks hold for other regions. It is easiest to start with the producers. Since there are ϕ1(1-γ)L farm workers in region 1 and production is proportional to the labor input, see equation (6), food production in region 1 equals ϕ1(1-γ)L, which is equal to the income generated by the food sector in region 1 and the wage income paid to farm workers there. Since we introduced transport costs in the model, the wage rate paid to manufacturing workers in region 1 will in general differ from the wage rate paid to manufacturing workers in other regions, as identified by the sub-index above, so W1 is the manufacturing wage in region 1. If we know the wage rate W1 in region 1, we can see from equation (12) that the price charged in region 1 by a firm located in region 1 is equal to $p_1 = \left(\beta W_1 N_1^{\tau/(1-\tau)} / \rho \right)$. The price this firm located in region 1 will charge in region 2 will be T_{12} times higher than in region 1 as a result of the transportation costs, etc. Note that this holds for all N1 firms located in region 1. Finally, since there are λ1γL manufacturing workers in region 1, we can deduce from equation (15) the number of firms N1 located in region 1: $N_1 = \left(\gamma \lambda_1 L / \alpha \varepsilon \right)^{1-\tau}$.

We now turn to the demand side of the economy. As discussed above, the price a firm charges to a consumer for one unit of the variety it produces depends both on the location of the firm (which determines the wage rate the firm will have to pay to its workers) and on the location of the consumer (which determines whether or not the consumer will have to pay for the transport costs of the good). As a result, the price index of manufactures will differ between the regions. Again, we will identify these with a sub index, so I1 is the price index in region 1. We can now, however, be more specific since we just derived the price a firm will charge in each region, and how many firms there are in each region. All we have to do is substitute this information in equation (6), see Technical Note 5:

$$I_r = \left(\frac{\beta}{\rho}\right)\left(\frac{\gamma L}{\alpha\varepsilon}\right)^{\frac{(1-\varepsilon\tau)}{(1-\varepsilon)}}\left[\sum_{s=1}^{R}\lambda_s^{1-\varepsilon\tau}W_s^{1-\varepsilon}T_{rs}^{1-\varepsilon}\right]^{1/(1-\varepsilon)} \tag{17}$$

Technical Note 5: Derivation of Equation (17)

The number of firms in region s equals: $N_s = \left[\frac{\gamma\lambda_s L}{\alpha\varepsilon}\right]^{1-\tau}$

The price a firm located in region s charges in region r equals: $\left(\frac{\beta}{\rho}W_s N_s^{\tau/(1-\tau)}T_{rs}\right)$

Substituting these two results in the price index for manufactures equation (6), assuming that there are $R \geq 2$ regions, gives the price index for region r, see equation (17):

$$I_r = \left[\sum_{s=1}^{R} N_s\left(\frac{\beta}{\rho}W_s T_{rs} N_s^{\tau/(1-\tau)}\right)^{1-\varepsilon}\right]^{1/(1-\varepsilon)} = \left[\sum_{s=1}^{R} N_s^{(1-\varepsilon\tau)/(1-\tau)}\left(\frac{\beta}{\rho}W_s T_{rs}\right)^{1-\varepsilon}\right]^{1/(1-\varepsilon)} =$$

$$\left[\sum_{s=1}^{R}\left(\frac{\gamma\lambda_s L}{\alpha\varepsilon}\right)^{(1-\varepsilon\tau)}\left(\frac{\beta}{\rho}W_s T_{rs}\right)^{1-\varepsilon}\right]^{1/(1-\varepsilon)} = \left(\frac{\beta}{\rho}\right)\left(\frac{\gamma L}{\alpha\varepsilon}\right)^{\frac{(1-\varepsilon\tau)}{(1-\varepsilon)}}\left[\sum_{s=1}^{R}\lambda_s^{1-\varepsilon\tau}W_s^{1-\varepsilon}T_{rs}^{1-\varepsilon}\right]^{1/(1-\varepsilon)}$$

The impact of location on the consumption decisions of consumers in different locations requires us to know the income level of the regions. This brings us to the determination of equilibrium in the next section.

6. Short Run Equilibrium

The short-run equilibrium relationships determine the economic equilibrium for an exogenously given distribution of the manufacturing labor force. It is thus assumed that the manufacturing labor force is not mobile between regions in the short-run. The spatial distribution of the manufacturing workers and firms is not yet determined by the model itself, but simply imposed upon the model. What are the short-run equilibrium relationships? Well, we have actually already used a few of these without explicitly stating it. For example, we have already assumed that the labor markets clear, that is (i) all farm workers have a job, and (ii) all manufacturing workers have a job. Point (i) has determined the production level of food in each region, in conjunction with the production function for food and perfect competition in the food sector. Point (ii) has determined the number of manufacturing varieties produced in each region, in conjunction with the production function for manufactures, the price setting behavior of firms, and entry or exit of firms in the manufacturing sector until profits are zero. Evidently, there are no profits for firms in the manufacturing sector (because of entry and exit), nor for the farmers (because of constant returns to scale and perfect competition). This implies that all income earned in the economy for consumers to spend derives from the wages they earn in their respective sectors. Which brings us to the next equilibrium relationship, that is how to determine income in each region. In view of the above, this is simple. There are $\phi_1(1-\gamma)L$ farm workers in region 1, each earning a farm wage rate of 1 (food is the numéraire), and there are $\lambda_1\gamma L$ manufacturing workers in region 1, each earning a wage rate W_1. As there are no profits or other factors of production, this is the only income generated in region 1. If we let Y_i denote income generated in region i:

$$Y_i = \lambda_i W_i \gamma L + \phi_i (1-\gamma) L \tag{18}$$

Where the first term on the right hand side represents income for the manufacturing workers, and the second term reflects income for the farm workers. The price index is already given in equation (17):

$$I_r = \left(\frac{\beta}{\rho}\right)\left(\frac{\gamma L}{\alpha\varepsilon}\right)^{\frac{(1-\varepsilon\tau)}{(1-\varepsilon)}} \left[\sum_{s=1}^{R} \lambda_s^{1-\varepsilon\tau} W_s^{1-\varepsilon} T_{rs}^{1-\varepsilon}\right]^{1/(1-\varepsilon)} \tag{19}$$

Demand in region 1 for products from region 1 is based on individual demand by summing the demand for all consumers in region 1. It is thus dependent on the aggregate income Y1 in region 1, the price index I1 in region 1, and the price charged by a producer from region 1 for a locally sold variety in region 1. We simply have to substitute these three terms for individual income, price index, and price to get total demand in region 1 for a variety produced in region 1. We can derive demand in another region for products from region 1 in a similar way, by substituting aggregate income, price index, and the price charged by a producer from region 1 for a good sold in the other region. Total demand for a producer in region 1 is the sum of the demands discussed above. We already derived the break-even level of production $x = \alpha(\varepsilon - 1)/\beta$ for a producer of manufactures. Equating this break-even production level to the total demand discussed above allows us to determine what the price (and thus the wage rate) of a variety should be, in order to sell exactly this amount. Solving this equation for the wage rate in region 1 gives (see Technical Note 6):

$$W_s = \rho\beta^{-\rho}\left(\frac{\delta}{(\varepsilon-1)\alpha}\right)^{1/\varepsilon}\left(\frac{\gamma L}{\alpha\,\varepsilon}\right)^{-\tau}\lambda_s^{-\tau}\left[\sum_{r=1}^{R} Y_r T_{rs}^{1-\varepsilon} I_r^{\varepsilon-1}\right]^{1/\varepsilon} \tag{20}$$

Technical Note 6: Derivation of Equation (20)

Equation (6) gives the demand for an individual consumer in a region. If we replace in that equation the income level W with the income level Y_r of region r, the price index I with the price index I_r of region r, and the price p_j of the manufactured good with the price $\beta W_s T_{rs} N_s^{\tau/(1-\tau)}/\rho$ which a producer from region s will charge in region r we get the demand in region r for a product from region s:

$$\delta Y_r(\beta W_s T_{rs} N_s^{\tau/(1-\tau)}/\rho)^{-\varepsilon} I_r^{\varepsilon-1} = \delta(\beta/\rho)^{-\varepsilon} Y_r W_s^{-\varepsilon} N_s^{-\varepsilon\tau/(1-\tau)} T_{rs}^{-\varepsilon} I_r^{\varepsilon-1}$$

To fulfill this consumption demand in region r note that T_{rs} units have to be shipped and produced. To derive the total demand in all $R \geq 2$ regions for a manufactured good produced in region s, we must sum production demand over all regions (that is, sum over the index r in the above equation and multiply each entry by T_{rs}):

$$\delta(\beta/\rho)^{-\varepsilon}\sum_{r=1}^{R} Y_r W_s^{-\varepsilon} N_s^{-\varepsilon\tau/(1-\tau)} T_{rs}^{1-\varepsilon} I_r^{\varepsilon-1} = \delta(\beta/\rho)^{-\varepsilon} W_s^{-\varepsilon} N_s^{-\varepsilon\tau/(1-\tau)}\sum_{r=1}^{R} Y_r T_{rs}^{1-\varepsilon} I_r^{\varepsilon-1}$$

In equilibrium this total demand for a manufactured good from region s must be equal to its supply $(\varepsilon-1)\alpha/\beta$, see the zero profit condition. Equalizing these two gives

$$(\varepsilon-1)\alpha/\beta = \delta(\beta/\rho)^{-\varepsilon} W_s^{-\varepsilon} N_s^{-\varepsilon\tau/(1-\tau)}\sum_{r=1}^{R} Y_r T_{rs}^{1-\varepsilon} I_r^{\varepsilon-1}$$

Which can be solved for the wage rate W_s in region *s:*

$$W_s = \rho\beta^{-\rho}\left(\frac{\delta}{(\varepsilon-1)\alpha}\right)^{1/\varepsilon} N_s^{-\tau/(1-\tau)}\left[\sum_{r=1}^{R} Y_r T_{rs}^{1-\varepsilon} I_r^{\varepsilon-1}\right]^{1/\varepsilon}$$

Substituting for the number of varieties produced in region s gives equation (20):

$$W_s = \rho\beta^{-\rho}\left(\frac{\delta}{(\varepsilon-1)\alpha}\right)^{1/\varepsilon}\left(\frac{\gamma L}{\alpha\,\varepsilon}\right)^{-\tau}\lambda_s^{-\tau}\left[\sum_{r=1}^{R} Y_r T_{rs}^{1-\varepsilon} I_r^{\varepsilon-1}\right]^{1/\varepsilon}$$

7. Discussion

Together equations (18) – (20), repeated below for convenience, determine the short-run equilibrium for an arbitrary number of regions, connected through an arbitrary geographic relationship determining the distances D_{rs} between these regions, and thus the transport costs Trs. Equation (21) gives the real wage for region s. These equations can very generally be used for empirical estimates, analyzing the impact of parameter changes, and simulations of the impact of applied policy changes.

(18)
$$Y_i = \lambda_i W_i \gamma L + \phi_i (1-\gamma) L$$

(19)
$$I_r = \left(\frac{\beta}{\rho}\right)\left(\frac{\gamma L}{\alpha\varepsilon}\right)^{\frac{(1-\varepsilon\tau)}{(1-\varepsilon)}} \left[\sum_{s=1}^{R} \lambda_s^{1-\varepsilon\tau} W_s^{1-\varepsilon} T_{rs}^{1-\varepsilon}\right]^{1/(1-\varepsilon)}$$

(20)
$$W_s = \rho\beta^{-\rho}\left(\frac{\delta}{(\varepsilon-1)\alpha}\right)^{1/\varepsilon}\left(\frac{\gamma L}{\alpha\,\varepsilon}\right)^{-\tau} \lambda_s^{-\tau}\left[\sum_{r=1}^{R} Y_r T_{rs}^{1-\varepsilon} I_r^{\varepsilon-1}\right]^{1/\varepsilon}$$

(21)
$$w_s = W_s I_s^{-\delta}$$

Normalization

First, suppose the labor force L increases by some multiplicative factor, say θ, taking the distribution of the labor force as given. Assume that the wage W does not change. From equation (18) it then follows that income in each region changes by the same factor θ, while equation (19) shows that the price index in each region increases by the factor $\theta^{(1-\tau\varepsilon)/(1-\varepsilon)}$. Using these two results in equation (20) shows indeed that the wage in each region does not change. The real wage in each region therefore changes equiproportionally by the factor $\theta^{-\delta(1-\tau\varepsilon)/(1-\varepsilon)}$, see equation (21), such that the distribution of relative real wages is not affected.

Second, suppose the fixed cost of production α increase by a multiplicative factor θ for all regions. Assume, for the sake of argument, that the wage does not change. From equation (18) it follows that income does not change, and from equation (19) that the price index increases by the factor $\theta^{-(1-\tau\varepsilon)/(1-\varepsilon)}$. Using these two results in equation (20) shows that the wage in each region indeed does not change. The real wage in each region therefore changes equiproportionally by the factor $\theta^{\delta(1-\tau\varepsilon)/(1-\varepsilon)}$, see equation (21), such that the distribution of relative real wages is not affected.

Third, suppose the marginal cost of production β increase by a multiplicative factor θ for all regions. Assume, for the sake of argument, that the wage W does not change. From equation (18) it follows that income in each region does not change, and from equation (19) that the price index increases by the factor θ. Using these two results in equation (20) shows again that the wage in each region indeed does not change. The real wage in each region therefore changes equiproportionally by the factor $\theta^{-\delta}$, see equation (21), such that the distribution of relative real wages is not affected.

Proposition

Suppose that (Y_r, I_r, W_r, w_r) solves equations (18)-(20). Then a change in the size of the population L or the manufacturing cost function parameters α and β by a factor θ changes this solution to:
$(\theta Y_r,\ \theta^{(1-\tau\varepsilon)/(1-\varepsilon)} I_r, W_r, \theta^{-\delta(1-\tau\varepsilon)/(1-\varepsilon)} w_r)$,
$(Y_r,\ \theta^{-(1-\tau\varepsilon)/(1-\varepsilon)} I_r,\ W_r,\ \theta^{\delta(1-\tau\varepsilon)/(1-\varepsilon)} w_r)$, *and*
$(Y_r, \theta I_r, W_r, \theta^{-\delta} w_r)$, *respectively.*
The equiproportional change in the real wage implies that the parameters L, α and β essentially do not influence the dynamics and stability of the model. These parameters do, however, influence the real wage (= welfare) level.

Based on the above proposition we can use the following normalization as it does not essentially affect the dynamics of the model:

Parameter Normalization

γ =	δ	L =	1
β =	ρ	α =	γL/ε

Using this normalization (where it should be noted that the first normalization [upper left corner] is for convenience) the equations (18)–(21) simplify to:

(18’) $$Y_i = \lambda_i W_i \gamma L + \phi_i (1-\gamma) L$$

(19’) $$I_r = \left[\sum_{s=1}^{R} \lambda_s^{1-\varepsilon\tau} W_s^{1-\varepsilon} T_{rs}^{1-\varepsilon} \right]^{1/(1-\varepsilon)}$$

(20’) $$W_s = \lambda_s^{-\tau} \left[\sum_{r=1}^{R} Y_r T_{rs}^{1-\varepsilon} I_r^{\varepsilon-1} \right]^{1/\varepsilon}$$

(21’) $$w_s = W_s I_s^{-\delta}$$

This is used in chapter 7 of Brakman et al. (2001; see equations (7.2)–(7.4), page 192).

Absence of Congestion

If there are no externalities in manufactures production, that is if $\tau = 0$, equations (18)–(21) simplify to:

(18”) $$Y_i = \lambda_i W_i \gamma L + \phi_i (1-\gamma) L$$

(19”) $$I_r = \left(\frac{\beta}{\rho}\right)\left(\frac{\gamma L}{\alpha\varepsilon}\right)^{\frac{1}{(1-\varepsilon)}} \left[\sum_{s=1}^{R} \lambda_s W_s^{1-\varepsilon} T_{rs}^{1-\varepsilon}\right]^{1/(1-\varepsilon)}$$

(20”) $$W_s = \rho\beta^{-\rho}\left(\frac{\delta}{(\varepsilon-1)\alpha}\right)^{1/\varepsilon} \left[\sum_{r=1}^{R} Y_r T_{rs}^{1-\varepsilon} I_r^{\varepsilon-1}\right]^{1/\varepsilon}$$

(21”) $$w_s = W_s I_s^{-\delta}$$

This is used in chapters 3 and 4 of Brakman et al. (2001; see equations (3.18), (3.19), (3.21), and (3.8’) on pages 86–93, and equations (4.1)–(4.4) on pages 101–103).

Absence of Congestion and Normalization

If there are no externalities in manufactures production, that is if $\tau = 0$, and the normalization is used, equations (18) – (21) simplify to:

(18”’) $$Y_i = \lambda_i W_i \gamma L + \phi_i (1-\gamma) L$$

(19”’) $$I_r = \left[\sum_{s=1}^{R} \lambda_s W_s^{1-\varepsilon} T_{rs}^{1-\varepsilon}\right]^{1/(1-\varepsilon)}$$

(20”’) $$W_s = \left[\sum_{r=1}^{R} Y_r T_{rs}^{1-\varepsilon} I_r^{\varepsilon-1}\right]^{1/\varepsilon}$$

(21”’) $$w_s = W_s I_s^{-\delta}$$

This is used in chapter 4 of Brakman et al. (2001; see equations (4.1') – (4.3') and (4.4) on page 108 and page 103).

8. Conclusions

We have derived and discussed a general, but simple geographical economics model with congestion. Negative congestion costs are equivalent to positive externalities. Congestion ensures that the balance between agglomerating and spreading forces is more easily reached, thus explaining the economic viability of small and large locations. Since the model allows for locations of different size, an arbitrary number of locations, and an arbitrary geographic structure providing connections between locations, it not only generalizes some previous models with a limited number of locations, a restricted geographic structure, without congestion, or without positive externalities, but also lends itself to analyzing the impact of public policy in terms of infrastructure changes on the size and location of economic activity. We show analytically that scale effects (total size of the economy) and changes in the cost structure (fixed and marginal costs) are important from a welfare perspective, but largely irrelevant from an economic dynamics perspective.

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Putting New Economic Geography to the Test: Free-ness of Trade and Agglomeration in the EU Regions

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Abstract

Based on a New Economic Geography model by Puga (1999), we use the equilibrium wage equation to estimate two key structural model parameters for the NUTS 2 (Nomenclature of Units for Territorial Statistics) EU regions. The estimation of these parameters enables us to come up with an empirically based *free-ness of trade* parameter. We then confront the empirically grounded free-ness of trade parameter with the theoretical relationship between this parameter and the degree of agglomeration. This is done for two versions of our model: one in which labor is immobile between regions, and one in which labor is mobile between

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regions. Overall, and in line with related studies, our main finding is that agglomeration forces still have only a limited geographical reach in the EU. Agglomeration forces appear to be rather localized.

1. Introduction

In his review of Fujita, Krugman and Venables (1999), but in fact of the whole New Economic Geography (NEG) literature, Neary (2001) reminds us that the real test for the NEG is beyond mere theory and to bring out its empirical and policy relevance. This paper addresses the empirical relevance of the NEG. In doing so, we take the basic message of Leamer and Levinsohn (1995, p.1341), "estimate don't test" seriously. We will show the usefulness of the NEG, but we will not really test it against alternative theories, though we will control for fixed "1st nature" endowments and, indirectly, for human capital or (pure) technological externalities. We also take their second message seriously and that is "don't treat theory too casually". For this paper their advice means that our empirical analysis is well grounded in NEG theory and that, in turn, we will explicitly address the theoretical implications of the empirical findings.

Estimations that take the NEG as a starting point often run into problems. It is well-known that agglomeration patterns can be found at all levels of aggregation (country, region, city). But this not necessarily implies that neo-classical theories of location are without merit. Geographical concentration of factor endowments or pure technological externalities could lead to agglomeration in neo-classical models. In the same vein, the absence of agglomeration does not imply that the NEG models are not relevant. NEG models are characterized by multiple equilibria, of which the symmetric or spreading equilibrium is one. In addition, one could point out that the application of these models to different economies with different (labor market) institutions (like the U.S.A. or the EU countries), or to different geographical scales (country versus city level) sits uneasy with the tendency in empirical NEG applications of a ´one size fits all' approach. Finally, from a more methodological angle, there are important questions about the (spatial) econometrics involved as well as about data measurement (see Combes and Overman, 2003). The conclusion is that the same empirical facts about agglomeration can be explained using different theoretical approaches. On the one hand this is good news, because it means that the facts are not in search of a theory. On the other hand it leaves unanswered the question as to the relevance of NEG and, within NEG, as to the relevance of specific NEG models. Recent theoretical work by Robert-Nicoud (2004) and Ottaviano and Robert-Nicoud (2004) also emphasizes these problems.

In this paper we will address some of the above issues. More in particular, based on a NEG model (Puga, 1999), we derive the equilibrium wage equation and estimate this equation. This procedure gives estimates of two key structural model parameters for our sample of the NUTS 2 EU regions, and it enables us to derive empirically based estimates for the so-called free-ness of trade parameter. In doing so we follow the suggestion by Head and Mayer (2004a, p. 2663), who state that for future NEG empirics to progress “it is critical to identify the free-ness of trade”. To our knowledge this is the first paper that tries to do so systematically. Subsequently, we will use the estimates of this empirical exercise to find out for the case of the EU regions what the free-ness of trade estimates imply for the degree and geographical range of agglomeration forces.2 Using the model by Puga (1999) as our benchmark model, we confront our estimates of the free-ness of trade parameter with the theoretical relationship between this parameter and the degree of agglomeration. Our results will be applied to two different settings: one in which labor is immobile between regions, and one in which labor is mobile between regions.

The paper is organized as follows. In section 2, the basic model is briefly presented and the equilibrium wage equation is derived and this equation is the vehicle for our empirical analysis. In terms of long-run equilibria section 3 describes two worlds that are consistent with this wage equation, but have different predictions as to what happens with the degree of agglomeration when trade costs fall. The first world is described by the now familiar Tomahawk diagram that is not only to be found in the core NEG model by Krugman (1991) but essentially in a very broad class of NEG models (Ottaviano and Robert-Nicoud, 2004). With two regions there is a symmetric or spreading equilibrium and there are two equilibria consistent with complete agglomeration. Ever-increasing economic integration will ultimately result in complete agglomeration in this model. In the second world the possible set of long-run equilbria is richer and (stable) incomplete agglomeration may belong to the set of long-run equilbria. Here, for high levels of economic integration agglomeration will turn into (renewed) spreading.

Section 4 presents our basic estimation results. Our estimation of the equilibrium wage equation yields coefficients for the transportation cost parameter and the substitution elasticity and thereby, for any given distance between a pair of regions, an estimate for the free-ness of trade parameter. Subsequently, section 5 confronts the findings of section 4 with our benchmark model. Analysing the break conditions of each model gives an indication whether or not more economic integration will lead to more agglomeration. By using bilateral country trade data section 6 extends the analysis to the sectoral level. Finally, section 7 concludes. Overall, our main finding is that agglomeration forces do not extend very far. Agglomeration forces appear to be rather localized.

[2] Note that by doing so we address two from the five empirical hypotheses that, according to Head and Mayer (2004a) follow from the NEG literature.

2. The Model and the Wage Equation

In this section we give a brief description of the model and focus on the derivation of the equilibrium wage equation. The model we use encompasses the two most important NEG models: the Krugman (1991) model with inter-regional labor mobility, and the Krugman and Venables (1995) model without inter-regional labor mobility. We take Puga (1999) as a starting point because he presents a general model that encompasses these two core models and in fact many other NEG models as special cases. The model without interregional labor mobility is considered to be more relevant in an international context, because it is a stylised fact that labor is internationally less mobile than nationally. For the EU, however, it is not a priori clear if this is true in the long run. Economic integration could stimulate international labor mobility. In the context of NEG such a gradual change to more labor mobility can have serious implications, as we will discuss below. We will now introduce and summarize the basic set-up of the Puga model (for more details see, besides Puga (1999), also Fujita, Krugman, and Venables (1999), chapter 14).

Demand

Assume an economy with two sectors, a numéraire sector (H), and a Manufacturing (M) sector. As a short cut one often refers to H as the agricultural sector to indicate that this industry is tied to a specific location. Every consumer in the economy shares the same, Cobb-Douglas, preferences for both types of commodities:

$$U = M^{\delta} H^{(1-\delta)}$$

The parameter δ is the share of income spent on manufactured goods. M is a CES sub-utility function of many varieties.

(1) $$M = \left(\sum_{i=1}^{n} c_i^{\rho} \right)^{1/\rho}$$

Maximizing the sub-utility subject to the relevant income constraint, that is the share of income that is spent on manufactures, δE, gives the demand for each variety, j:

(2) $$c_j = p_j^{-\varepsilon} I^{\varepsilon-1} \delta E \quad ,$$

in which $I = [\sum_i (p_i)^{(1-\varepsilon)}]^{1/(1-\varepsilon)}$ is the price index for manufactures, $\varepsilon = \dfrac{1}{1-\rho}$ the elasticity of substitution, and E= income.

Firms also use varieties from the M sector as intermediate inputs. Assuming that all varieties are necessary in the production process and that the elasticity of substitution is the same for firms as for consumers, we can use the same CES-aggregator function for producers as for consumers, with the same corresponding price index, I. Given spending on intermediates, we can derive demand functions for varieties of producers which are similar to those of consumers.

Total demand for a variety, j, can now be represented as:

(3)
$$c_j = p_j^{-\varepsilon} I^{\varepsilon-1} Y ,$$

where Y is defined as $Y = \delta E + \mu n p x^*$. The first term on the right hand side of Y comes from consumers, representing the share of income E that is spent on all M-varieties, the second term on the right hand site comes from firm demand for intermediate inputs, this is equal to the value of all varieties in a region, npx*, multiplied by the share of intermediates in the production process, μ (see below).

Manufacturing Supply

Next, turn to the supply side. Each variety, i, is produced according to the following cost function, C(xi):

(4)
$$C(x_i) = I^{\mu} W_i^{(1-\mu)} (\alpha + \beta x_i)$$

where the coefficients α and β describe, the fixed and marginal input requirement per variety. The input is a Cobb-Douglas composite of labor, with price (wages) W, and intermediates, represented by the price index I. Maximizing profits gives the familiar mark-up pricing rule (note that marginal costs consists of two elements, labor and intermediates):

(5)
$$p_i (1 - \frac{1}{\varepsilon}) = I^{\mu} W^{(1-\mu)} \beta ,$$

Using the zero profit condition, $p_i x_i = I^{\mu} W_i^{(1-\mu)} (\alpha + \beta x_i)$, and the mark-up pricing rule (5), gives the break-even supply of a variety i (each variety is produced by a single firm):

(6)
$$x_i = \frac{\alpha(\varepsilon - 1)}{\beta}$$

Equilibrium with Transportation Costs in the 2 Region Model

Furthermore, transportation of manufactures is costly. Transportation costs T are so-called iceberg transportation costs: $T_{12}>1$ units of the manufacturing good have to be shipped from region 1 to region 2 for one unit of the good to actually arrive in region 2. Assume, for illustration purposes, that the two regions – 1 and 2 – are the only regions. Total demand for a product from, for example region 1, now comes from two regions, 1 and 2. The consumers and firms in region 2 have to pay transportation costs on their imports. This leads to the following total demand for a variety produced in region 1:

$$x_1 = Y_1 p_1^{-\varepsilon} I_1^{\varepsilon-1} + Y_2 p_1^{-\varepsilon} (T_{12}\ )^{-\varepsilon} I_2^{\varepsilon-1}$$

We already know that the break-even supply equals $x_1 = \frac{\alpha(\varepsilon - 1)}{\beta}$, equating this to total demand gives (note that the demand from region 2 is multiplied by T12 in order to compensate for the part that melts away during transportation):

$$\frac{\alpha(\varepsilon-1)}{\beta} = Y_1 p_1^{-\varepsilon} I_1^{\varepsilon-1} + Y_2 p_1^{-\varepsilon} (T_{12})^{1-\varepsilon} I_2^{\varepsilon-1}$$

Inserting the mark-up pricing rule, (5), in this last equation and solving for the wage rate gives the two-region version of the wage equation in the presence of intermediate demand for varieties.3 This version of the NEG model is also known as the vertical linkages model, because this model introduces an extra agglomeration force: the location of firms has an impact on production costs. The wage equation for the 2 region case can be stated as:

(6) $$W_1 = Const.(I_1)^{-\mu/(1-\mu)} (Y_1 I_1^{\varepsilon-1} + Y_2 (T_{12})^{1-\varepsilon} I_2^{\varepsilon-1})^{1/\varepsilon(1-\mu)}$$

where the constant, Const, is a function of (fixed) model parameters.

Similarly for the n region (n=1,…r) case we arrive at the following equilibrium wage equation:

(7) $$W_r = Const\{I_r\}^{-\mu/(1-\mu)} \left[\sum_s Y_s I_s^{\varepsilon-1} T_{rs}^{\ (1-\varepsilon)}\right]^{1/\varepsilon(1-\mu)}$$

W_r is the region's r (nominal) wage rate, Ys is expenditures (demand for final consumption and intermediate inputs), Is is the price index for manufactured goods, ε is the elasticity of substitution for manufactured goods and T_{rs} are the

[3] The reason to derive a wage equation instead of a traditional equilibrium price equation is twofold. First, labor migration between regions is a function of (real) wages, second, data on regional wages are easier to obtain than regional manufacturing price data, see section 4.

iceberg transportation costs between regions r and s. Note that when we want to estimate wage equation (7) for our sample of NUTS2 EU regions we need to come up with a specification of the transportation costs T_{rs} , this will be done in section 4. In particular we will have the answer the question how transportation costs vary with the distance between regions. In the short-run, when the spatial distribution of firms and labor is fixed, the model reduces to three equations with three unknowns (wages W, expenditures Y, and the price index I). In the long-run the spatial distribution of economic activity is endogenous because then footloose firms and, depending on the particular version of the model used, manufacturing workers can move between sectors and regions.

Equation (7) closely resembles the "old-fashioned" market potential function. Regional wages are higher in regions that have easy access to high-wage regions nearby. This is reflected by the term $\sum YT_{rs}{}^{(1-\varepsilon),}$ known as nominal market access (Redding and Venables, 2003). Wages are also higher when there is less competition, this is the extent of competition effect, measured by the price index I_s. Note, that the price index I_s does not measure a competition effect in the sense in which this term is normally used (price are fixed mark-ups over marginal costs and there is no strategic interaction between firms). A low price index reflects that many varieties are produced in nearby regions and are therefore not subject to high transportation costs, this reduces the level of demand for local manufacturing varieties. Since firms' output level and price mark-up are fixed, this has to be off set by lower wages. Hence, a low (high) price index I_s depresses (stimulates) regional wages W_r. The inclusion of the price index in the market access term in the wage equation is important since it makes clear that we are dealing with real market access (RMA) as opposed to the gravity equation or market potential function where typically only nominal market access matters.

Finally, the term $I\text{-}^{\mu/(1-\mu)}$ in wage equation (7), is known as supplier access, SA (Redding and Venables, 2003). A lower value of I, lowers production costs and allows a higher break-even wage level. Supplier access means that when the price index is low (high), intermediate input-supplying firms are relatively close (far) to your location of production, which strengthens (weakens) agglomeration. A better supplier access (a lower value of I) lowers wage costs. This effect is stronger the larger the share of intermediate products, μ, in the production process. Note that with $\mu=0$ (no intermediate inputs) only the real market access term is left in the wage equation.

Wage equation (7) will do for our empirical purposes.[4] In the short-run when the spatial distribution of fims and workers is fixed, demand differences between regions will be fully reflected in regional wage differences. Or, in other words,

[4] This has an additional advantage in that we do not have to consider the long-run adjustment mechanism, that is, whether or not firms are mobile or instead labor (see Puga, 1999, p. 310).

regional differences in real market access, RMA, and supplier access, SA, (both of which are fixed in the short run) will result in regional wage differences. In the long run when firms and workers can move, these differences will also give rise to re-location of firms and workers (which amounts to saying that in the long run RMA and SA are endogenous).[5] All that matters for our empirical analysis is that wage equation (7) is the equilibrium wage equation and can be estimated. However, to learn more about the relationship between economic integration and agglomeration the wage equation will not do and we have to address the nature of the long-run equilibria.

3. The Relation between Economic Integration and Agglomeration[6]

3.1 Interregional Labor Mobility: The Tomahawk

NEG models that have the same set-up as Puga (1999) predict that with interregional labor mobility economic integration will lead to complete agglomeration of the footloose agents in the end. The intuition behind this is simple and is illustrated, for the two region case in chart 1. Assume that there are two regions. Economic integration implies lower transportation costs. In chart 1 this is a movement from left to right along the horizontal axis, from low to high φ's (more on the important role of φ below). The parameter φ is called the free-ness of trade or "phi-ness" of trade parameter (Baldwin et al., 2003) and, in terms of our model, is defined as $\varphi_{rs} \equiv T_{rs}^{\ 1-\varepsilon}$ It is easy to interpret: $\varphi_{rs} = 0$ denotes autarky and the absence of economic integration whereas $\varphi_{rs} = 1$ denotes free trade and full economic integration between regions r and s. In empirical work this gives an extra degree of freedom: one has to choose a functional form for T_{rs}. The vertical axis in chart 1 shows the share of the footloose production factor in region 1.

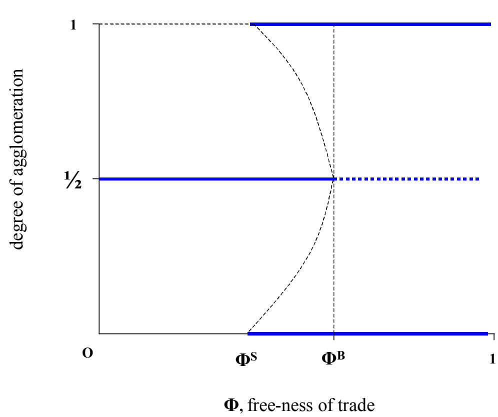
Assume that the initial situation is one of autarky ($\varphi = 0$) and that (footloose) labor is equally distributed over the two regions, indicated by the horizontal solid line at ½. Because the regions are identical this situation is also a long-run

[5] Whether or not in the long run both prices (here, wages) and quantities (here, mobile firms and workers) act as adjustment mechanism, depends on the inter-sectoral elasticity of manufacturing labor supply (see Head and Mayer, 2004b). With an infinite elastic labor supply all the adjustment has to come from the quantity side (and there will be no regional wage differences). In case, as we will assume too, of a positively sloped labor supply function to the relative (= manufacturing/agricultural) wage at least part of the adjustment will come through regional wages, see the next section for an analysis of this issue.

[6] Our discussion in this section is based on the 2 core NEG models as discussed in Puga (1999), but compare also Fujita, Krugman and Venables (1999), chapters 4 and 5 with chapter 14.

equilibrium. This is why this situation is known as the symmetric or spreading equilibrium. What happens if the degree economic integration increases, that is moving from left to right in the chart? Mobile workers have to decide if re-locating to the other region, say from region 1 to 2 (that becomes slightly larger than region 1), is beneficial for them. Initially, re-locating is not beneficial because transportation costs are still quite high and relocating means that exporting from region 2 to region 1 is still too expensive. Furthermore, competition in region 2 increases. This implies that prices and wages in region 2 have to go down in order to be able to sell the break-even amount. A defecting worker will return to its original location. But if transportation costs decline beyond a certain point, the advantages of moving to region 2, outweighs the disadvantage of exporting to region 1. This stimulates further migration towards region 2 until all workers and firms have moved towards this region. Chart 1, the Tomahawk chart, gives the theoretical relationship between economic integration φ and the degree of agglomeration.

Chart 1: The Tomahawk



Source: Authors' calculations.

As chart 1 illustrates the point where it becomes profitable to agglomerate is indicated by φB, in the literature this point is known as the so-called break point: the point where the symmetric equilibrium (degree of agglomeration = ½) is no longer a stable equilibrium (indicated by the dashed horizontal line). At this point the re-location decision of a worker means that others will follow, triggering a process of agglomeration. So, in our NEG model version with interregional labor mobility we either have perfect spreading or full agglomeration as a long-run equilibrium. Analysing the effects of increasing economic integration on agglomeration is now reduced to the question where an economy is located on the horizontal axis in chart 1, that is, one is interested in whether or not an economy is in actual fact to the left or to right of φ^B.[7] Where we are on the horizontal is an empirical question to which the estimations of the free-ness of trade parameter based wage equation will give us the answer in sections 4 and 5. Furthermore, the estimates for φ help us to infer φ^B.

Puga (1999, eq. 16) derives the following analytical solution for the break-point for the 2 region case (dropping subscripts r and s):

$$\phi^B = (T^{1-\varepsilon})^B = \left[1 + \frac{2(2\varepsilon - 1)(\delta + \mu(1-\delta))}{(1-\mu)[(1-\delta)(\varepsilon(1-\delta)(1-\mu) - 1] - \delta^2 \eta}\right]^{(1-\varepsilon)/(\varepsilon-1)} \tag{8}$$

The elasticity η is the elasticity of a region's labor supply from the H-sector to the manufacturing sector. If $\eta = 0$, no inter-sector labor mobility is possible, if $\eta = \infty$ there is perfect labor mobility between sectors, that is to say the inter-sectoral labor supply elasticity is infinite. In the latter case wages in the manufacturing sector and the H-sector are identical until a region becomes specialized in manufactures. If $0 < \eta < \infty$ migration from the H-sector to the manufacturing sector can be consistent with a wage increase in both sectors. The inclusion of an upward sloping labor supply function thus implies that the model is more general than Krugman (1991, where $\eta = 0$), or Krugman and Venables (1995, where $\eta = \infty$). Most importantly, if $0 < \eta < \infty$, the bang-bang long run solutions as in Tomahawk model might disappear once we do no longer allow for inter-regional labor mobility. This is discussed next.

3.2 No Interregional Labor Mobility: The Bell-Shaped Curve

How relevant is the Tomahawk chart for the analysis of EU integration and agglomeration? In international trade theory it is standard to assume that labor is mobile between sectors, but not across national borders. This assumption reflects the stylised fact that labor is less mobile across borders than within regions or countries. Without interregional labor mobility agglomeration, however, is still possible (see Krugman and Venables, 1995, Puga, 1999, Fujita, Krugman and Venables, 1999).

[7] For the purpose of this paper the sustain point, φ^S is deemed not relevant under the assumption that we are only interested in the case where we move from less to more economic integration, that is, we only move from left to right along the horizontal axis in chart 1. The characteristics of break and sustain points are analysed in detail by, for example, Neary (2001), Robert-Nicoud (2004) and Ottaviano and Robert-Nicoud (2004).

The absence of interregional labor mobility still allows agglomeration in the presence of intermediate goods. Firms may find it to be advantageous to agglomerate because of intermediate input linkages, they want to be near the suppliers of these inputs, recall the discussion about the supplier access term in wage equation (7) from the previous section. The labor required to sustain the agglomeration of firms comes from the immobile H sector. To persuade workers to move from the H-sector to the manufacturing sector, each firm has to offer workers in this sector a higher wage than the existing wage in this sector: the more inelastic labor supply is to manufacturing wages, the higher this wage offer has to be. Agglomeration in this class of NEG models, and opposed to the case where the Tomahawk chart applies, is associated with increasing wage differences *between regions*. In the peripheral region, wages decrease, because once firms agglomerate in the more attractive region, labor that is released in the manufacturing sector, increases labor supply in the agricultural sector.

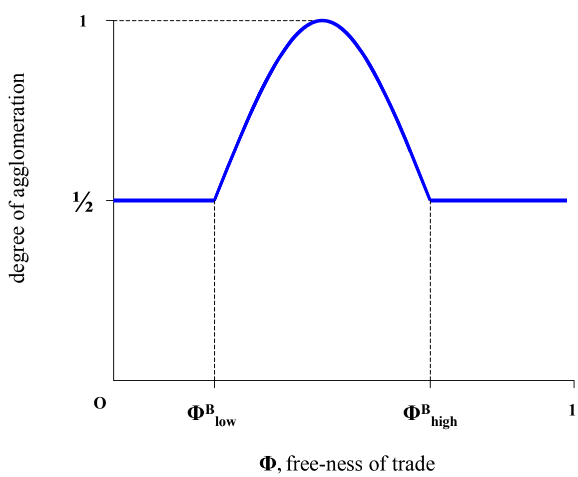
The point to emphasize here is that (with $0<\eta<\infty$) agglomeration drives up wages in the core region. This ultimately reduces the incentive for firms in the manufacturing sector to concentrate production in the region where manufacturing economic activity is agglomerated for a number of reasons. First, an increased demand for labor raises production costs in the region where manufacturing is concentrated. Second, the importance of being close to a specific market diminishes as transportation costs become less important due to increased economic integration, that is when φ, the degree of economic integration, increases. Third, the peripheral region, with its lower wage rate becomes more and more attractive.

Without interregional labor mobility the long-run relationship between the free-ness of trade (economic integration) and agglomeration might look like chart 2 which has aptly been called the bell-shaped curve by Head and Mayer (2004a).[8] As in chart 1 for the 2 region case we have φ on the horizontal axis and the degree of concentration on the vertical axis. For low degrees of economic integration (to the left of φBlow) we have spreading and similar to the previous section, once economic integration passes the break-point (here φBlow) a process of agglomeration starts. The main difference with the previous model, is that agglomeration can be partial and go along with interregional wage differences. If

[8] It might but it need not, this depends on exact parameter configuration, see the Appendix in Puga (1999) or Robert-Nicoud (2004). The point to emphasize is that what really distinguishes chart 2 from chart 1 is that once agglomeration has arrived the economy will stay in the agglomeration regime in chart 1as economic increases further whereas in chart 2 for high levels of economic integration (high levels of φ) agglomeration will turn into (renewed) spreading. Here we assume that the latter possibility occurs with "smooth", that is, partial agglomeration, equilibria like depicted in chart 2 but one can also come up with a double Tomahawk (Robert-Nicoud, 2004, p. 22–23) to depict this second possibility.

economic integration is pushed far enough, a second(!) break point, denoted φBhigh, will be reached. From φBhigh onwards we have re-newed spreading, no agglomeration is left whatsoever and interregional wages will now be equal (because both regions will have the same number of manufacturing firms and an equally sized manufacturing sector).

Chart 2: The Bell-Shaped Curve



solutions for φBlow and φBhigh are the (real) solutions to the quadratic equation in φ (Puga, 1999, equation (33)):

$$\text{(9)}\quad [\varepsilon(1+\mu)-1][(1+\mu)(1+\eta)+(1-\mu)\gamma]\varphi^2 - 2\{[\varepsilon(1+\mu^2)-1](1+\eta)-\varepsilon(1-\mu)[2(\varepsilon-1)-\gamma\mu]\}\varphi$$
$$+(1-\mu)[\varepsilon(1-\mu)-1](\eta+1-\gamma)=0$$

If, depending on the exact parameter configuration for ε,γ, μ and η, these solutions exist, this expression gives us the two break-points. To follow Head and Mayer (2004a) we would like to answer the question for the case of the EU regions "where in the bell are we?" Finally, and this must be emphasized, since the difference between the two classes of NEG models (chart 1 versus chart 2) only comes to the fore when we are dealing with long-run equilibria, the equilibrium wage equation (7) is at home in both classes of NEG models. This means that our estimations of the free-ness of trade parameter φ based on the equilibrium wage equation can be confronted with the Tomahawk chart as well as the above bell-shaped curve!

4. The Estimation of the Wage Equation

Before we can estimate wage equation (7) we have to take the following issues into account. First, we have to specify the distance function. We considered two options:

- $T_{rs}=T^{Drs}$, where the transports costs increase exponentially with the distance between r and s, and T represents the transportation cost parameter that does not vary with distance (applied by Hanson, 2001, Brakman, Garretsen, and Schramm, 2004).
- $T_{rs}=TD_{rs}^{\gamma}$, where the parameters T, $\gamma > 0$ (Crozet, 2004). The size of the distance decay parameter γ needs to be estimated and the data will decide whether transportation costs rise or fall more or less than proportionally with increased distance between r and s. If $0 < \gamma < 1$ transportation costs rise less than proportionally with distance, and reflects that economies to scale (or distance) are possible with respect to transportation.

We opted for the second possibility because in that case the data decide whether transportation costs rise or fall more or less than proportionally with increased distance between r and s. The distance variable D_{rs} will be measured in km. between NUTS 2 regions. The distance from a region r to itself, D_{rr} can be modelled in several ways. We use the proxy 0.667 $\sqrt{\frac{area}{\pi}}$ in which area is the size of region r in km^2, (see Head and Mayer, 2000 for a discussion of this measure for internal distance). Given our specification for T_{rs} we can calculate $\varphi_{rs} \equiv T_{rs}^{\ 1-\varepsilon}$, for each combination of D_{rs} and D_{rr}.

A second issue that we need to address is that we cannot estimate equilibrium wage equation (7) directly. There are no (sufficient) regional price index data for NUTS 2 regions and this means that Ir cannot be measured as such. In addition, even if we somehow get around measuring the regional price indices, the equilibrium price index is itself a function of the regional wages Wr. As can already be guessed from equation (2), the equilibrium price index in region r is also not only a function of wages in other regions but also of the price index in other regions. This follows directly from the fact that in the model with intermediate inputs firms there are 2 inputs (labor and manufacturing goods).

This "price index" problem can be solved in two ways. First, as for instance shown by Hanson (2001), one can make use of other equilibrium conditions (of a non-tradable service) to get rid of the price index altogether. This has its drawbacks too. For the case of the EU regions this leads to new data requirements that cannot (easily) be met. Also, this strategy may imply that one needs additional assumptions that are troublesome for the present analysis (in particular that interregional real wages are always equalized which clearly too strong an assumption to make for the case of the EU regions). We can, in principle, express the price index in region r as an average of the wage in region r and the wages in centre regions corrected for the distance between region r and these centre regions (see the Appendix for an explanation and further references).[9]

As a third and final issue, we observe that regional wages across Europe may differ for reasons that have nothing to do with the demand and cost linkages from the NEG literature. This leads us to another issue that needs to be addressed. Positive human capital externalities or (pure) technological externalities might also give rise to a spatial wage structure! These externalities imply that regions may simply differ in terms of their marginal factor productivity and this is something we would like to take into account when estimating the wage equation. Also, the physical and political geography of Europe might be a factor in explaining regional wage differences, these are the fixed endowments that are truly fixed geographically (Combes and Overman, 2003).

To take these alternative explanations for regional wage differences on board as control variables we proceeded as follows. We allow for labor productivity to differ across the EU regions. We cannot measure human or technological externalities separately (due to lack of relevant data on NUTS 2 level). The Appendix derives the corresponding equilibrium wage equation once labor productivity is no longer assumed to be equal across regions. Relative marginal labor productivity is [MPL_{EU} /MPL_r], where MPL_{EU} is the average real gross value added per employee in the NUTS 2 regions and MPL_r is the real gross value added per employee for region r. By allowing for MPL-differences the wage equation changes into:

$$W_r = \text{constant} \cdot \left(\frac{MPL_{EU}}{MPL_r} \right)^{(1-\varepsilon)/\varepsilon} I_r^{-\mu/(1-\mu)} \left[\sum_{s=1}^{R} Y_s \left(T_{rs} \right)^{1-\varepsilon} I_s^{\varepsilon-1} \right]^{1/\varepsilon}$$

where, MPL = marginal productivity of labor in a specific region (indicated by the subscript).

The possibility that the physical geography (climate, elevation, access to waterways etc.) or the political geography (borders, country-specific institutional wage arrangements etc.) might also explain regional wage differences will be addressed below. As proxies for physical geography we will use for the NUTS 2 regions the mean annual sunshine radiation (in kWH/m^2) and the mean elevation above sea level. We will also use dummy variables when a region borders the sea,

[9] Another solution to be able to estimate the wage equation if data on the price index *I* are lacking is to simply assume that I_r=I_s . This assumption (see Niebuhr, 2004 for an example) effectively boils down to stating that only nominal market access matters, which is not relevant for our case.

has direct access to (navigable) waterways, or is a border region. To capture the possibility of country-specific determinants of wages (like the centralisation of wage setting) we also use country-dummies as control variables. The physical and political geography variables capture the fixed (= not man-made) features of the economic geography that may have a bearing on regional wages. By fixed we mean that these variables are not determined by the location decisions of mobile firms or workers.[10]

The log-transformation of the equilibrium wage equation gives the specification that, see wage equation below, actually has been used as the central wage equation in our estimations, and by adding physical and political geography control variables we thus end up with:

$$\text{(7')} \qquad \log(W_r) = \text{constant} + \frac{1-\varepsilon}{\varepsilon(1-\mu)} \log\left(\frac{MPL_{EU}}{MPL_r}\right) - \frac{\mu}{1-\mu}\log(I_r) + \frac{1}{\varepsilon(1-\mu)}\log\left[\sum_{s=1}^{R} Y_s (T_{rs})^{1-\varepsilon} I_s^{\varepsilon-1}\right] + \sum_i \beta_i Z_i$$

where $(T_{rs})^{1-\varepsilon} = (TD_{rs})^{\gamma(1-\varepsilon)}$ and internal distance $D_{rr} = 0.667\sqrt{\frac{area}{\pi}}$ in which area is the size of region r in km^2 ; and Zi = set of additional control variables for each region that potentially consists of mean annual sunshine; mean elevation above sea-level; and dummy variables (country dummy, border-region dummy, access to sea dummy, access to navigable waterway dummy), for more information on the data used and the definition of variables see the *Appendix*.

What is immediately apparent from the wage equation is that the supplier access (SA) term is correlated with the real market access (RMA) term. The multicollinearity between RMA and SA is discussed at length by Redding and Venables (2003) and Knaap (2004), and it leads these authors to opt for either SA or RMA in the actual estimations. We follow these authors and opt thereby for RMA. In our case the lack of data on regional price indices makes this choice rather straightforward! In some of our estimations we have, following Redding and Venables (2003), experimented with including the distance of each region to the economic centers as an (time-invariant) approximation for supplier access, this did, however, not affect our main results. Implicitly we will assume that in our estimations SA is constant.

In addition, there are other econometric issues to be addressed like the endogeneity of the variables (wages and income) that make up the real market

[10] This is why we decided not use the regional production structure as control variable. In NEG models this is clearly an endogenous variable. NEG models are all about the simultaneous determination of demand and production across regions.

access term (Hanson, 2001, Mion, 2003). We have estimated wage equation (7') in levels and also, without the time-invariant control variables, in 1st differences. In doing so, we have also performed IV-estimations and used both non-linear least squares (NLS) and weighted least squares (WLS). In particular, when estimating in levels, the Glejser test indicated the presence heteroscedasticity so we choose WLS. But for the sake of comparison (for instance with Crozet, 2004) we also present the NLS regression. The sample period is 1992–2000. Our goal for this paper is not solve all these econometrical issues since the estimation of the wage equation is only a means to an end. The means is to arrive at "reasonable" estimates for the substitution elasticity ε and the distance parameter γ so as to be able to infer the free-ness of trade parameter. Table 1 gives the results of estimating equation (7') in levels. The 1st column gives the WLS results of estimating (7'). The 2nd column does the same but now the estimation is the second stage of a 2SLS regression where in the first stage regression wages and income were regressed upon the exogenous controls *Z*, a time trend, and 1-period lagged wages or income. This is a simple way to instrument wages and income. The third column shows the estimation results for a 2SLS regression of wage equation (7') but now we use NLS instead of WLS.

To save space we only show the estimation results for our 2 key variables (results for other variables and/or other specifications are available upon request).

The coefficient for the substitution elasticity is relatively high (indicating relative weak economies of scale) but many studies find values in the range of 7–11 (see for instance Broda and Weinstein, 2004 for sectoral evidence for the U.S.A. or Hanson and Xiang, 2004 for recent international evidence). The distance coefficient $\gamma < 1$ which indicates that transportation costs increases less than proportionally with distance (see Crozet 2004 for an opposite finding).[11]

[11] Estimating in 1st differences (in 2SLS) instead of in levels, gave significant (and correctly signed) results for ε and γ too. But, more in line with Crozet, the substitution elasticity is much lower (between 2–3) and $\gamma>1$ (around 1.8). Our concern here is, however, not so much the estimated coefficients as such but their compound effect on the free-ness of trade parameter φ. In this respect, the 1st difference results yield a free-ness of trade parameter that is very similar to the one based on the estimations in levels shown in table 1.

Table 1: Estimating Wage Equation (7'), 1992–2000 (t-values between Brackets)

	Levels , WLS	Levels, 2SLS, WLS	Levels, 2SLS, NLS
Variable: ε	9.62 (24.9)	9.53 (16.9)	5.48 (11.7)
Variable: γ	0.21 (33.4)	0.19 (22.1)	0.32 (13.0)

Note: t-values for 2SLS have been corrected for the fact that fitted values for wages and income from the first stage regression are included in the second stage. Number of obs.: 1st column: 1830; 2nd column: 1566.

Source: Authors' calculations.

transportation cost. To be able to show what the estimations mean for the relationship between economic integration and agglomeration, we need to go back to the underlying theoretical model as introduced in sections 2 and 3, and in particular to charts 1 and 2. In doing so, we take the estimates of the second column of table 1 as our empirical benchmark, ε=9.53, and γ=0.19. Note that the various estimations of ε and γ yielded roughly the comparable results in terms of the implied value of the free-ness of trade parameter.[12]

5. Economic Integration and Agglomeration: φ Meets φ^B

Given the estimates we are now ready to confront our estimations with the theoretical insights with respect to the relationship between economic integration and agglomeration from section 3. In section 3 we explained that when it comes to this relationship we distinguish in this paper between two relevant classes of NEG models. In our analysis based on Puga (1999), the distinguishing feature between both classes was the assumption about interregional labor mobility. With interregional labor mobility, full agglomeration is the only feasible outcome whenever the degree of economic integration passes a certain threshold level, recall *Tomahawk* chart 1. In the absence of interregional labor mobility, agglomeration outcomes are less extreme (partial agglomeration). More importantly, if the degree

[12] As explained above, the inclusion of both the supplier access (SA) term and the real market access (RMA) term in our estimation of (7') is troublesome a priori, because of the expected degree of multicollinearity between SA and RMA. Because of lack of data we cannot directly compute SA but, see the Appendix (equation 3''), we can approximate the price index I_r for each region by filling the following values for γ (0.19) ε (9.53) and, not based on estimations, μ (0.3). If we confront the resulting SA (= $I_r^{\mu/(1-\mu)}$) with the RMA (the $\sum$ term in (7')) we indeed find a high degree of correlation, 0.64.

of economic integration continues to increase the degree of agglomeration will diminish and ultimately the economy returns to a spreading equilibrium, recall the *bell-shaped curve* from chart 2.

Armed with our estimations for the structural parameters ε=9.53 and γ=0.19 for the EU *NUTS 2* regions, we would like to know what these estimations imply when confronted with the Tomahawk and bell-shaped charts, that is when confronted with our NEG model. In this way we are able to say more about the relationShip between economic integration, here proxied by φ, and the extent of agglomeration. The break-points φ^B for both the Tomahawk and bell-Shaped Curve can be derived from equations (8) and (9). In order to be able to infer for any pair of regions r and s with bilateral distance D_{rs} the implied value for the free-ness of trade parameter φ_{rs} based on our estimates for γ and ε, we have to take into consideration that the NUTS 2 regions are not of equal size and that therefore the internal distance D_{rr} matters to assess the free-ness of trade between a region r and any other region s. This is why the associated value of φ_{rs} is in fact a measure of relative distance D_{rs}/D_{rr} and thereby of relative transportation costs T_{rs}/T_{rr}.

We dub the break-point φ^B_{labmob} for the version of the NEG model with interregional labor mobility, see equation (8). Given certain restrictions on the model parameters (see Puga (1999), p. 315), this break-point gives us the critical value of φ below which the symmetric equilibrium (no agglomeration) is locally stable. If, however, $\varphi > \varphi^B_{labmob}$ we have complete agglomeration just like chart 1 illustrates. Note, however, that due to presence of internal distance we thus have to adjust the definition of φ^B as follows, that is we have to define the free-ness of trade in terms of relative distance D_{rs}/D_{rr} (see Crozet, 2004, equation 16, p. 454 for a similar approach) and this holds for the break points in both the model with and without interregional labor mobility:

$$\phi^B = \left[\left[T(D_{rs})^{\gamma} \Big/ T(D_{rr})^{\gamma} \right]^{1-\varepsilon} \right]^B = \left[\left[\frac{D_{rs}}{D_{rr}} \right]^{\gamma(1-\varepsilon)} \right]^B \quad (10)$$

The break-condition (8) is not affected by our particular definition of the free-ness of trade parameter as given in equation (10), and this is also true for the break-condition (9). For the bell-shaped curve depicted by chart 2, and provided that equation (9) gives us 2 real solutions we know that (φ^B_{low} and φ^B_{high} denote the 1st and 2nd breakpoint in chart 2):

- for phi-values where $\varphi < \varphi^B_{low}$ or $\varphi > \varphi^B_{high}$ the spreading equilibrium is locally stable (there is no agglomeration),
- for phi-values where φBlow < φ < φBhigh, the economy is on the Bell part of the bell-shaped curve where the equilibria display (partial) agglomeration.

From equation (9) it is thus clear that the value of the 2 break- points φ^B_{low} and φ^B_{high} do as such *not* depend on the specification of the transportation costs function. Given, see equations (8) and (9), parameter values for μ,η,δ and ε, we can arrive at a specific value for the various break points φ^B. If we then use this in equation (10) and also plug in our estimates for ε and γ, we know the threshold value for the relative distance $\frac{D_{rs}}{D_{rr}}$ that corresponds with the break point. Comparing this threshold with the actual relative distance between regions r and s provides then information as to the spatial reach of agglomeration forces.

Before we can confront our estimation results with the break-point conditions (8) and (9) and taking into account that the definition of the free-ness of trade as given by equation (10), we thus finally need some benchmark numbers for the parameters μ,η,δ (given that we already have an estimate for ε). Recall that these 4 parameters suffice to yield the break-points for the 2 models. For the last parameter we can start with our own estimations for the substitution elasticity (see Table 1) for the other three parameters we follow Puga (1999) and Head and Mayer (2004a) and use as our benchmark values $\mu=0.3, \eta=200, \delta=0.1$. It is important to keep in mind that the conclusions are of course sensitive to the choice of parameter values. Having said this, an extensive sensitivity analysis showed that our main conclusions hold up for a broad range of parameter values (not shown here but available upon request).

Table 2 gives for both the Tomahawk and Bell curve and for a number of alternative parameter values the break points φ^B_{low}, φ^B_{high}, and φ^B_{labmob} respectively. That is to say, these are the results for the break points when we apply the benchmark values for the 4 parameters to equations (8) and (9). Generally speaking it is true in *both* versions of the NEG model that the range of values of φ for which the symmetric equilibrium is stable shrinks and, conversely, for which (partial) agglomeration is stable expands whenever, *ceteris paribus,* $\mu,\eta,$or δ get larger and/or ε gets smaller (see also Puga, 1999, eq. 18). The economic intuition for this is clear. If the importance of intermediate inputs in production increases (larger μ) it gets more attractive for firms to agglomerate in order to benefit from the intermediate cost and demand linkages between firms as explained in section 3. If the elasticity of labor supply increases, firms will find that relatively low manufacturing wages can already persuade workers to move from the H-sector to the manufacturing sector. This decreases the strength of this congestion or spreading force. Also, a larger expenditure share of manufacturing goods benefits agglomeration because it increases the relevance of demand linkages. Finally, a lower value for the substitution elasticity stimulates agglomeration. Note, that this elasticity provides a measure of the (equilibrium) economies of scale, where the economies of scale are measured as ε/(ε-1). A decrease of ε thus means an increased relevance of firm specific increasing returns to scale which boosts agglomeration.

Table 2: The Break-Points for Alternative Parameter Settings (Benchmark Parameter Values in Bold, Including the Estimated Value for ε)

Key parameters	Φ^{B}_{low}	Φ^{B}_{high}	Φ^{B}_{labmob}
M=0.2 ,η=200,δ=0.1, ε=9.53	0.55	0.77	0.20
M=0.2 ,η=200,δ=0.1 , ε=4	0.44	0.90	0.05
M=0.3 *,η=200, δ=0.1, ε=9.53*	0.30	0.89	0.11
M=0.2 ,η=250,δ=0.1 , ε=9.53	0.51	0.83	0.18
*M=0.2 ,η=200,δ=*0.05, *ε=9.53*	0.55	0.77	0.33
M=0.1 ,η=200,δ=0.05 and *ε=5*	Symm	Symm	0.52
M=0 ,η=0,δ=0.1 and *ε=8*	Symm	Symm	0.65

Notes: symm indicates that the symmetric equilibrium is stable for all values of phi. The break-points are derived for the case of n=2 regions. In case n>2, analytical solutions for the break-points do not exist unless, sse the Appendix in Puga 1999, one sticks to the assumption of equidistance between all regions, see the main text for a further discussion of this issue.

Source: Authors' calculations.

Table 2 gives rise to the following three conclusions.

First, the values for the various break-points are indeed sensitive to the parameter settings even though the direction of change can thus be predicted.

Second, it matters whether one chooses the model version with or without interregional labor mobility. As a rule, over the whole range of permissible φ's, $0 < \varphi < 1$, the agglomeration range is smaller (!) in the bell-shaped world than in the Tomahawk world. Also, the symmetric equilibrium gets unstable for lower values of φ. Hence, a process of economic integration gives rise more quickly to agglomeration in the model without interregional labor mobility.

The third and, most important, conclusion relates for our set of benchmark parameters values (see table 2), the empirical estimates for the free-ness of trade parameter from table 1 with the break-conditions (8) and (9). With μ=0.3 *, $\eta=200$, $\delta=0.1$* and *$\varepsilon=9.53$* (from table 1, second column), we get from break conditions (9) and (8) respectively that φ^{B}_{low} =0.30, φ^{B}_{high} =0.89 and, for the tomahawk, that φ^{B}_{labmob} =0.11. Combining this with our estimates of γ=0.19 and ε=9.53 we can derive the critical or threshold relative distance D_{rs}/D_{rr} that corresponds with each of these 3 break-points.

From condition (9) or (8) we get values for φ^B and we also know, see equation (10), that $\phi^B = \left[\left[\frac{D_{rs}}{D_{rr}}\right]^{\gamma(1-\varepsilon)}\right]^B$ and given our estimates for the distance parameter γ and the substitution elasticity ε we get the hypothetical relative distance that corresponds with the break point.

More precisely we get for

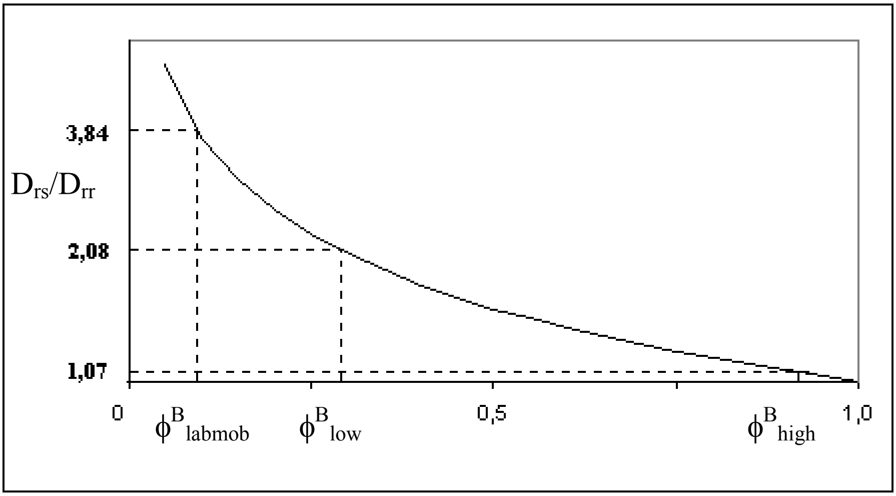
- $\varphi^B_{low} = 0.30 \rightarrow D_{rs}/D_{rr} = 2.08$
- $\varphi^B_{high} = 0.89 \rightarrow D_{rs}/D_{rr} = 1.07$
- $\varphi^B_{labmob} = 0.11 \rightarrow D_{rs}/D_{rr} = 3.84$

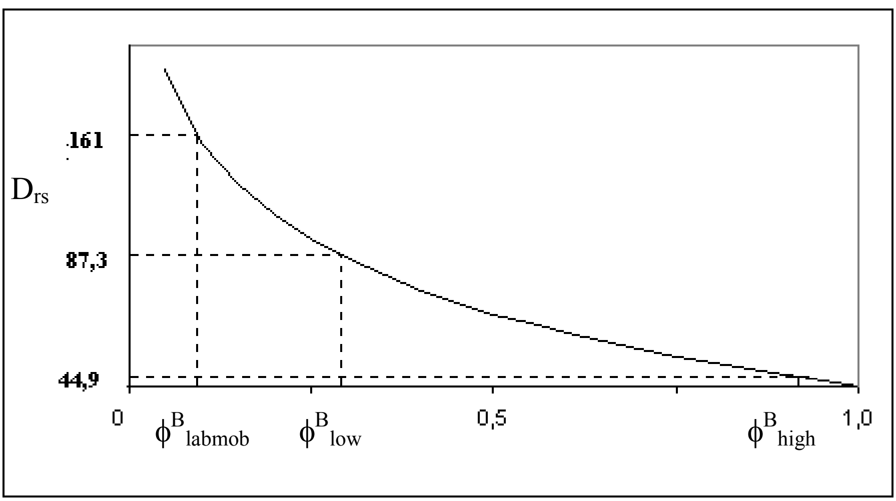
These results imply that the agglomeration does not extend further than 1–4 times the internal distance of a region. To see this, note that the average internal distance for the *NUTS 2* regions is 42 km. With this value for internal distance D_{rr} we get from the perspective of region *r* a "critical" or threshold external distance D_{rs} for the model underlying the bell-shaped curve of 87.3 km. for φ^B_{low} and 44.9 km. for φ^B_{high}. This means that for any actual $D_{rs}>87.3$ km we are in chart 2 to the left of the first break-point where spreading rules. Along similar lines, it is only when the actual $D_{rs}<44.9$ km. that spreading rules again. In between, that is for 44.9 km$<D_{rs}<$87.3 km, we are on the part of chart 2 with (partial) agglomeration. For the Tomahawk, chart 1, the threshold external distance D_{rs}=161 km. Here, the range or radius of agglomeration forces is thus somewhat stronger but still rather limited if one considers the fact that the distance between any pair of economic centres for the case of the EU *NUTS 2* regions is often much larger than 161 km. Chart 3 summarizes our findings.[13] The conclusion about the rather limited spatial reach of agglomeration forces does not change when we substitute our benchmark parameter values for one of the other possibilities shown in table 2. In most other cases and compared to our benchmark, the values for φ^B_{low} and φ^B_{labmob} are higher which means that the threshold distance D_{rs} beyond which agglomeration forces are no longer present is even *lower* than for the set of benchmark parameter values.

Chart 3 summarizes our findings. The top panel of chart 3 gives for our three respective break points the relative threshold distance D_{rs}/D_{rr} and the bottom panel does the same for the external distance D_{rs} under the assumption that the internal distance is 42 km.

[13] Our third conclusion is in line with the findings by Crozet, 2004, table 6). He conducts a similar analysis the major difference being that the break point analysis is limited to the Krugman (1991) model (the break condition (8) with μ=η=0) and the fact that Crozet estimates his model for 5 EU countries (for each country separately).

Chart 3: Break Points and Threshold Distances





Note: Top panel: ε=9.53, γ=0.19; Bottom panel: ε=9.53, γ=0.19 , D_{rr}=42 km. Benchmark parameter values: μ=0.3, η=200, δ=0.1

Source: Authors' calculations.

To put our results into perspective, in the *Appendix* we estimate a simple market potential function to get some idea about what the centre regions are in our sample of EU+ regions. We list 39 regions with the highest market potential (we stopped when London entered the list), this is, of course, rather ad-hoc but it nevertheless gives an indication as to what chart 3 implies. For these 39 centre regions, the average distance to each other is 309 km. (of these regions, the region Limburg in Belgium has the lowest average distance to the other 38 regions: 220 km.). Set against chart 3 these distances imply that *on average* agglomeration forces emanating from a centre region *r* are too small or weak to affect other centre regions. Another way to illustrate our results is to take one particular region like the "most central" region, Limburg in Belgium (with D_{rr}=18.5 km.*),* or the region with highest market potential, Nordrhein-Westfalen in Germany (with D_{rr}=69.4 km*.),* and to calculate for these individual regions their threshold distance D_{rs}. Also for these 2 regions the spatial strength of agglomeration forces is such that only a very limited number of the other 38 regions are affected. For the region of Nordrhein-Westfalen for instance, 7 (14) other regions fall within the reach of Nordrhein-Westfalen, that is have a distance to Nordrhein-Westfalen that is lower than the threshold D_{rs} that corresponds to $\varphi^{B}{}_{low}$ ($\varphi^{B}{}_{labmob}$).

To understand what we do and do not claim, it is important to be clear as to what we have done. For our sample of NUTS 2 regions, we estimate the wage equation (7') and this helps us to arrive at the free-ness of trade parameter for any region r with distances D_{rs} and D_{rr}. Once we do this we can derive region-specific free-ness of trade parameters. The NEG theory (the Tomahawk and bell-shaped curve) gives us the break-points, but only for the case of 2 regions. Solutions for these break points for the case of n>2 only exist for the case where distance is normalized (this is an innocent assumption to make as long as n=2 but no longer so when n>2 because it means assuming equidistant regions).[14]

Using our estimates for the substitution elasticity and the distance parameter from table 1 we can calculate implied threshold distances between regions r and s at which a break point occurs. This implied distance is shown in chart 3, and gives

[14] Suppose that we stick to the assumption of equidistant regions for n>2, then it can be shown (Puga, 1999, Appendix), that the number of regions (n) enters the break conditions (8) and (9) as an additional parameter. For a large number of regions, like our sample of NUTS 2 regions, the result is that when n increases $\varphi^B \approx 0$, which means that the corresponding threshold distance D_{rs} also approaches zero km. This would mean that for any real distance D_{rs} between any pair of regions we are always in the agglomeration regime. Symmetry is no longer viable (which is not very surprising in the sense that symmetry, every region having exactly a share of 1/n of the footloose production, is a rather stringent condition when n is large). Besides, it is not clear how to call an equilibrium in which n-1 regions have the same share of the manufacturing production but the n^{th} region is larger: is this symmetry or agglomeration? Most importantly, however, the underlying assumption of equidistant regions is hard to maintain for n>2 to start with. If one wants to analyse the long run equilibria and the associated break points for n>2 regions, analytical solutions do not exist and one has to restore to simulations which also has clear drawbacks.

an idea about the geographical reach of agglomeration forces. Or stated differently, these differences "indicate how far the agglomeration forces emanating from a region extend across space" (Crozet, 2004, p. 454). For a region r with an internal distance of D_{rr} , we arrive at the threshold distance D_{rs} at which the balance between agglomerating and spreading forces changes sign. We thereby establish in chart 3 for any region r for both NEG models the radius (measured by D_{rs}) within which agglomeration or spreading forces dominate. This is of course a partial analysis. An alternative approach would be to confront our estimation from table 1 with a NEG model and corresponding break-points for n regions, where n is the number of NUTS 2 regions. The difficulty with such a strategy is that we have to rely on simulations since no analytical solutions thus exist (or make sense) for the break-points in case of n>2 regions (see footnote 14).

5.1 Choosing between Models and Some Sub-Sample Estimations

The discussion so far begs the question, which of the two models is the most relevant. A priori, our preference is with the second class of NEG models, in which labor is not mobile between regions. It implies less extreme agglomeration patterns (compare charts 1 and 2). This seems more in line with the stylized facts for the EU and elsewhere. These models also incorporate the stylised fact that labor mobility is larger within countries than between countries. Having said this, we cannot dismiss the first of class of NEG models out of hand for basically three reasons:

- Both models assume wage flexibility. With wage rigidity (Faini, 1999, Puga, 2002) we return to the Tomahawk chart because agglomeration by definition does not lead to a wage differential between regions and there will be no thus wage gap (and even no wage cost differential) between core and peripheral regions.
- Wage rigidity is larger within EU countries than between EU countries, this might be relevant in deciding which (regions versus countries) which NEG model is relevant.
- Even though interregional labor mobility is relatively low in the EU (compared to for instance the U.S.A.), labor mobility is higher within than between countries and this might be relevant in deciding which class of NEG models applies for what geographical scale. Also, with increasing economic integration in the EU interregional labor mobility might increase in the future which might make the world of the Tomahawk curve more relevant.

Given the stylised facts on wage rigidity and labor (im)mobility within the EU, does this mean that the “bleak conclusions” of the Tomahawk model as to the impact of ongoing economic integration on agglomeration are pervasive? No, not necessarily. One can think of alternative congestion forces for core regions besides higher wages that also give rise to a bell-shaped curve even with (!) interregional labor mobility. The best example is due to Helpman (1998) and Hanson (2001) where instead of immobile workers (a non-traded input) we have a non-traded consumption good, in their case housing but one think of various non-traded services of which the price rises when agglomeration increases. This can be looked upon as agglomeration costs. Ottaviano, Tabuchi and Thisse (2002) show that such a non-traded good may act as a powerful dispersion force that may act as a brake on agglomeration.[15]

Finally, and partly inspired by the relevance of the workings of the labor market, we checked whether our estimation results and hence the conclusions with respect to the implied free-ness of trade φ would change if we (i) changed the sample period; (ii) estimated wage equation (7') for a sub-set of countries. To start with the first issue, recall that the estimation results in table 1 are based on a pooled estimation for all EU regions for the period 1992–2000. We also estimated wage equation (7') for each of these years separately. Assuming that the degree of economic integration in the EU, if anything, increased during the 1990s, one might expect the degree of competition as measured by the mark-up of price over marginal cost, $\varepsilon/(\varepsilon\text{-}1)$, to fall and thus the substitution elasticity ε to fall overt time. Similarly, one might expect the distance parameter γ to fall during these years. It turns out that, however, that both substitution elasticity and the distance parameter hardly change over time. This also means that the implied free-ness of trade parameter hardly changes over time. For our preferred estimation procedure (WLS, 2SLS) for instance, we got (t-value between brackets) for ε a coeffcient of 10.1 (11.4) and 8.9 (10.8) for respectively the period 1992–1995 and 1997–2000, and similarly for γ a coeffcient of 0.18 (14.5) and 0.20 (14.4).

As indicated above, the degree of interregional labor mobility and wage flexibility is important in deciding which of the 2 models is more relevant. National labor market institutions are important determinants of labor mobility and wage flexibility and these institutions differ markedly between EU countries. In corporatist countries for instance there is coordination of wage bargaining with relatively little room for interregional wage differences and, if anything, interregional labor market adjustments have to be realized through labor mobility. Relatively, that is to say compared to non-corporatist countries where there is ceteris paribus more room for interregional wage differences. This would imply that the Tomahawk (Bell curve) model seems more relevant for corporatist (non-corporatist) countries. We have therefore also estimated wage equation (7') for the period 1992–2000 for a group of corporatist countries (Belgium, Germany, Netherlands, Austria, Sweden, Denmark and Ireland) as well as for a group of non-corporatist countries (UK, France, Spain, Portugal, Italy and Greece).[16] For both

[15] The key here for the possibility of (renewed) spreading at low trade costs (a large φ) arises in NEG models when the strength of the spreading or congestion forces do not fall when trade costs fall: "with any (…) congestion force unrelated to trade costs, the equilibrium pattern of location will return to dispersion for some (low) trade costs threshold" (Head and Mayer, 2004a, p. 2652).

[16] The classification is based on Schramm (1999).

groups the estimation results for ε and γ are such that the relative threshold distances D_{rs}/D_{rr} that correspond to the three φ break points (given the estimates for ε and γ), see chart 3, are nearly the same as those shown in chart 3. Also, using other criteria to split the sample into groups of countries, like the size of countries (area per km^2), showed that our conclusions w.r.t. the implied relative threshold distance, as shown by chart 3, are quite robust.

6. Bilateral Country Trade Flows and Sector φ's

Our estimations are based on *aggregate* data for each *NUTS 2* region. That is to say, we did not use regional data on the distribution of wages, valued added or other variables for the various *sectors* in a region. The reason is simply that these data are not available at the NUTS 2 level. In order to arrive at an "educated guess" what the free-ness of trade parameter could look like for various manufacturing *sectors* for the EU, we follow Head and Mayer (2004a). They explain that the free-ness of trade parameter can be approximated through the use of bilateral trade and production data. These data are available at the *country* level (and, not at the EU regional level). Based on Head and Ries (2001), they define a very simple estimator for the free-ness of trade parameter which can be derived from any basic NEG model:

$$\varphi\text{trade}=\sqrt{m_{ij}m_{ji} / m_{ii}m_{jj}}$$

where the numerator denotes the imports of country i from country j and vice versa; the denominator denotes for both country i and country j the value of all shipments of a industry minus the sum of shipments to all other countries (Head and Mayer, 2004a, p. 2618)

If the bilateral trade between these 2 countries is relatively important (unimportant), φ_{trade} is relativey high (low): $0<\varphi_{\text{trade}}<1$. The advantage of this "estimator" for the free-ness of trade parameter is that no actual estimations are required. Head and Mayer calculate φ_{trade} for 21 industries and two country pairs (Canada/U.S.A. and France/Germany) for 1995 and then confront their implied free-ness of trade parameter with *industry-specific* Bell curves. These are derived by plugging in industry-specific values for the respective parameters in the break condition (9).[17] The main result is that, almost without exception, for each of the 21 industries φ_{trade} is rather low (in the range of 0.1–0.2) to the effect that for both

[17] For the data-sets and the actual values used to come up with industry specific measures for the intermediate input share, the labor supply elasticity, the share of manufacturing gods in total expenditure, and the substitution elasticity for manufactures (a.k.a. the increasing returns parameter) see Head and Mayer (2004a, pp. 2664–2665).

pairs of countries most industries are still to the left of the Bell part: that is, $\varphi_{trade} < \varphi^{B}_{low}$.

We applied Head and Mayer's methodology for the case of the EU to see how our results compared to their findings and also to see if our main conclusions from the previous section carry over to the sector level. In our first experiment we took Germany as our benchmark country and paired Germany with 3 other EU countries (Spain, UK, and the Netherlands) and with a new EU member (Poland). Using as much as possible the Head and Mayer sector classification (see table 4 below) we calculated φ_{trade} for the 4 country pairs for the years 1985, 1990, 1994 and 1998. For the first 3 years we used World Bank data and for 1998 we used the OECD STAN data. Data for Poland were only available for 1990 and 1994. In line with the findings by Head and Mayer, the respective values for our φ_{trade} gradually increase over time but they remain relatively low. Only for a few sectors we came up with a φ_{trade} that exceeds the break point φ^{B}_{low} in the Bell-curve model and φ_{labmob} in the Tomahawk case. The sectors with agglomeration in some years are clothing, wood, plastics and drugs, ferrous metals, and transport. The overall picture is, however, one of a "pre-agglomeration" degree of economic integration (results not shown here but available upon request).

Table 3: Sector-Specific Free-ness of Trade

IOcode	*Sector*	φ_{trade}	φ^{B}_{low}	φ^{B}_{labmob}
1	Agriculture	0.027	NA	NA
2	Energy	0,012	NA	NA
3	FoodBevTobacco	0.047	0.46	0.22
4	Clothing	0.1355	0.21	0.18
5	Wood	0.046	0.39	0.36
6	Paper	0.033	0.17	0.16
10/8	Plastics and Drugs	**0,127**	0.109*	0.104
9	Petro	0.017	symm	0.71
11	Minerals	0.036	0.47	0.44
12	Ferrous metals	**0.038**	0.0**	aggl
13	Non-ferrous metals	0.029	0.09	0.06
14	Fab. Metals	0.050	symm	0.69
15/16	Machinery (and Computers)	0.253	0.43	0.36
17	Electrical	0.090	0.67	0.39
19/20	Ships/railroad/transport***	0.0112	0.46	0.39
21	Vehicles	**0.132**	0.10****	0.08
23	Instruments	0.0155	0.57	0.45
18	Services	0.162	NA	NA

*Note: * $\varphi_{bell\text{-}top}$=0.545; ** $\varphi_{bell\text{-}top}$=0.50; **** $\varphi_{bell\text{-}top}$=0.49*
****=based on railroad which has lowest φ^{B} of these 3 sectors in Head and Mayer, 2004a*
NA=not available; symm= local stability of symmetric equilbria for all values of φ;
aggl= only full agglomeration stable.

Our second experiment was to compute φ_{trade} for the bilateral sector trade between the group of 15 EU countries versus the group of 10 accession countries, the new EU members from central and eastern Europe. Based on GTAP data for 1997, table 3 gives the computed free-ness of trade parameter φ_{trade} and compares this implied degree of economic integration with the two break-points φ^B_{low} (the Bell-curve model) as well as with φ_{labmob} (the Tomahawk model). The parameter values needed for the derivation of these 2 break-points for the various manufacturing sectors are taken from Head and Mayer (2004a, Appendix). For "non-manufacturing sectors" agriculture, energy and services such a theoretical benchmark was not readily available. For the manufacturing sectors the overall conclusion must be that the degree of economic integration for most sectors is such that we are not (yet) in the agglomeration regime. The exceptions are (see the scores in bold) Plastics and Drugs, Ferrous Metals, and Vehicles. However, even for these 3 sectors the free-ness of trade parameter is such that these sectors are only at the start of the upward sloping part of the Bell curve (see the respective $\varphi_{bell\text{-}top}$ values which gives the peak of the Bell curve for these sectors).[18]

In our view the results in table 3 with a free-ness of trade parameter based on bilateral trade data on the *country* level are in line with our calculations of φ for the case of the NUTS 2 regions. In the previous section it was only for regions that are relatively near to each other (in terms of D_{rs}/D_{rr}), that we found it possible to come up with implied values for φ that clearly exceeded the φ break-points for our two benchmark NEG models.[19]

7. Conclusions

The estimation of the equilibrium wage equation from a model by Puga (1999) for the EU *NUTS 2* regions yielded information on the so called free-ness of trade parameter, the NEG variable that stands for the degree of economic integration. The confrontation of the estimated free-ness of trade parameter with our two theoretical benchmarks as to the relationship between economic integration and agglomeration led us to conclude that the agglomeration regime is only relevant for regions that are relatively close to each other. At least in our 2 region setting, agglomeration seems to be a rather localized phenomenon. This last conclusion

[18] Where $\varphi_{bell\text{-}top}$ is simply taken to be the midpoint $\dfrac{\phi^B_{low} + \phi^B_{high}}{2}$

 Compared to our calculations for the 3 break points in the previous section, the most notable difference is that in table 4 φ^B_{labmob} is on average larger. This is mainly due to the fact that Head and Mayer assume that the share of manufactured goods (which in their case refers to the share of the goods produced by a specific sector only) is smaller that the benchmark of δ=0.1 that we used in the previous section (a lower δ ceteris paribus means weaker agglomeration forces).

was substantiated by free-ness of trade estimations based on bilateral trade data on the EU country level.

Where does this leave us? In our view the main findings of this paper are in line with the notion that agglomeration in the EU seems to be most relevant at lower geographical scales. Our findings are also in line with related studies like Davis and Weinstein (1999), Forslid et al. (2002), Midelfart et al. (2003), Head and Mayer (2004a) and, also in terms of the methodology employed, Crozet (2004). The relevance of the proximity of agglomeration effects is also underlined by Brülhart, Crozet, and Koenig (2004) w.r.t the impact of the EU enlargement and its impact on incumbent EU regions. In their survey Head and Mayer (2004a) conclude that it seems that agglomeration forces are very localized, unable to generate core-periphery patterns in Europe at a large geographical level at least as long as labor remains so sensitive to migration costs. Our results back up this conclusion and they also show that if the degree of interregional labor mobility would increase (in our terms a move from the Bell curve towards the Tomahawk) that the geographical reach of agglomeration forces would increase. Finally, and this must be emphasized, even though we have gone at some length to take the NEG theory seriously empirically, these are very much preliminary results. Clearly, more research is needed in order to tell which NEG model is the most relevant at which geographical scale for the EU. As such, our results are very much illustrations of the potential empirical relevance of the NEG approach. Nevertheless, the main findings are interesting because they constitute, to our knowledge, one of the first attempts to confront estimations of the key structural NEG model parameters with theoretical NEG predictions as to how economic integration may impact upon the spatial distribution of economic activity. There is much that can be done to improve upon our initial findings. In this respect the NEG approach needs to be taken even more seriously. Two avenues of research come to mind. The first one is to come up with NEG models that incorporate key features like the difference between interregional and international labor mobility within a single model (see Behrens et al., 2003, Crozet and Koenig, 2002). This might lead to additional testable hypotheses that allow for a better choice between various NEG agglomeration mechanisms. The second one is simply to engage in better testing by making use of (econometric) insights from outside NEG proper and by making use of new (micro) data sets that are increasingly becoming available (Fingleton, 2004, Combes and Overman, 2003).

Appendix

A1. Data Description

Nominal wage is defined as compensation of employees per worker (NUTS 2 level, except for Germany – NUTS 1).

The measure of regional purchasing power is gross value added (all sectors). Time series are nominalised by using the GVA-series of Cambridge Econometrics, which are denominated in euro's of 1995, and the price deflator of national GDP (AMECO-database).

In the RMA we included the NUTS 2 regions of EU14 (=EU-15 excluding Luxembourg) + Norway, Czech Republic, Poland, Hungary, Switzerland. MPL (marginal labor productivity) is proxied by real gross value added per employee. EU+= EU 14 (= EU excluding Luxembourg) + Norway, Switzerland, Hungary, Poland, Czech Republic. For the approximation of the price index I_r see the appendix.

For wages we used the EU 14 only. All wage, income and production data are taken from The European Regional Database (summer 2002 version) from Cambridge Econometrics.

Distance is in km.

A set of additional control variables for each NUTS 2 region that potentially consists of mean annual sunshine; mean elevation above sea-level; and dummy variables (country dummy, border-region dummy, access to sea dummy, access to navigable waterway dummy). The variables mean annual sunshine radiation in kWh/m² (sunshine) and mean elevation above sea-level in metres are taken from the SPESP database
(see:http://www.mcrit.com/SPESP/SPESP_reg_ind_final%20report.htm).

A2. Introducing Regional Factor Productivity Differences in the Model with Intermediate Inputs

Free entry and exit and the use of the zero-profit condition leads to the equilibrium output for firm *i* in region *r*:

$$x_{ir} = \frac{\alpha.(\varepsilon - 1)}{\beta_{ir}}$$

The point to notice is here is that the marginal input requirement β_{ir} is now region specific which means that factor productivity can differ between regions. Suppose the regional factor productivity gap can be approximated by the difference in marginal labor productivity in region r and the average of the marginal labor productivity for the EU NUTS 2 regions

We define $MPL_{EU+}/MPL_{ir}=\beta_{ir}$

The equilibrium demand facing each firm *i* is

$$x_d = \frac{p^{-\varepsilon}}{I^{(1-\varepsilon)}} Y$$

Summing over all firms, using the mark-up pricing rule $p = \frac{\varepsilon}{\varepsilon - 1}\beta_r W^{1-\mu} I^{\mu}$, and taking iceberg transportation costs into account gives:

$$x_r = \sum_{s=1}^{R}\left[\left(\frac{\varepsilon}{\varepsilon-1}\frac{W_r^{1-\mu} I^{\mu} T_{rs}\beta_r}{I_s}\right)^{-\varepsilon} T_{rs}\frac{Y_s}{I_s}\right]$$

where T_{rs} is transportation costs, and I is the price index of manufactures.
This expression is equal to the break-even supply of each firm:

$$\frac{\alpha.(\varepsilon-1)}{\beta_r} = \left(\frac{\varepsilon}{\varepsilon-1} W_r^{1-\mu} I^{\mu}\beta_r\right)^{-\varepsilon}\sum_{s=1}^{R}\left[\left(\frac{T_{rs}}{I_s}\right)^{1-\varepsilon} Y_s\right]$$

The wage in region *r* determined by solving this break even equation for the wage W_r, and this gives:

$$W_r = \beta_r^{\frac{1-\varepsilon}{\varepsilon.(1-\mu)}}\varepsilon^{\frac{1}{\mu-1}}(\varepsilon-1)^{\frac{\varepsilon-1}{\varepsilon.(1-\mu)}} I_r^{-\mu/(1-\mu)}\alpha^{\frac{-1}{\varepsilon.(1-\mu)}}\sum_{s=1}^{R}\left[\left(\frac{T_{rs}}{I_s}\right)^{1-\varepsilon} Y_s\right]^{\frac{1}{\varepsilon.(1-\mu)}}$$

where $I_r=[\sum(T_{rs}\, p_s)^{1-\varepsilon}]^{1/(1-\varepsilon)}$

The log transformation of this expression results in the log transformation of wage equation (7), equation (7') in the main text:

$$\log(W_r) = \text{constant} + \frac{1-\varepsilon}{\varepsilon.(1-\mu)}\log(\beta_r) - \frac{\mu}{1-\mu}\log(I_r) + \frac{1}{\varepsilon.(1-\mu)}\log\left[\sum_{s=1}^{R} Y_s (T_{rs})^{1-\varepsilon} I_s^{\varepsilon-1}\right]$$

The productivity gap β_r is thus measured as $MPL_{EU+}/MPL_r=\beta_r$

To really be able to estimate this specification of the wage equation we finally need to approximate the price index *I*

A3. How to Approximate the Price Index I?

For the model without intermediate inputs (μ=0), we do so as follows:

For each region we focus on two prices: the price in district *r* of a manufactured good produced in district *r* and the *average* price outside district *r* of a manufactured good produced outside district *r*. The determination of the simplified local price index for manufactures requires a measure of distance between region *r* and the regions outside. The distance from the economic center is an appropriate measure in our view. This center is obtained by weighing the distances with relative Y. Here we make use of the estimation results based for a simple market-potential function for our sample of EU *NUTS 2* regions. Regions with largest market-potential MP, see table A1, are considered to be centres where for each region its MP is defined as:

$$MP = \log\left[\sum_s Y_s e^{-\kappa_2 D_{rs}}\right]$$

Table A1: Regions with Largest Market Potential, 1995 Data (in Descending Order of Market Potential)

1995	κ_2= .007
1	Nordrhein-Westfalen
2	Limburg
3	Limburg(B)
4	Luik
5	Noord-Brabant
6	Vlaams-Brabant
7	Baden-Württemberg
8	Rheinland-Pfalz
9	Gelderland
10	Antwerpen
11	Waals-Brabant
12	Brussel
13	Namen
14	Utrecht
15	Ile de France
16	Oost-Vlaanderen
17	Hainaut
18	Bayern
19	Zuid-Holland
20	Zeeland
21	Nord-Pas de Calais
22	Saarland
23	Luxembourg(B)
24	West-Vlaanderen
25	Picardie
26	Champagne-Ard.

27	Alsace
28	Noord-Holland
29	Overijssel
30	Flevoland
31	Niedersachsen
32	Lorraine
33	Vorarlberg
34	Ostschweiz
35	Zurich
36	N_W Schweiz
37	London
38	Kent
39	Zentralschweiz

The distance between a region r and the nearest center region (out of the list of the 35 regions with the largest MP for the *NUTS 2* regions, see table A1) gives us $T_{r,center}$ in the equation below:

$$I_r = \left[\lambda_r W_r^{1-\varepsilon} + (1-\lambda_r)\left(\overline{W}_r T_{r,center}\right)^{1-\varepsilon}\right]^{1/1-\varepsilon},$$

where $\overline{W}_r$ is the average wage outside district *r*, and weight λ_r is region *r*'s share of employment in manufacturing, which is proportional to the number of varieties of manufactures (λ is proxied by (regional employment) / (EU+employment)).

This simplified price index makes it possible to directly estimate our specification of the wage equation with factor productivity differences and *without* intermediate inputs.

The productivity gap between EU regions and the EU average also affects the price index equation, because marginal costs changes into (with μ=0):

$$MCir = Wir\beta ir,$$

and so the simplified price index equation finally becomes –dropping subscript *i*:

$$I_r = \left[\lambda_r (W_r \beta_r)^{1-\varepsilon} + (1-\lambda_r)\left(\overline{W} T_{r,center}\right)^{1-\varepsilon}\right]^{1/(1-\varepsilon)}.$$

Now we are ready and our specification for the wage equation from the main text for the case of μ=0 and hence with the above approximation for the price index.

For the model with intermediate inputs this "trick" to approximate the price index, now the price index for *intermediates*, will not do as easily. The reason is that the equilibrium price index is now not only a function of wages but also of itself:

$$I_r = \left[\sum_{s=1}^{R} \frac{\varepsilon}{\varepsilon - 1} \beta T_{rs} W^{1-\mu} I^{\mu} \right]^{1/(1-\varepsilon)} \tag{3''}$$

This follows directly from the fact that we now have two factors of production (labor and the intermediate goods) and that the equilibrium price a manufacturing firm charges is

$$p = \frac{\varepsilon}{\varepsilon - 1} \beta_r W^{1-\mu} I^{\mu}$$

As a result the equilibrium price index, the summation of the price each firm charges corrected for distance (the suppliers access variable), is a function of both the wage *W* and the price index *I*.

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The Use of Geographical Grids Models in NEG: Assessing the Effects of EU Integration

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1. Introduction

Since its birth with Krugman (1991, 1993) the growing New Economic Geography (NEG) literature has made substantial progress in theoretical adjustments and refinements. Almost inevitably, concentrating on this means that the implementation of realistic empirical models has been receiving less attention. On of the main gaps to fill is the introduction of a realistic geographical space, a first attempt of which has been Stelder (2005a/b). After the phase of model calibration adjustments in this space can then be introduced as a change of the socio-economic context of the agglomeration process. This allows us to simulate what will happen to regional development and spatial agglomeration when new infrastructure is build and /or countries are joined into more economically integrated groups. This paper gives a rough summary of how this can be done in practice and what are the main obstacles ahead that need to be solved in order to achieve realistic geographic agglomeration models that can be used for forecasting and or policy simulation. In section 2 the use of a geographical grid in an NEG model is briefly summarized. Next, section 3 presents some abstract simulation examples of economic integration. Finally, in section 4 an application for a large model for Europe and Japan is outlined.

2. Geographical Grids in an NEG Model

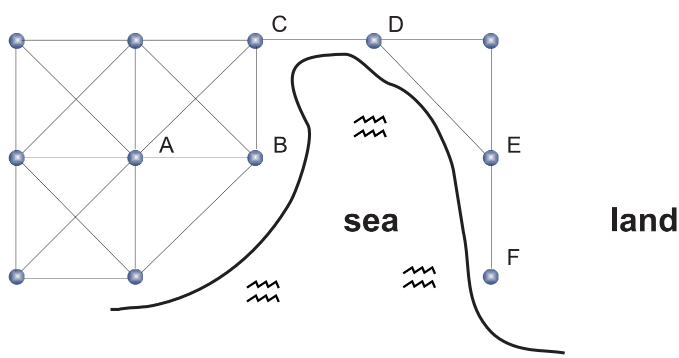
Our starting point is the basic multiregional NEG model presented in Krugman (1993) who uses a discrete system of *n* locations located on a circle at equal distance from each other[1]. Labour is the only production factor and the economy is divided into two sectors, one geographically fixed sector that does not move to other locations, usually referred to as "agriculture", and a footloose sector called

[1] Later NEG models, such as presented in Venables (1996), Helpman (1998) and Fujita, Krugman and Venables (1999), are not discussed here. Technically, the introduction of a geographical grid in these models would be exactly the same as for the basic model.

"manufacturing" that can choose its optimal location. The starting assumption of zero agglomeration means that each location has a share of $1/n$ of national manufacturing labour (μ) and agricultural labour ($1-\mu$). Under the assumption of monopolistic competition (Dixit and Stiglitz, 1977), consumers like varieties, every product variety is produced by only one firm, and firms and workers tend to migrate to regions where many manufacturing firms are concentrated. Depending on the substitution elasticity σ, workers benefit from a higher real wage in larger cities where more product varieties are produced. The counterforce of this concentration process is transportation costs. Both agricultural and manufacturing workers consume products from other regions under the Samuelson iceberg assumption: when a good travels a distance D, only a fraction of $e^{-\tau D}$ arrives. Long-term equilibrium is achieved when real wage has become the same in all regions and there is no further incentive to migrate[2]. The three basic parameters that determine the outcome are the share of manufacturing labour μ, the transportation cost parameter τ, and the substitution elasticity σ.

In order to transform this model into a geographical one we need three modifications. First, instead of the circle, we use a discrete grid of equidistant locations in the two-dimensional economic plane. With GIS techniques we can put the geographical shape of a country as an overlay on this grid. The result is a "cloud of dots" that represents our economic space just as we would have cut the shape of the country out of a piece of gridline paper. Chart 1 shows the example of a bay cutting out some locations from the grid.

Chart 1: A Grid of Locations in Geographical Space



Source: Stelder (2005a).

Next, assume that each location is connected with all its direct neighbours on the grid, either by a horizontal or vertical road with distance 1 like (A,B) or (B,C), or a

[2] See Stelder (2002), Krugman (1993) or Fujita, Krugman and Venables (1999), chapter 4, for the full description of the basic model.

diagonal road with distance √2 like (A,C). The starting assumption is that there is no sea transport possible so transport from A to F must go over land along the coast. This condition will be relaxed later. Finally, the model needs a shortest path algorithm (SPA) finding its most efficient way through the grid for any pair of two locations *p* and *q*:

$$D1(p,q) = \sqrt{[(pi - qi)2 + (pj - qj)2]} \tag{1}$$

$$\text{if } D1(p,q) > \sqrt{2},\ D1(p,q) = z \tag{2}$$

with *z* being a very large number. The matrix D_1 resulting from (1)–(2) will have entries of 1 for all direct horizontal and vertical neighbours, √2 for all direct diagonal neighbours and *z* for all other combinations of *p* and *q*. From D_1 we derive the final distance matrix D_2 by

$$D2 = SPA\ (D1) \tag{3}$$

using the shortest path algorithm of Floyd (1985). In the simple case of chart 1 transport from A to F will pass C, D and E and total distance will be 2+2√2.

The model can now be run using distance matrix D_2. In order to get a first impression of its behaviour let us take a look at chart 2a–d. It shows the results of four experiments with an 8x11 rectangle and a peninsula added on the southeast side of size 2x5. We could think of this economic space with a total of 98 possible locations as a simple model for the U.S.A., where the peninsula represents Florida.

The assumed initial distribution is zero agglomeration or what can be mentioned as the "no history assumption": the model starts with each location having an equal share of national agricultural and manufacturing labour. Another way of putting it is "in the beginning there were only little villages". The prime purpose of this type of simulation is to get a pure assessment of the influence of the geographical space on the economic agglomeration tendencies in the country without any historical distribution to start with. We will return to this issue later.

Chart 2a is the result of a first run with a strong concentration bias (low τ value). Two large cities emerge, but not symmetrical because the eastern city is draw down by the "Florida market". All manufacturing labour has concentrated in these two cities. The remaining grid points have become true "villages" in the sense that only their immovable agricultural sector has remained. If we assume a less extreme concentration bias by changing σ into 6 and τ into 0.3, the result is two three-city belts in the north and the south (chart 2b). Because of the Florida market, the southern city in the East is larger than its northern counterpart while the two western cities are of equal size. In addition, as would be expected, something like the city of Miami emerges in the south of the peninsula as a smaller seventh city that, despite its smaller size and scale economies, remains competitive with the other larger cities due to its remote position. Next, if transportation costs are again raised one point from 0.3 to 0.4 the pattern starts to shift and becomes less symmetrical (see chart 2c). Another city emerges in the mid-west and the two largest centre cities move away from each other creating some like a Chicago/Detroit and a Dallas/Houston agglomeration. In Florida a second smaller city is formed in the northwest, but not at the cost of Miami, which remains of the same size.

Chart 2a: μ=0.3, σ=5, τ=0.2

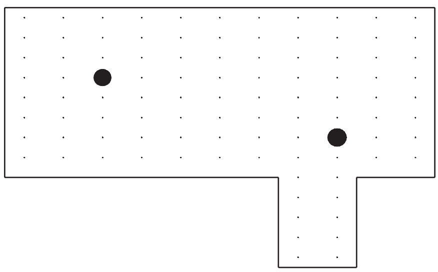


Chart 2b: μ=0.3, σ=6, τ=0.3

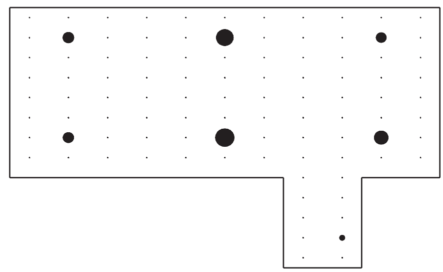


Chart 2c: μ=0.3, σ=6, τ=0.4

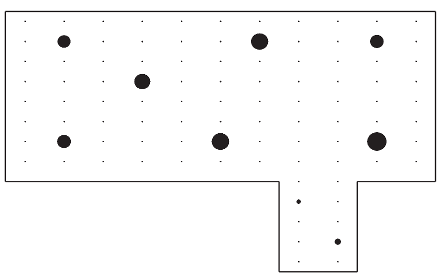
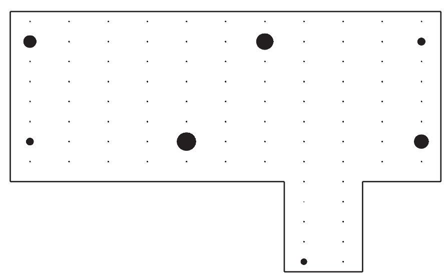


Chart 2d: μ=0.3, σ=6, τ=0.3, foreign trade

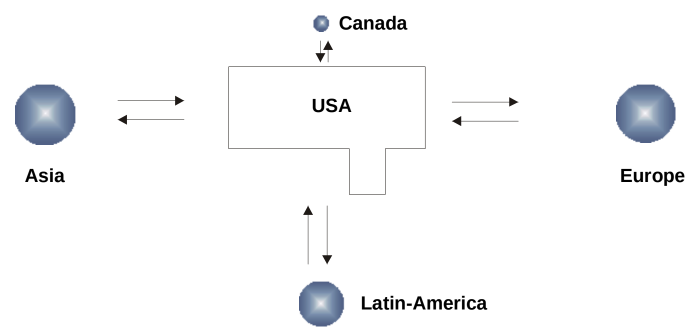


Source: Stelder (2005a).

The reason why there are no large cities along the east- and west coast is because we do not assume any locational advantages of coast locations as possible harbours and because there is no foreign trade. Chart 2d shows how the city distribution changes compared to chart 2b when trade with the outside world comes into effect leading to agglomerations along the borders. We have chosen the easiest way to do this by simply giving all locations along the east coast and the west coast, and the two most southern locations of Florida a twice as high value in the initial distribution. This gives them an initial advantage in economies of scale over all other locations. The result shows that harbour cities now enter the equilibrium, including the Miami city, which in turn causes the two agglomerations in the middle again to move in opposite direction away from each other.

Of course this solution is not very satisfactory because giving locations along the coast a higher initial value is telling the model what you want it to tell you[3]. A better alternative would be to add the main foreign trade partners as extra locations proportional to their economic size at the correct distance (see chart 3). In this grid model all locations along the border can be given a straight connection to the foreign trade partners. For all other inland locations the shortest path algorithm can then decide through which border location (port) their foreign trade flows will go.

Chart 3: Integration Example 1: Adding Foreign Trade



Source: Stelder (2005a).

The model in chart 3 now would have 102 locations: the 98 locations on the U.S.A.-grid and four extra locations representing the foreign trade partners. The constraint on the model should be that only the internal city distribution of the U.S.A. is endogenous while keeping the relative size of the U.S.A. as a whole and the foreign trade countries constant. In other words: all eight import- and export flows are kept constant of which each U.S.A. city takes its endogenous share.

The approach in chart 3 can now be seen as a first simple option of how economic integration can be handled in a NEG model. It shows how the opening up of international borders of a country can effect domestic regional development and spatial agglomeration trends.

3. Real Geographical Grids: A Model for Europe

Having set out the basic structure of a geographical agglomeration model, the next step towards a real empirical model is pretty straightforward. The actual geographical shape of a country can now be approximated by the same type of base grid of equidistant locations combined with a geographical map.

[3] In the same way we could instruct the model to come up with larger agglomerations in the North-East because that is where the historical inflow of immigrants started.

Because of its differentiated geographical shape, Western Europe seems a promising and interesting case to test the explanatory power of the model. Just as the number of pixels in a digital picture, the accuracy of modelling an economic space of a particular shape is determined by the resolution of the grid. Our current computational limits allow us a maximum number of around 2700 locations. Chart 4 shows the grid of the basic model with 2637 locations created from an overlay of a high resolution square grid and a geographical map[4]. The borders are chosen along the former Iron Curtain, but with unified Germany included. Ireland and Great Britain are included but Scandinavia and the Balkan are left out. These choices are purely pragmatic. Dividing the present computational maximum over Scandinavia and the Balkan as well would make the grid resolution too low.

First, the colours in chart 4a–b shows that geographical altitude is included, so natural barriers like mountains can be reflected in D_1. With GIS each location p_{ij} is modified to p_{ijk} with the third height dimension k indicating the local altitude. Equation (1) – (3) is thus replaced by:

$$D_1(p,q) = \sqrt{[(p_i - q_i)^2 + (p_j - q_j)^2 + (p_k - q_k)^2]} \tag{4}$$

$$\text{if } \sqrt{[(pi - qi)2 + (pj - qj)2]} > \sqrt{2},\ D1(p,q) = z \tag{5}$$

$$D2 = SPA\ (D1) \tag{6}$$

It should be noted that in a low-resolution model some height barriers might not enter the grid because a mountain top may fall right between two low grid locations. In such a case the distance and consequently the transportation costs between the two locations are underestimated[5]. In chart 4b the grid resolution is detailed enough to capture the main height barriers of the Alps and the Pyrenees.

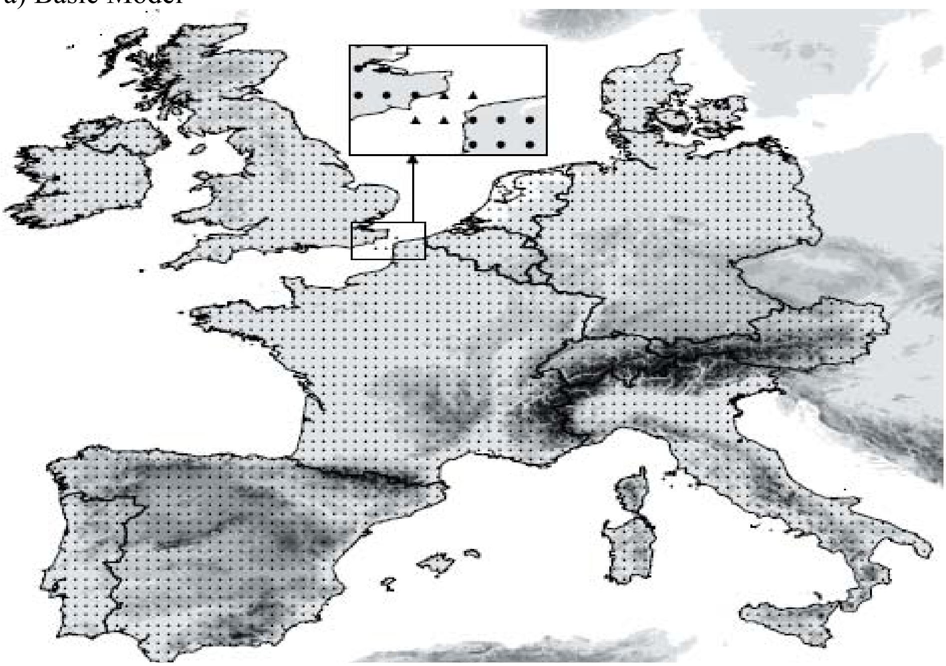
Next, sea transport is enabled at specific points as extra grid locations along which the shortest path function SPA can find its way, but which are excluded as possible locations in the equilibrium. The inlay in chart 4a shows these "transport only locations" between Great Britain and France. In the basic model version connections are added in the same way between Northern Ireland and the Glasgow region, between the two main islands in Denmark, and between Sicily and the Italian mainland. Note that Mallorca, Corsica, Sardinia and other smaller islands are isolated groups of locations in the model and therefore cannot trade with other locations.

[4] The grids in chart 4 are projected as a flat surface. This is an abstraction because in reality it is impossible to draw an equidistant grid on a round globe surface.

[5] Transportation across mountains can be given an extra weight indicating higher costs. See Stelder (2005a) for more details.

Chart 4: A Geographical Grid for Europe

a) Basic Model



b) Extended Model

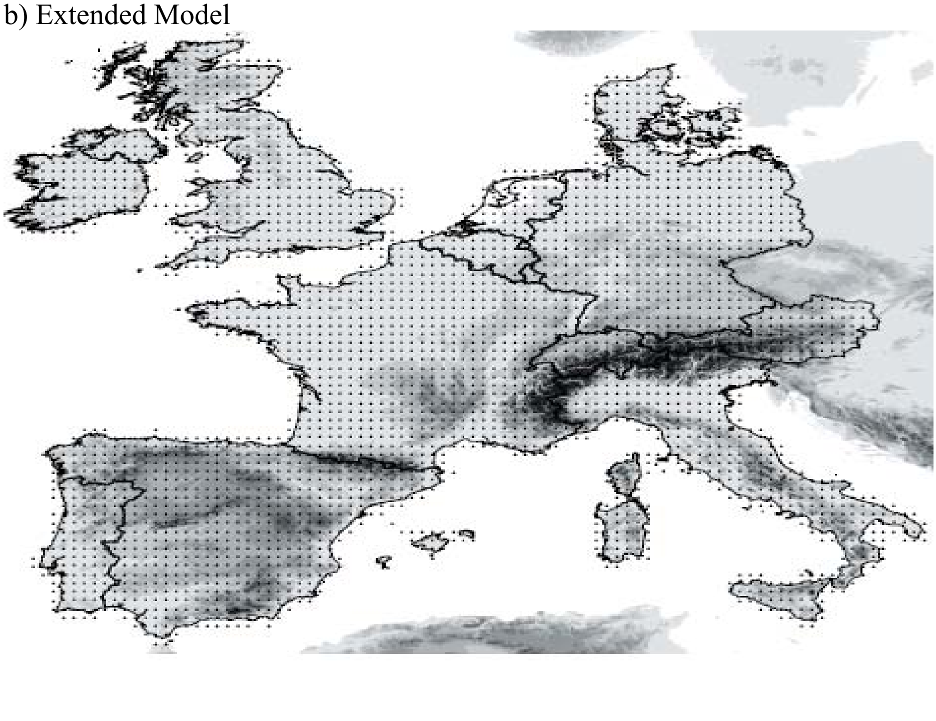


Chart 4b shows an extended model version allowing sea transport along the coasts and from/to all islands. Again, a pragmatic choice had to be made. The grid cannot be extended over sea too much because we do not want the network to become too large[6]. A differentiation between the two transportation modes can be achieved through replacing D_2 in (6.6) by

$$D3(p,q) = \alpha \; D1 \; (p,q) \tag{7}$$

and

$$D4 = SPA \; (D3) \tag{8}$$

with

$\alpha = 1$ if p and q are both land locations
$\alpha = \beta_1$ if p is a land and q is a sea location or vice versa
$\alpha = \beta_2$ if p and q are both sea locations

Parameter $\beta_1>1$ is a "transhipment mark-up" representing extra costs of (un)shipping in a harbour. Parameter β_2 indicates whether sea transport is relatively more or less efficient than transport across land. In the basic model (chart 4a) β_1 and β_2 are both set to 1 assuming toll-less bridge connections from and to all sea locations. In the extended model (chart 4b) β_2 can be set lower to 1 in order to take account of the historical influence of earlier centuries when water transport was the most efficient mode. Specific connection costs like toll-levies for the Channel were not used but may be entered ad hoc in D_1. It is clear that in this way the agglomeration effects of a wide range of infrastructure investments can be simulated[7].

The choice between model a) and b) and the setting of matrix D is yet another option for economic integration analysis. When land transport becomes more efficient, which is typical for the transition period around 1850–1900 with the introduction of railroads, the comparative economic efficiency between regions and cities start to change. In addition, EU integration in more recent times can be handled by reducing transport costs in matrix D at those locations where international borders are crossed. For illustration purposes, however, let us first look at the model behaviour as a simple comparison between model a) and b) and a first evaluation of how relevant the geographical structure of the model is for the predicted agglomeration forces.

[6] The calculation of the matrix of all shortest paths is the main limitation.
[7] The effects of a high speed train connection in the Netherlands was modelled in this way by Knaap and Oosterhaven (2000). A comparable study is being undertaken in the EU-funded IASON project, aimed at simulating the regional economic effects of a new transeuropean infrastructure network. See Bröcker et al. (2002) for more details.

Chart 5: (S1) Basic Model (n=130), τ=0.45, μ=0.55, σ=5

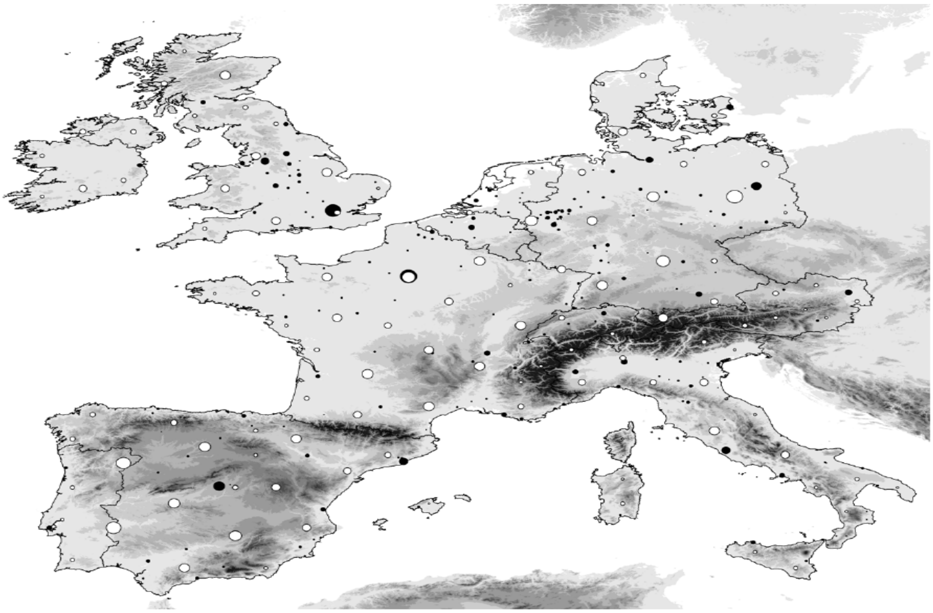
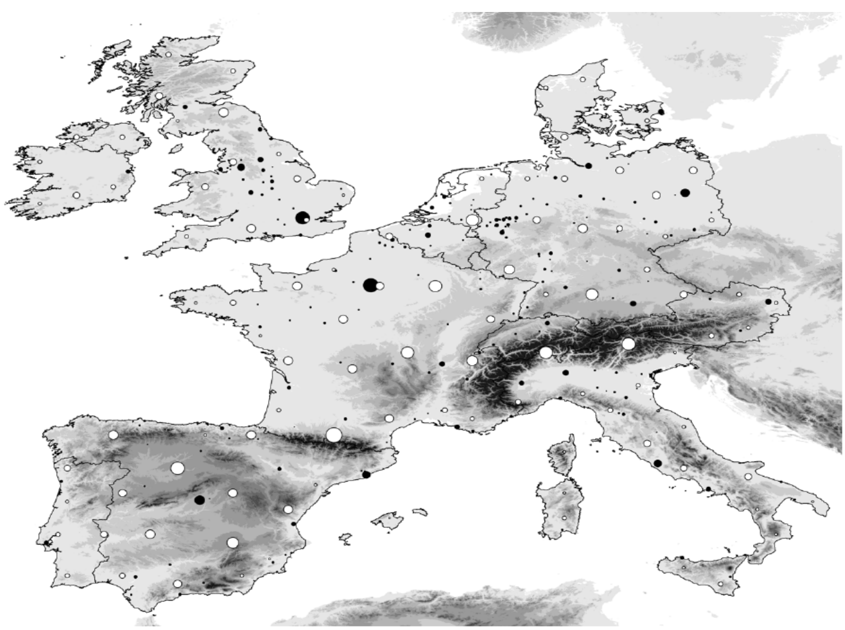


Chart 6: (S2) Basic Model (n=115), no Altitude, τ=0.45, μ=0.55, σ=5



Experiments with different parameter configurations for abstract grids have shown that equilibria which are not extremely dispersed or concentrated are usually found with values in the range of 0.35-0.45 for τ, 0.45–0.55 for μ and 4.5–5.5 for σ. Both the basic and the extended model were calibrated for different parameter configurations in order to find the maximum possible fit with reality, which will be discussed in the next section.

Chart 5 (simulation S1) shows an equilibrium of 130 cities with τ=0.45, μ=0.55 and σ=5. The white dots are the model results plotted proportionally to manufacturing labour and the black dots are the 250 largest cities plotted proportionally to population in 2000[8]. As expected with the no history assumption, the model produces a long-term equilibrium that is more evenly spread than in reality. Because population density is historically higher in the north than in the south, the model predicts too many large cities in Spain and too few cities in the UK, the Netherlands, Belgium and the Ruhr area.

All large countries have 4–6 main cities. In the UK and Ireland there are white dots close to Belfast, Glasgow, Dundee and Newcastle. The Midlands agglomeration, however, is only approximated by a white dot close to Liverpool. In the south, Norwich and the Plymouth/Southampton area are pretty close and there is a correct simulation of London, although far too small. In France the largest white dot is indeed on the spot (Paris). The other simulated cities are too large because in reality Paris is 6 times as large as France's second largest city Lyon. Both Lyon and Marseille, however, have a white dot nearby and Clermond-Ferrand is on the spot.

The model seems to fit a little better for Germany, which has a less centralized tradition. The largest white dot is close to Berlin and there are white dots close to the Rurhgebiet, Hannover/Braunscheig, Strasbourg, Nurnberg and Munich. For Italy there are remarkably good simulations for Turin, Milan, Bologna, Rome and Napels. On Sicily, the three largest cities Palermo, Catania and – to a lesser extent – Messina are pretty close. On the Iberian Peninsula the model does not work at all: there is a circle of cities around instead of one on the spot of Madrid, and the simulated total population of Spain is just as large as that of France. Only Barcelona has a correct simulation in its vicinity.

Simulation S2 (chart 6) is identical to S1, but without the geographical altitude taken into account. As expected, without regions being isolated by mountains the total number of cities decreases from 130 to 115. In addition, treating Europe as a flat area means that the Pyrenees and the Alps become central areas with large agglomerations. The largest French city is now almost on the Spanish border taking up some agglomerations of Northern Spain, including the correct simulation of Barcelona in S1. The good simulations for Turin and Milan in S1 are gone

8 The actual database consists of 522 cities with a population over 50.000 inhabitants. In chart 6.5–6.8 only the 250 largest cities are plotted.

indicating that these agglomerations are better predicted in the "protection shadow" of the Alps.

Chart 7: (S3) Basic Model (n=208), τ=0.45, μ=0.5, σ=5.5

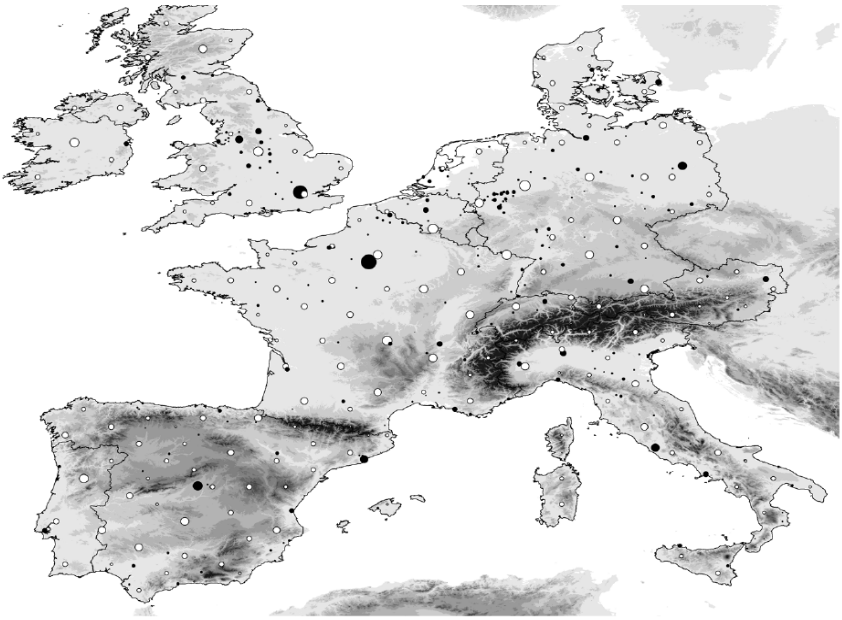


Chart 8: (S4) Extended Model (n=193), τ=0.45, μ=0.5, σ=5.5, β_2=0.25

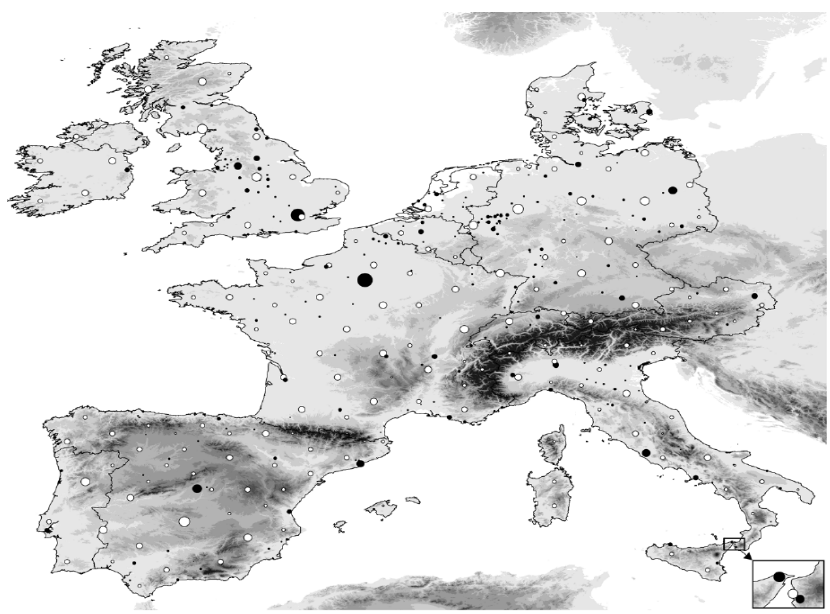


Chart 7 shows simulation S3 with much more cities (208), caused by lowering the share of the manufacturing sector from 55% to 50% (μ=0.5) and decreasing the economies of scale by raising σ from 5 to 5.5. In the UK, there now is a correct large agglomeration predicted in the heart of the Midlands and London has become larger. The white dot close to Dundee has disappeared but another one has merged close to Aberdeen. In France, Paris is still there, but smaller, accompanied by some close approximations of Bordeaux and Clermond-Ferrand (both on the spot), Toulouse, Lyon, Nantes and Rouen. In Spain and Portugal, the simulation has not improved in the centre (no large Madrid), but there are now close white dots for – again – Barcelona, Zaragosa, Pamplona (on the spot), Bilbao, Vigo and Lisbon. In Northern Italy, now both Turin and Milan are almost on the spot and of the right size, accompanied by good approximations of Verona, Parma and a close but small dot for Geneva. There is still a close white dot for Bologna, although slightly shifted to the south, and another one close for Florence.

Going from France to Germany there seems to be a good simulation of seven white dots along the line Paris-Brussels-Ruhrgebiet-Hannover-Braunscheig-Magdeburg-Berlin, although the second dot (Brussels) should be more to the north and Berlin itself is now simulated too small. In the south of Germany, the approximation of Munich is improved and there is now also a white dot in the Frankfurt area. Denmark has a remarkably good approximation of its three main cities Copenhagen, Aarhus and Odense, but the other large cities predicted in Jutland do not exist in reality. Finally, in Austria the three white dots close to Linz, Vienna and Graz do not change compared to simulation S1.

Finally, simulation 4 (chart 8) is a rerun of S3 with the extended sea-tranport model of chart 4b. The parameter $\beta 2$ is set to 0.25 meaning that transport costs over sea are assumed to be 25% of transport costs across land. As expected, this assumption has the largest effects in the northern UK and Denmark, were islands and peninsulas now all become interconnected. Ireland is now better connected with the UK leading to a better simulation of Dublin, but there is no approximation of Glasgow and Dundee anymore. In the rest of the UK there is only a better approximation of the coastal agglomeration of Newcastle. The situation is better in the Netherlands that now has a correct simulation of the Rotterdam harbour. In Denmark, the predicted size of Aarhus is now much better, but Copenhagen has shifted and has become smaller, probably due to competition from Rostock at the northern coast of Germany, which in its turn is now much better predicted. It should be expected, however, that inclusion of the rest of Scandinavia into the model should lead to a better estimate of Copenhagen again because of its strategic trading position with Sweden. In the rest of Europe, the sea transport assumption does not change very much. In France, the three largest cities close to Paris move slightly up in the north-west direction, and the harbour city Bordeaux has become larger. Likewise, in Portugal the estimate for Lisbon has become both closer and larger. Finally, the zoomed inlay shows that the harbour city of Reggio di Calabria is correctly predicted on the mainland side of the Street of Messina.

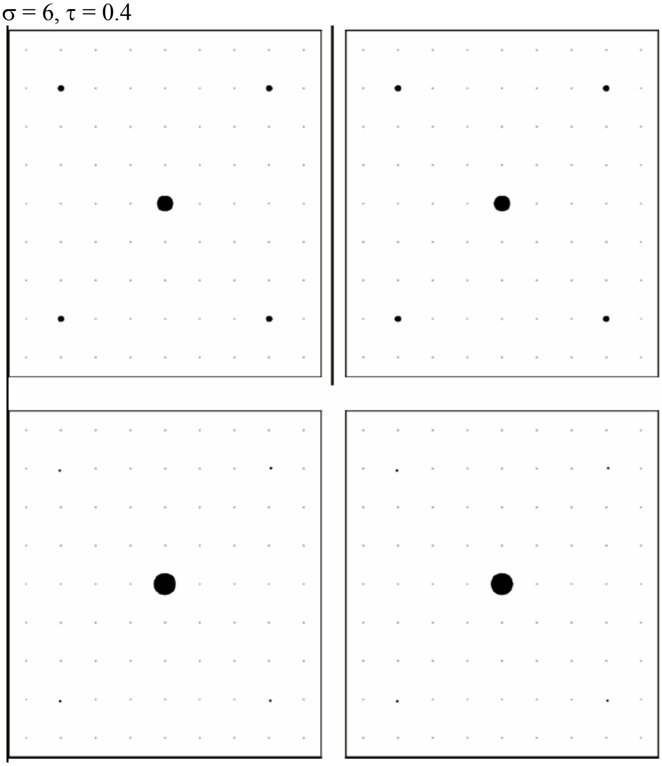
The question to what extent these models can actually assess the influence of geography on economic agglomeration over time is discussed in detail in Stelder (2005a/b) but falls beyond the scope of this paper. For the purpose of this paper we need a more elaborate discussion about the possible implementations for economic integration analysis.

4. Towards Economic Integration

Let us assume that we now have two countries with a historical agglomeration result but which do not trade with each other. The most simple simulation for this situation is given in chart 9. Two identical square grids are adjacent but isolated from one another. This is comparable with the former situation in Europe where Easty and West were isolated by the Iron Curtain.

Chart 9: Introducing Integration

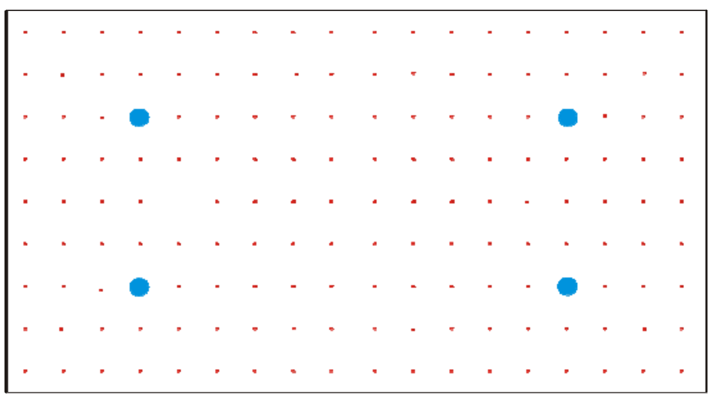
9x9 grid; $\pi = 0.4$, $\sigma = 6$, $\tau = 0.4$



In the original situation, each country has the central largest agglomeration in the centre accompanied by 4 second order cities in each quadrant. These separate equilibria where obtained as a long term result of the parameter configuration mentioned. After removing the separation between the two countries the two country grids become connected as if they now together form a new integrated 18x9 location grid. The agglomeration effect of this integration is that the satellite cities loose some agglomeration advantage to the two larger centres because the latter now can have access to each others market areas. As a comparison, chart 10 shows that indeed the historical growth of the two centres in the middle has occurred on a place that would not have been natural when under the same parameter assumption the 19*8 grid would have been an integrated economy from the start. In that situation, there would have been four middle sized cities in each quadrant.

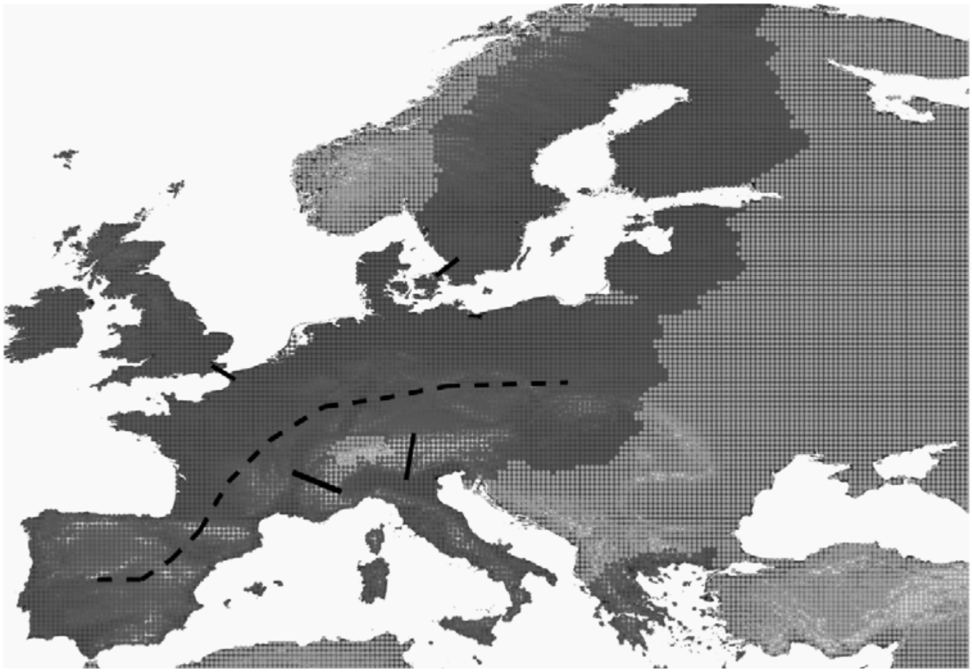
Chart 10: Full Integration from the Start

18x9 grid; $\pi = 0.4$, $\sigma = 6$, $\tau = 0.4$



It is not very useful to further elaborate on different simulations with abstract models of the type described above because our main interest is how these processes work in more realistic models. In this example there is indeed increasing agglomeration c.q. increasing concentration inside both countries as a result of their integration. This is typical for recent economic growth in the former eastern European countries that has a strong bias towards the main agglomerations. Integration in this view can be detrimental to the periphery leading to increasing regional inequality.

Chart 11: Reach of the Larger European Grid Model



The implementation of the kind described in charts 9–10 in currently under construction for a larger model of Europe that covers all EU-25 countries (see chart 11). Although there are no results yet some remarks can be made here about its implementation issues. First, the original grid of charts 5–8 will not be simply extended, but it will be combined with a realistic matrix of distance and transport costs that reflects the increasing integration phase of countries like Poland etc. while keeping the Ukraine, Belarussia and Russia at a relatively higher "economic distance" from the EU. Second, extending the model further to the east than the EU itself enables the model to keep track of trade and economic connections of the former eastern European countries to their Russian neighbours as well. This is a more sophisticated modification of the external trade option discussed in chart 3. Third, as shown in chart 11, several infrastructure projects can be inserted into the model like a transeuropean network (illustrated by the dashed line) or tunnels and bridges across water or mountains. Finally, contrary to the "no-history assumption" in chart 9–10, the model in chart 11 will start with the actual city distribution of today. Once calibrated to today's agglomeration structure, a change in infrastructure and/or economic integration policy can be evaluated as to what effects this will have on the European agglomeration structure in the future.

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Economic Challenges in the CENTROPE Region[1]

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"CENTROPE" is a region that was established by policy makers in several countries in Central Europe as a platform for cross-border coordination and cooperation. The will to cooperate across borders is driven by the understanding that the competitiveness of the region as a whole can be improved by working together. In doing so they are proceeding from the assumption that this (border) region, which has moved from the edge to the middle of Europe, can now assume the function of a bridge. A situation analysis will give details of the strengths and weaknesses of this region. For reasons of data availability the analysis is divided into a national and a regional section. In the national section information about the competitiveness and its determining causes will be given for those Central European countries that are found in the CENTROPE region: Austria, the Czech Republic, Slovakia, and Hungary. In the regional section the emphasis will be placed on the structural and also partly functional characteristics of the CENTROPE region. In doing so, CENTROPE as a region will be defined as consisting of the following NUTS 2 (Nomenclature of Units for Territorial Statistics) regions: Vienna, Lower Austria, Burgenland, West Transdanubia, Bratislava, Western Slovakia, South Moravia and South Bohemia.[2]

1. Favourable Cost and Market Factors in Central Europe

Central Europe is an interesting sales market. The four small Central European countries constitute a relatively wealthy and dynamic economic area, even though the level of prosperity is lower than in the European Union, which is clear since the Czech Republic, Slovakia and Hungary are transition countries. Overall, the per capita gross domestic product (GDP) at purchasing power parity (PPP) in Central

[1] This is a short version of a project report that can be found under http://www.oenb.at/de/service_veranst/fruehere_va/va2006/HZZ_Workshop/speeches_papers.jsp

[2] In contrast to the definition used in this paper, South Bohemia is not always considered a part of the CENTROPE region.

Europe was about 14.3% below the average of the EU-25 (2004). The transition countries of Central Europe only started to change to market economies in the early 1990s and only became members of the European Union[3] in 2004. However, they have higher per capita income than all the "new" EU members together. Also, Austria generated a higher GDP per capita than all the "old" members of the EU-15. Furthermore, Central Europe is very dynamic, which helps its market perspectives. Since surmounting the transition crisis in the middle of the 1990s, the new EU Member States of Central Europe are now in a catching-up phase. With the exception of the Czech Republic, in the last ten years they have shown economic growth that is clearly above the EU average.

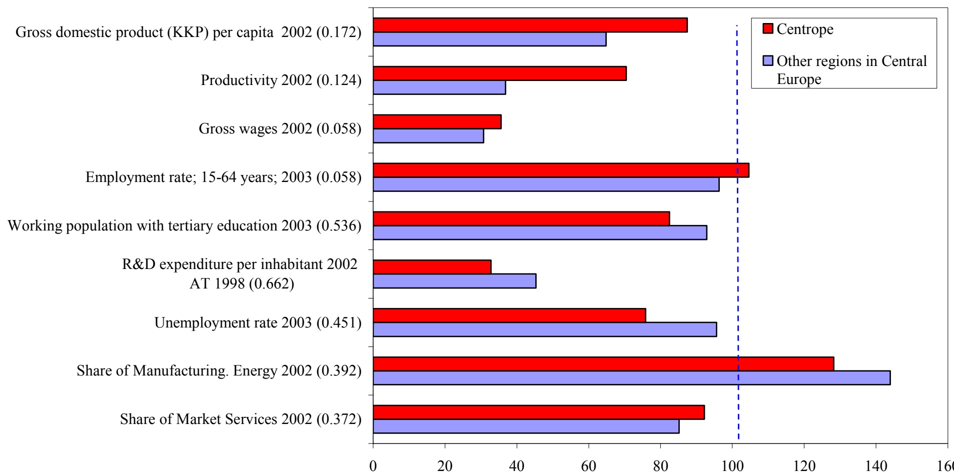
Another important location factor is the relatively low labour costs. To be sure, Austria has a high wage level, but due to high productivity its unit labour costs are relatively low. In the new EU Member States of Central Europe wages and unit labour costs are relatively low. Moreover, the unit labour costs might be improving because the transition countries are quickly catching up in productivity. Technological progress is particularly important, in order to survive competition from the "new low-wage countries" (e.g., Rumania, Bulgaria).

Aside from low labour cost advantages, Central Europe has also become an attractive location for business investments due to the relatively low taxes on businesses. Particularly in recent times taxes on business have been in part significantly lowered, and not only in some of the new Member States (e.g., Slovakia, Hungary), but partially as a reaction to that, also in Austria.

The dramatic structural changes in the transition countries of Central Europe have had their effects on the labour markets. Employment trends have remained muted, and unemployment has increased. Still, labour market conditions are not any more adverse than in the European Union. Labour participation is comparable to the European average; however, older employees are more likely to exit the labour market. The unemployment rate (Central Europe 2004 8.3%) is in fact about one percentage point below the average of the EU-25 (9.2%). An exception is Slovakia, which has a very high rate of unemployment (18.2%).

[3] These will be referred to below as the "new EU Member States".

Chart 1: Indicators of the Regions in Central Europe (EU-25=100)



Note: Dotted line: EU-25=100; Terms in brackets: probability of error.

Source: Eurostat, Austrian Institute of Economic Research calculations.

2. Central Europe is Integrated into the Economy of the European Union

The economy in Central Europe has been developing dynamically not at least due to foreign trade. In 2003, exports from the four countries of Central Europe were 2.3 times higher than in 1995; imports increased 2.1-fold in this time period. In contrast to that, exports and imports in the European Union (EU-25) each increased 1.7-fold. In the transition countries foreign trade has completely adapted to the European Union market; in Austria after the accession to the EU in 1995 trade was further intensified. More than two thirds of the exports from the Central European countries go to the countries of the EU-15, more than three fourths to the countries of the EU-25. In the meantime, Central Europe is closely integrated into the division of labour within Europe; the emphasis is upon trade with semi-finished goods of relatively low quality. The competitive advantage of low labour costs is evident particularly in labour and technology intensive industries that use many blue-collar skilled labourers. The medium term development in the transition countries of Central Europe also tends toward trade in semi-finished and/or finished goods of higher quality.

The opening of Central Europe to the West was not only evident in foreign trade, but also in direct foreign investment. The strong commitment of multi-national companies can be seen as evidence that Central Europe is advantageously located. Multinational companies are responsible for a large part of the comparably high business investments. 2003 in the new EU Member States 35% of GDP was made up of the capital stock of foreign direct investment. This is clearly higher than the worldwide figure (23%) and somewhat more than the EU-15 figure (33%). Austrian companies are also participating in this, and have thereby advanced their internationalization considerably. Multinational companies are very important for the economic development of Central Europe. Since foreign direct investment transfers modern know-how increase productivity, the technological catching-up process of the new EU Member States is furthered. Cost and efficiency motives are of particular importance in industries with middle and high technological levels. Foreign manufacturing companies have attained a level of productivity in the new EU Member States that is 60% higher than local businesses (Hunya-Geisheker, 2004).

3. Deficiencies of the Transportation and Education Infrastructures in Central Europe

The process of catching-up has not yet been completed. There is still somewhat of a gap, particularly with regard to "modern" location factors. This is true both of the physical infrastructure as well as of schooling at higher qualification levels. In particular the transportation and communication infrastructures of the new EU Member States need to be modernised. This includes both the high quality development of local infrastructure within the individual countries as well as the interconnection between these countries. If CENTROPE is to develop into a region with intensive economic integration, then some infrastructure bottlenecks need to be eliminated. This shortcoming particularly hinders the division of labour within CENTROPE. Furthermore, the interconnection within the framework of the larger European transportation network is in need of improvement. In that way, opportunities arising from a favourable geographical location would multiply.

With respect to the endowment in human resources, Central Europe does not have the best preconditions. That has caused a deficit in one of the most important competitive factors at this time. With respect to participation in the educational system, the problem is in the higher qualifying levels, not the lower levels. With regard to the participation at the university (tertiary) educational level, every one of the four Central European countries shows clear deficiencies with respect to the rest of Europe. The portion of the working age population with a tertiary education is 14.1% in Central Europe and 21.8% in the EU-25. The difference is even greater with respect to scientific-technical education: Hungary, the Czech Republic and Austria are in bottom place among the members of the European Union. The amount of student exchange is also relatively small within CENTROPE. A second problem area is continuing education. None of the Central European countries reaches the level of the European average with respect to "lifelong learning."

Not unrelated to this situation in human capital is the position in the area of research. Central Europe does not play a leading role in the area of either innovation or research and development in Europe. The new EU Member States of Central Europe have not yet progressed so far in transition to enable, aside from the multinational companies, small and middle-sized businesses to increase their competitiveness through product and process innovation. Not only is the innovator rate clearly lower than in the EU average, but also nearly all the important indicators in an innovation system are lower. An innovation index calculated by Eurostat shows that all three of the new Member States in Central Europe (values between 0.24 and 0.27) fall clearly below the European average (EU-25 0.41). Austria approximately reflects the European average. With respect to the innovation index Austria (0.39) is slightly lower, with respect to the innovator rate (35.5% of the businesses have introduced innovation) slightly above (EU-25 31.7%). In Austria the deficiency tends to be in the area of research and development, even though expenditure in research and development is somewhat above the European average. One problem can be found in the numerous small and medium sized firms that take part in innovation activities, but do not contribute to research and development. An important goal for structural policy in all four countries of Central Europe is to increase the intensity of research and development, despite different technological policy challenges.

In the following, the perspective of the analysis will be narrowed down to the CENTROPE region itself. With respect to the regional dimension of the location factors, the most important question is if the CENTROPE region is a homogeneously structured and functionally closely integrated region.

4. CENTROPE is Not a Homogenous Structural Region with Specific Characteristics

CENTROPE is not a region with a unified structure. It is not a "structural region" with characteristics that cause it to be clearly differentiated from the region around it in Central Europe. So, for example, there is no significantly higher level of prosperity nor is there greater educational and research intensity than in the other NUTS 2 regions of Central Europe. Furthermore, there are no significant differences, with regard to the structure of the sectors and branches or in the labour market, between both the comparable regions in Central Europe. Only the employment rate (especially due to higher female employment) in the CENTROPE region is higher, and one might even be able to speak of a higher level of productivity. For most of the indicators the mean of the CENTROPE region differs clearly from that of the rest of the regions of Central Europe. However, the differences are not significant because the variation within CENTROPE is relatively high. Therefore, the CENTROPE region not only is not a specific region in Central Europe, it is also not a homogenous region; it is in fact a diversified region with large inner-regional differences.

The variety is also a result of the "division" of the CENTROPE region. Roughly speaking, CENTROPE is "divided" into an Austrian regional portion and a new EU Member States regional portion. There is a kind of economic "fault line" with significant differences, in which the Austrian regional portion tends to have more favourable structural characteristics (with the exception of the educational system). The importance of the secondary sectors is lower and that of market services higher. Also, the Austrian regional portion shows a higher level of research and development intensity. The "division" is a result of differences in economic history in the last decades. Also, as a result of the transition, the regional structures in the new Member States have become more diversified and regional differences have been reinforced. However, the "economic" border has not always stopped at the national border. In the new Member States there are also regions with relatively high prosperity, high wages and high employment rates. This occurs mostly in the regions in and around the capital cities, which also have higher levels of research and development. On the other hand, in the Austrian portion of CENTROPE there are also regions with higher unemployment rates (e.g., Vienna) or lower wealth indicators (e.g., Burgenland). Only with respect to productivity is the economic border clearly also a national border.

As a whole, CENTROPE is also not a region that has higher economic growth than the Central European area adjacent to it. The average yearly growth of GDP (at PPP) was 5.2% in CENTROPE between 1995 and 1992 and 5.1% in the other regions of Central Europe. The new EU portion of the CENTROPE regions did not grow significantly faster than the Austrian portion. In fact, there was a yearly difference in growth of 1.3 percentage points but that was not enough to cause any significant differences. For that, economic growth in Northern Bohemia, Moravia, and partly Eastern Hungary was much too moderate. In contrast to that, there is a more or less continuous zone of high growth consisting of Slovakia, West and Central Hungary, as well as Central Bohemia. As a result of the different dynamics between the various parts of the regions of the new Member Statesof the EU there is no catching-up process within CENTROPE or Central Europe. It could not be shown that the least developed regions of Central Europe (or for that matter CENTROPE) have achieved the highest growth rate in the medium term. Though the correlation coefficient was negative (e.g., –0.468 for the eight regions of CENTROPE), it was not significant (probability of error 0.242).

CENTROPE is neither a homogenous structural region, nor a "functional region" that is held together by close economic relationships.

5. Is CENTROPE a "Functional" Unit in the Economic Sense?

The economic relationships can be analysed by using the descriptive methods of spatial statistics and econometrics[4]. Calculating the spatial autocorrelation statistics makes the analysis of the economic relationships among the individual regions possible without having to work with the (sparsely available) business statistics on the micro level. In the present study, the measure of productivity and economic well-being (in level and change), the unemployment rate and the market potential of the CENTROPE regions were examined.

Calculations of the market potential[5] of the NUTS 2 regions of the EU-25 showed that the core of Europe[6] could be found in the regions of Germany, the Netherlands, England, France and Italy. The development of clusters of level variables is not uncommon. Patterns in growth rate are often interpreted as spillover effects. (i.e., the reciprocal influence of the growth of the regions to one another) Calculations of the Local Moran's I coefficient for the average yearly growth rate of the GDP[7] show that CENTROPE is in an intermediate zone, surrounded by two different growth clusters. The dynamic regions of the new Member States demonstrate a high rate of growth, while in the high purchasing power areas of the West lower rates dominate. This leads to this intermediate zone of statistical insignificance, in which CENTROPE falls.

The analysis of the level of economic well-being (2002)[8] for CENTROPE shows that Bratislava, Lower Austria and Vienna stand out as "islands of prosperity." They are characterised by a relatively high GDP at PPP, whereas the neighbouring regions show a low level. Burgenland, West Transdanubia and South Moravia[9] are characterised by a low level of prosperity in their own region as well as in the neighbouring regions ("low-low"). The analysis by means of spatial

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[4] Principally, the local Moran's I coefficient was used, which is calculated as follows:

$$I_i = \frac{(x_i - \overline{x})}{\frac{1}{n}\sum_{k=1}^{n}(x_k - \overline{x})^2}\sum_{j=1}^{n} w_{ij}(x_j - \overline{x})$$

where "n" is the number of observations, "x" the researched variable, $\overline{x}$ the arithmetic means of these variables and w_{ij} are elements as a function of distance of a matrix that represents weighted values.

[5] The market potential was calculated by multiplying the distance matrix by a vector of the regional nominal GDP. Consequently, for each region the individual GDP (nominal) + a (distance) weighted average of the adjacent regions is obtained.

[6] According to economic theory (New Economic Geography) the so-called core regions are characterised by a strong concentration of suppliers and consumers in the respective industrial branches.

[7] At purchasing power parity (PPP), over the period 1995-2005.

[8] Gross domestic product at PPP.

[9] The calculated value for South Bohemia was, at the 10% level, statistically not significant.

autocorrelation statistics confirms that only productivity[10] and, to a lesser extent, wages stay within national borders. It follows that the Austrian portion of CENTROPE has a high level of productivity, while Bratislava, South Bohemia, South Moravia, West Transdanubia, and West Slovakia can be found in a spatially concentrated "low-low" area. The dispersion of regional unemployment also indicates that it is a regional rather than a national pattern. Within the region of CENTROPE, West Slovakia[11] has a very high unemployment rate (2003). South Moravia and South Bohemia, on the other hand, are regions of low unemployment surrounded by neighbouring regions of high unemployment. The values for the rest of the CENTROPE regions were not statistically significant.

The economic structure of the CENTROPE region is in fact very heterogeneous. One cannot speak of an economically integrated area; at the same time, national effects – and therewith the differences in economic history– are only evident for two variables (productivity, wages).

The lack of economic relationships is no surprise if one realizes that proximity does not always have to lead to intensive integration, especially when parts of the region were isolated from each other for a long period of time. Even, for example, in Austria there is no close interchange between some federal states. The integrated eastern region is more of an exception than the rule.

6. CENTROPE is an "Intermediary Region" with Economies of Scale and Transaction Cost Advantages

For strategic considerations concerning the economic development of CENTROPE, it is of some importance whether CENTROPE is really positioned in the middle of Europe, as the name suggests. This is related to the question of which geographical location advantages CENTROPE has. From a geographical point of view, CENTROPE does not lie in the middle of Europe, if a Europe is assumed that reaches from the Atlantic to the Urals. In that case, the geographical centre would be somewhere in the Baltic States. From a regional economics point of view, CENTROPE is also not in the centre of Europe. The "core region" of Europe with the highest prosperity (partly connected to the highest market potential) is situated clearly to the west. As already mentioned it stretches approximately from London over Paris, Belgium, the Netherlands and the German Rhineland to Northern Italy. That does not yet mean that CENTROPE is on the periphery of Europe. The peripheral regions of Europe are further east, north and south.

It seems most fitting to view the regional economic position of CENTROPE as an "intermediary region" between the core and the periphery of Europe. This description should emphasize that CENTROPE is in the intersection of Western

[10] Gross value added per employee.

[11] The Local Moran's I coefficient for Bratislava was, at the 10% level, statistically not significant.

and Eastern market areas, from where both Western as well as Eastern markets are relatively easy to reach and access. CENTROPE would have a location disadvantage for products that were only sold in markets in the West, and it would also have a location disadvantage for products that were sold only in markets in the East. It does, however, have a location advantage for products or components that are in demand in the Western markets with their sophisticated preferences and high levels of purchasing power, as well as in the dynamic Eastern markets. This advantage of location can lead to rising internal economies of scale or to lower transaction costs.

The internal economies of scale would above all be relevant in branches of trade that have products in markets with dynamic demand and that are produced with an intensive division of labour. Then, the division of labour would be organized so that the human capital intensive components would be produced predominantly in the West and the labour intensive components predominantly in the East. The products would also be assembled in the eastern part of Central Europe. The markets for the products would be both in Western Europe, where there is strong demand as well as in eastern Central Europe where, as a result of the economic process of catching-up, there is a backlog of demand. Prototypical for this advantage in location and scale is the modern consumer goods industry (particularly the automobile and electronics industry). Both industries have developed very strongly in CENTROPE in the last 10 to 15 years, mostly as a result of foreign direct investment in the new EU Member States of Central Europe. Already, a remarkable concentration of the automobile industry has developed in West Slovakia and West Hungary (automotive cluster). This locational advantage seems to be relatively permanent, even if the big investment push could soon level out. Possibly, there will be hardly any more investment in major factories that become key factors for regional economies. Still, there could be a consolidation of the location advantage, in which forward and backward linkages increase sharply. Production networks could develop that might lead to CENTROPE becoming more strongly integrated at the production level and develop into a functional region.

The locational advantage for transaction costs can, in principle, benefit the service sector. It is particularly significant with respect to the “headquarter” function. In that case CENTROPE would provide an advantageous site for regional headquarters, because from here the markets of Central and East Europe are relatively easily accessed and the European headquarters are easily reached. This advantage has been particularly well used by Vienna, where many regional headquarters have been established, partly by upgrading former Austrian branch offices. In this way Vienna has redefined its “bridgehead” role after the Cold War and has become a kind of transaction centre for Central Europe. This advantage seems to be only temporary, as a “window of opportunity” that after some time will become narrower. The more intensively the neighbouring markets are penetrated, the more advantageous it will be to set up national headquarters in these markets in order to save transaction costs. This development has already begun and will probably continue to Vienna's disadvantage.

The locational advantage of CENTROPE has probably just about been exhausted; large investment and take-offs in development are therefore no longer to be expected. Rather than a boom phase, a phase of consolidation and intensive internal integration is more likely to take over. In this regard, it should be kept in mind that CENTROPE is a diversified region in which regionally specific, border-crossing strategies are promising.

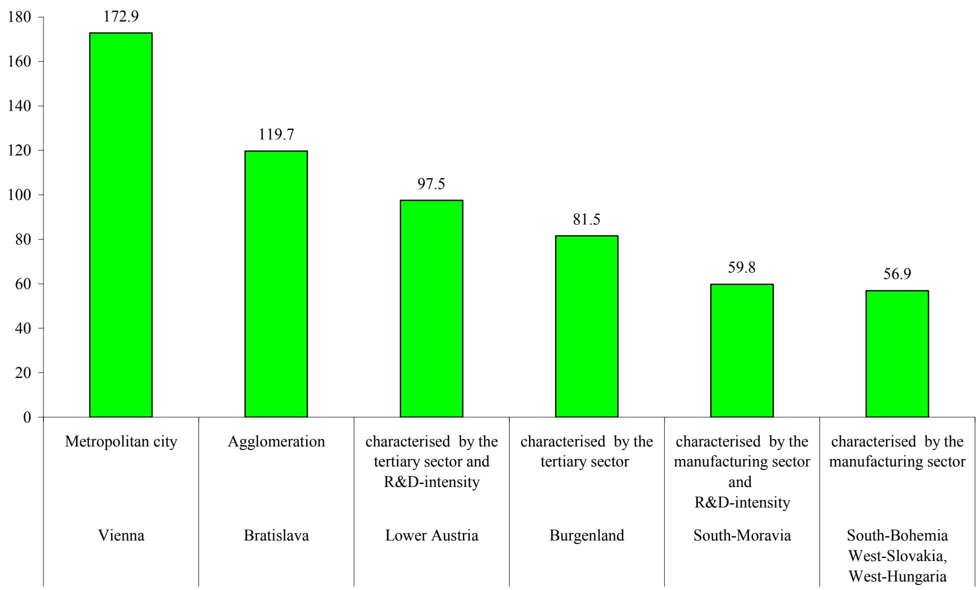
7. Diversification of CENTROPE in Accordance to its Regional Variety

CENTROPE has a variety of regions that are suitable to different types of specializations. Due to this variety, the region can work with a wide range of products. Diversification is possible, which will reduce the risk of short and long-term setbacks as well as increase the attractiveness of the location for investors in real and human capital. CENTROPE has a great deal of potential for investors of various backgrounds.

The types of regions can show the regional variety of CENTROPE. Taking as a group-building criteria the level of the tertiary sector (or of industrialization) and the intensity of research and development, then one obtains types of regions that reflect different levels of prosperity.

At the bottom end of the scale of wealth are those regions in which industry is still of relatively high importance. Among these, South Moravia (with Brno) shows a relatively high intensity of research and development and a somewhat higher level of prosperity than the other industrialized regions. Also, South Bohemia, West Slovakia and West Transdanubia belong in this category. The industrialized regions are confronted by the need to intensify production networks in order to consolidate advantages of location and scale. These advantages tend to be strengthened by further expansion in the Eastern markets. With the Ukraine and Russia on the one side and Turkey and the Balkans on the other, large markets of the future can be reached from CENTROPE, as long as they are not serviced by their own local plants and offices, which is to be expected in larger countries. With respect to the networks, cooperating partners in the West are not confined to be to the Austrian region of CENTROPE. Basically, all the industrial regions can be considered (with an emphasis in Austria, Southern Germany and Northern Italy).

Chart 2: GDP per Capita in the Sub-Regions of CENTROPE (EU-25=100)



Source: Eurostat, Austrian Institute of Economic Research calculations.

A higher level of economic well-being can be seen in those regions that have a relatively important tertiary sector. These are the two Austrian regions of Lower Austria and Burgenland, though in Lower Austria the intensity of research and development as well as the level of economic well-being is higher.

For service businesses there are various possibilities for improving competitiveness. A lot of investment in the new EU member countries has already been made "on location," since this is the best way to enter regional markets. In this way, structural change has been promoted in the fields of trade and financial services in the new EU Member States. The full potential of the services markets with small market radii has not yet been tapped because providing services across borders has not yet been completely liberalised. This will eventually increase the pressure of competition in the "local" markets. The companies that will succeed are those that have used the opportunities offered by cross-border markets.

The competitive conditions in tourism are basically different, because an emphasis can be placed more heavily on opportunities arising from cooperation. Through cross-border cooperation the attractiveness of the destinations can be increased by expanding the potential of resources that are useful for tourism. In the process it must be discerned if the resources are top quality and unique or more or less ubiquitous. In the case of top quality resources (lakes, thermal springs, particularly charming and unique landscape conservation areas) the offerings should be so much improved that it is interesting for a broadly dispersed international demand both in Europe and partly also overseas. More or less ubiquitous resources can be found in many rural areas that are suitable for internal consumption. Through cross-border cooperation these can be developed into delightful attractions for the leisure economy (in combination with the food and energy industries) with a market area extending across borders to all of Central Europe.

The highest level of wealth, above the EU average, can be found in both of the research and development intensive urban areas, whereas there is a difference between the Viennese metropolis and the agglomeration Bratislava. Vienna clearly surpasses Bratislava in research and development as well as in regional prosperity. Both regions (particularly Vienna) are important locations for business-related services, which have received demand impulses as a result of the transition of the new EU Member States of Central Europe. The greatest challenge is on the supply side, as the large cities are invigorated by internationally competitive research and development. They need to have attractive educational and research infrastructures at their disposal in order to be able to recruit talented and highly qualified human capital internationally. The high quality of life that undoubtedly exists in CENTROPE is a good, but not sufficient prerequisite. There should also be specialised research networks that are soundly anchored in CENTROPE. Cooperation within CENTROPE will allow human resources to expand, which only then will allow the necessary minimum size to be reached. In doing so, cooperation should not be limited to Vienna and Bratislava; in order to increase the chances of success also Brno and both capital cities, Prague and Budapest, should be included in the network.

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Regional Convergence within the EU-25: A Spatial Econometric Analysis

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Abstract

This study investigates absolute convergence within the EU-25 for the time period 1995–2002. It is shown that growth performance and convergence depend crucially on the development of a region's surrounding. The detected spatial autocorrelation is of substantive form indicating that least squares estimation of the absolute convergence model yields biased results. A yearly convergence rate of 0.7% to 0.9% is estimated by using a spatial autoregressive model specification. Several robustness checks are carried out: First, it is examined whether the functional relationship of the convergence equation is stable over space. Secondly, the sensitivity of the estimation results on the specified weight matrix is investigated. Third, the paper identifies the source of spatial dependence.

1. Introduction

Since the 1990s considerable attention has been drawn to the question of regional income convergence in Europe. A lot of quantitative research has been conducted, and several new theoretical approaches have been proposed. A similarity of most studies is the neglected spatial interaction of the underlying observations. Now, there seems to be wide-spread agreement that spatial dependencies should be taken into account when analyzing growth. Recent studies suggest that geographic location does matter for a region's growth performance and consequently its pace of convergence. Spatial interactions such as technological spillovers[1] or factor mobility, both being important forces for the process of convergence, should not be neglected. There are two ways to deal with this phenomenon using standard econometric techniques: The data can be either nationally weighted or country dummy variables can be incorporated in the regression equation. Indeed, as this study will show, a great extent of spatial correlation is based on country-specific

[1] See López-Bazo et al. (2004) for a spatial econometric estimation of technological spillover effects.

effects. These approaches have been criticized[2] as being too restrictive for two reasons: First, spatial effects across national borders are excluded and secondly, the assumption that all regions of a country belong to the same national growth cluster seems not to be in line with reality. In addition, these approaches aim solely to eliminate possible spatial correlation in the regression's disturbance term and do not provide any further insights of the convergence process itself.

Spatial econometric regressions are thus more flexible in comparison to other approaches, and will pose the econometric rationale for this study. One focus of this paper is on the sensitivity of estimation results with respect to spatial proximity. Consequently all models and descriptive statistics are estimated using several weight matrices. Another issue discussed is the source of spatial dependence. Do spatial spillovers have a bigger influence on a region's growth performance than country effects?

The paper is organized as follows: Section 2 introduces the unconditional β-convergence model. Chapter 3 provides a description of the data. Section 4 examines the spatial structure of the underlying data by means of exploratory spatial data analysis. Section 5 consists of estimation results. Section 6 deals with several tests for robustness of the results, including estimations of the two-club-convergence model and section 7 concludes.

2. Convergence Based on the Neo-Classical Growth Theory

In the neo-classical growth theory, growth is solely determined by the rate of technology which is assumed to be exogenous. The main force that drives economies (homogenous countries, regions) to converge is the fact that returns to physical capital are diminishing. Localities with low initial income per capita have low ratios of capital to labor, and hence they also exhibit a higher marginal product of capital.[3] Thus there is a point at which per capita income growth converges to zero assuming that technology does not grow. This so-called steady state y^* can be assumed to vary (conditional β-convergence) or to be equal for all analyzed economies (unconditional β-convergence). The diminishing returns to physical capital imply that economies far away from y^* grow faster than those that are closer to y. In a regression context, absolute β-convergence can be estimated by regressing yearly average growth rates on a constant term and initial income.[4] Evidence of convergence is found whenever the β-coefficient is significantly different from zero and negative, thus implying that economies (regions) with low initial GDP per capita grow on average faster than others having a relatively high initial GDP. The underlying assumption here is that all economies are intrinsically

[2] Niebuhr (2001).
[3] Jones (2002).
[4] I will use GDP per capita in purchasing power parities as a proxy for income. Henceforth, the terms income and GDP per capita will be used both to denote GDP per capita (PPP).

the same (i.e. they share the same production function, savings rates, etc.), except their initial conditions making the concept of unconditional β-convergence applicable. A spatial regime switching model is estimated in section 6 devoting attention to the stability of the regression model over the data. Motivation for this model specification can not only stem from a spatial econometric point of view but also from economic theory. Here the identified regimes are called "convergence-clubs". Regions within these clubs are assumed to interact more with members of the club than with others from outside. The assumption of a single steady state for all regions belonging to the EU-25 is relaxed by allowing for club-specific steady states.

3. Data

The data used in this study is taken from the Eurostat-database "Regio"[5]. The explanatory variable is initial GDP per capita (purchasing power parities) in 1995 in logarithms; the dependent variable is the yearly average growth rate from 1995 to 2002. Although recent convergence studies[6] analyze data for a larger time horizon, this makes no sense for the purpose of this study for several reasons. Firstly, there is no reliable data available for the new Member States of the enlarged EU-25 before 1995. Secondly, even if available, interpretation and comparison of data on income with that for the old Member States could not be done in a meaningful way. This is due to the transition of the former CEE countries from a centrally planed to a market economic system.[7]

The data consists of 246 NUTS 2 regions for all the Member States of the EU-25 except Cyprus and some regions of France and Portugal. Those were dropped due to their isolated geographic position. The territorial classification "NUTS" (Nomenclature of Units for Territorial Statistics Classification) is proposed by Eurostat and does not deviate in most instances from administrative borders set by the specific countries. Hence, this NUTS classification is not based on functional, economically integrated units, which is the source of frequent criticism.[8]

4. Exploratory Spatial Data Analysis (ESDA)

According to Anselin (1988) one can distinguish between two spatial effects: Spatial dependence and spatial heterogeneity. Intuitively, observations from adjacent regions can on the one hand be correlated (*Spatial dependence / Spatial autocorrelation),* or on the other hand a functional relationship can vary across the regions (*Spatial Heterogeneity*).

[5] http://epp.eurostat.cec.eu.int.
[6] Mella-Marquez and Chasco-Yrigoyen (2004), Niebuhr (2001).
[7] Fischer and Stirböck (2004).
[8] Martin (2001).

The first effect – *Spatial autocorrelation* – can stem from aggregation of variables[9]. Because the underlying spatial scale of the variable is not correctly reflected within the aggregated variable, the result might be exposed to spatial autocorrelation. Although this kind of measurement error is likely to occur – and definitely is evident in the data underlying this study – it is not the main source of spatial dependence. Spatial autocorrelation derives to a large extent from the fact that localities interact with each other. The relationship of correlation and distance is in most instances a negative one. The second effect – *Spatial Heterogeneity* – can be dealt with by standard econometric methods. In many cases the assumption of a stable functional relationship across space might not hold. The following section introduces descriptive spatial statistics to assess whether the first spatial effect is present in the data.

4.1 Local Moran's I and Getis-Ord G_i*

The Local Moran's I statistic can be used to test whether the variables of the absolute convergence equation are clustered in space:

$$I_i = \frac{(x_i - \overline{x})}{\frac{1}{n}\sum_{k=1}^{n}(x_k - \overline{x})^2}\sum_{j=1}^{n} w_{ij}(x_j - \overline{x}) \tag{1}$$

where x_i represents the underlying variable for region i, $\overline{x}$ the sample mean and w_{ij} the corresponding elements of a specified weight matrix W[10]. The null-hypothesis of the test statistic is the absence of spatial autocorrelation, implying that location does not matter. Inference is based on the z-transformed values of the statistic. The Local Moran's I decomposes the global spatial pattern and indicates to which extent a geographic locality is surrounded by similar / dissimilar values forming a geographical pattern. This implies that some structure is present in the data, which can be regarded as additional information. Most economic variables display positive spatial autocorrelation. Similar values are likely to cluster in space. Negative autocorrelation implies that contiguous areas are more likely characterized by dissimilar values than in a random pattern, which is a result not to expect intuitively, since it is the opposite of clustering. The four possible decomposition categories are:

Positive spatial correlation:

1) high-high
2) low-low

[9] Anselin (1988).

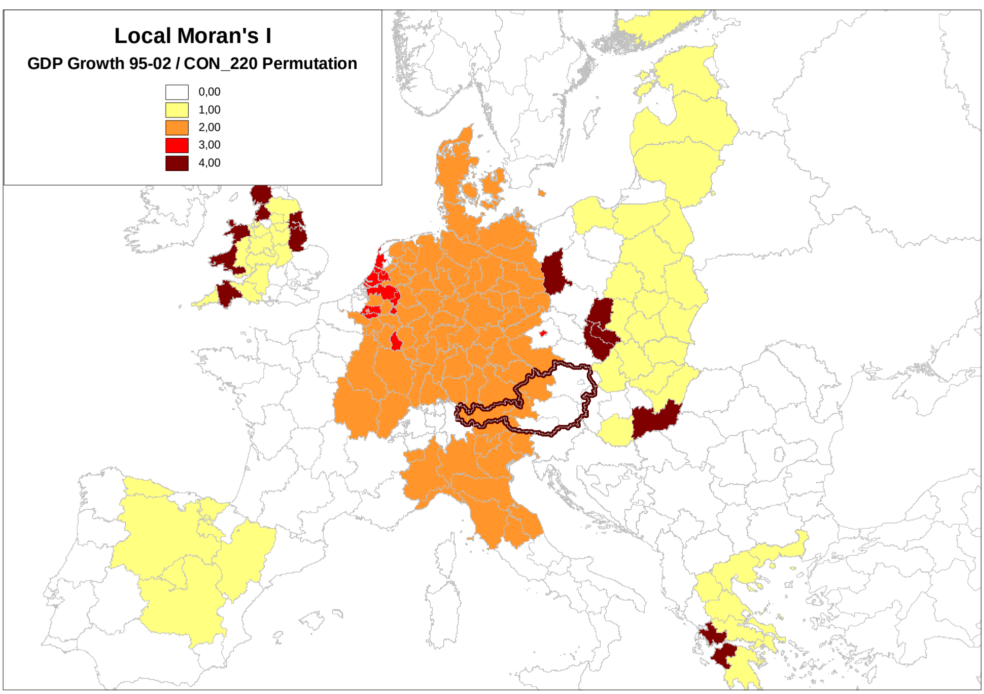
[10] For a description of the weight matrices consider the Appendix section.

Negative spatial correlation:
3) high-low
4) low-high

A region belonging to one of the two first categories is surrounded by observations that are characterized by similar values in magnitude. Spatial outliers (hot-spots) are found in categories 3) and 4).

Chart 1 shows the Local Moran's I significance map (at the 10% level[11]) for the yearly average growth rates 1995–2002 using the color-coding scheme from above. It was computed using a permutation approach, by empirically generating a reference distribution from which mean and variance are taken. This reference distribution is simulated under the null-hypothesis of no spatial dependencies. The permutation approach is then carried out by randomly reshuffling the observed values over all locations and by re-computing the *I* statistic for each sample.[12]

Chart 1: Local Moran's I – Yearly Average Growth Rates 1995–2002



Source: Author's calculations.

[11] Regions for that the test statistic did not reject the null-hypothesis are not assigned a color.
[12] For further description of Local Moran's I test statistic see Anselin (1992).

The chart reveals that Europe is divided into three growth zones: Clusters of fast growing regions in the East and West of Europe and in between a cluster of slow growing regions. Significant growth clusters indicate that regions located in a dynamic surrounding of high growing localities are more likely to show high growth rates than ones that are neighbors of "slow-growing" areas. This clustering phenomenon can be due to the existence of regional spillovers. A similar pattern with respect to the three clusters can be identified for per capita initial income in 1995 as well as in 2002. The overall structure with respect to the three zones remains the same but the low-low clusters are located in the East and West and the high-high cluster in between.

A second way to examine the spatial pattern of the data is by using the Getis and Ord Gi* distance statistic. It is used to identify the regimes of the spatial regime-switching model estimated in chapter 6. Unlike the Global Moran's I, which is a kind of correlation coefficient between observed values and locations, the Gi* statistic measures the concentration of a spatially distributed variable. It can be calculated as a global measurement or as a local indicator of spatial association. The local version of the distance statistic is defined as:

$$G_i^* = \left(\frac{\sum_{j=i}^{N} w_{ij}(\delta) x_j}{\sum_{j=i}^{N} (x_j)} \right) \tag{2}$$

The w_{ij} elements correspond to a weight matrix (not standardized in rows) that is based on a threshold distance point δ. For every region i, the numerator of (2) gives the sum of the underlying variable for all regions lying within δ, including the observation i itself.[13] If large values of the variable examined are clustered close to region i, G_i* will be large as well. Inference is based on the z-transformed values of the statistic, and indicates to which extent an observation is surrounded by high or low values. This means that the G_i^* statistic shows solely positive spatial correlation, "high-high" clusters are indicated by positive z-values of the statistic, and "low-low" clusters by negative ones.

5. Estimation

As mentioned in section 2 the unconditional β-convergence model is given by:

[13] The G_i^* distances statistic includes also the values for the region under consideration i in the sum of the denominator, whereas G_i –not used in this study – does not.

$$\frac{1}{t}\log\left(\frac{y_{i,02}}{y_{i,95}}\right) = \alpha + \beta\log\left(y_{i,95}\right) + u_i$$
$$u_i \sim i.i.d.(0, \sigma^2{}_u) \tag{3}$$

with the disturbance term assumed to be *i.i.d*. Six dummy variables are added on the right-hand side of (3). Three of them ("Southern and Eastern Ireland", "Közép-Magyarország" and "Mazowieckie") were identified by examining the residuals of least squares estimation of (3). By including them into the regression equation, the Jarque-Bera test does not reject the null-hypothesis of non-normality of the error term. The remaining three dummy variables correspond to outlying regions identified by the Cook's Distance statistic. According to the statistic, the regions "Luxembourg", "Latvia" and "Inner London" were recognized to possibly have serious influence on the regression coefficient.

As outlined in chapter 4 there are two main sources of spatial correlation: The measurement error and the interaction of localities. In the terminology of Anselin (1988) he refers to the first one as a "by-product of measurement errors" (sometimes also called *nuisance dependence*). The latter one is due to "the existence of a variety of spatial interaction phenomena" which is in the literature referred to as *substantive form* of spatial autocorrelation. The former is more likely to occur and evident in most data sets of empirical cross-sectional studies. In case that the data exhibits spatial dependence of the nuisance form, spatial error models (henceforth SER) are a proper econometric model class to work with. They model the error term of equation (3) as a spatial moving average or spatial autoregressive process. In words this means that if spatial dependencies are present in the data, but to a rather "small" extent, modeling the error term is sufficient to get efficient estimates. In contrast, ignoring spatial correlation would yield still unbiased but *inefficient* OLS estimates. The SER model estimated in this paper is of the form:

$$\frac{1}{t}\log\left(\frac{y_{i,02}}{y_{i,95}}\right) = \alpha + \beta\log\left(y_{i,95}\right) + dummies + \varepsilon_i$$
$$\varepsilon_i = \lambda W \varepsilon_i + u_i \tag{4}$$
$$u_i \sim i.i.d.(0, \sigma^2{}_u)$$

with λ being a spatial parameter and W a specified weight matrix. In contrast to the former case, severe consequences occur whenever spatial dependence is of *substantive* form. In accordance to time series analysis, auto-correlated disturbances might point to an omitted lagged variable. Put differently, if the error term reveals a certain structure, it could be that not all of the information given by the data was properly taken into account. With respect to convergence, spatial autocorrelation of the substantive form means that regional spillovers do not only exist but are even determining a region's convergence process. The so-called spatial autoregressive model (henceforth SAR) – designed for this problem – explicitly adds a spatially lagged variable on the right-hand side of equation (3). In most, but not necessarily all instances, the added regression coefficient is a spatial lag of the dependent variable (therefore spatial "autoregressive" model).

In the context of convergence the spatial autoregressive model is given by:

$$\frac{1}{t}\log\left(\frac{y_{i,02}}{y_{i,95}}\right)=\alpha+\beta\log\left(y_{i,95}\right)+\rho W\left(\frac{1}{t}\log\left(\frac{y_{i,02}}{y_{i,95}}\right)\right)+dummies+u_i \qquad (5)$$
$$u_i \sim i.i.d.(0,\sigma^2_u)$$

where ρ is the autoregressive parameter and W the weight matrix. The estimation results are given in Table 1.

Table 1: Estimation of Convergence

	OLS Model		*SER Model*	*SAR Model*
α	0.181669	α	0.146387	0.077043
t-value	9.831427	z-value	6.110031	4.091827
Pr(>|t|)	0.000000	Pr(>|z|)	0.000000	0.000043
S.D.	0.018478	S.D.	0.023958	0.018829
β	–0.014192	β	–0.010546	–0.006743
t-value	–7.320362	z-value	–4.180739	–3.735143
Pr(>|t|)	0.000000	Pr(>|z|)	0.000029	0.000188
S.D.	0.001939	S.D.	0.002522	0.001805
	-	ρ / λ	0.729551	0.714431
	-	z-value	10.540210	10.676990
	-	Pr(>|z|)	0.000000	0.000000
	-	S.D.	0.069216	0.066913
Log.Lik.	747.107		777.804	782.201
AIC	1478.210		–1539.61	–1546.40
Obs.	246		246	246
Weight matrix	-		INV2_400	INV2_400

Source: Author's calculations.

All three models confirm the convergence hypothesis but the β-coefficient is varying in size. It is about two times larger than that of the SAR model. Compared to least squares estimation, both spatial models obtained a better fit indicated by the value of the maximized log likelihood function and a smaller AIC information criterion.[14] The significance of the two spatial coefficients ρ / λ indicates that the OLS model is not appropriate, which will be further explored in the next table consisting of selected specification diagnostics.

Table 2: Diagnostics for Spatial Dependence of the OLS Model

Test	*MI/DF*	*Value*	*Prob.*
Moran's I (error)	0.281891	10.288409	0.000000
RLMerr	1	2.700637	0.100308
RLMLag	1	10.572667	0.001148
Lagrange Multiplier (SARMA) Weight matrix INV2_400	2	105.706119	0.000000

Source: Author's calculations.

The Moran's *I* test (error) points to spatial dependence. Since this test is a measurement of global spatial dependence, it gives no conclusions about the source of spatial autocorrelation, which is the task of several Lagrange Multiplier tests. Even more so, they are the most important decision tools in spatial econometrics, clarifying whether spatial dependence is of substantive or nuisance form. There are robust versions of the LM-tests[15], which both take the possible specification of the respective other test into account. For example the "RLMerr" tests for spatially autocorrelated error terms, and also controls for the possible presence of a missing spatially lagged variable. The opposite is true for "RLMLag". Since the RLMLag rejects the null-hypothesis of no omitted spatial lag, inference goes in favor of the SAR model specification. The autoregressive parameter ρ indicates a positive relationship of the dependent variable and its spatial lag. With respect to convergence, this means that convergence speed is not solely determined by a region's initial income, but also by a high degree of its neighbourhood region's growth performance.

6. Robustness of the Results

The sensitivity of estimation results to the definition of spatial proximity is often criticized as a severe drawback in spatial econometrics. Hence it has to be assessed whether the estimated convergence speed is sensitive to the choice of the weight matrix. Chapter 5 outlined the economic implications of the spatial autoregressive model in contrast to that of the spatial error model. It would be unsatisfactory if the

[14] The standard R^2 is not appropriate to value the fit of a spatial model (Anselin 1988).
[15] See Anselin (1992) for a description of the test statistics.

model specifications as well as its implications are sensitive to spatial proximity, which is incorporated by the design of the weight matrices. Thus equation (3) including the six dummy variables is re-estimated using five different weight matrices. In every case the Lagrange multiplier tests come to the same conclusion: The detected spatial correlation is of substantive form. Table 3 gives a summary of the estimation results using different weight matrices.

Table 3: Summary Convergence Speed

Matrix	Model	β-Coefficient[16]	Convergence Speed (%)	AIC	HD[17]
-	OLS	–0.0142	1.49480	–1478.21	46.37
CON350	SAR	–0.0088	0.90778	–1520.84	76.36
CON220	SAR	–0.0075	0.76932	–1519.82	90.01
INV1_400	SAR	–0.0073	0.75290	–1532.26	92.06
INV2_400	SAR	–0.0067	0.69077	–1546.40	100.34
INV2_220	SAR	–0.0069	0.70578	–1544.32	98.21

Source: Author's calculations.

Since in the case of substantive spatial correlation the least squares estimator is biased, it is not surprising that the convergence rate also differs for the results based on the other matrices when compared to that of the ordinary least squares results. This is also reflected in the implied "half-distances" to steady state indicating how many years it takes the region to pass half of the distance to the common steady state. Table 3 reveals that the annual convergence rate falls into a certain range of 0.7% to 0.9%. Hence it is concluded that the SAR model specification holds for a range of matrices, and the specification of the matrix does not seem to be a source of non-robustness of the obtained results.

6.1 Spatial Heterogeneity

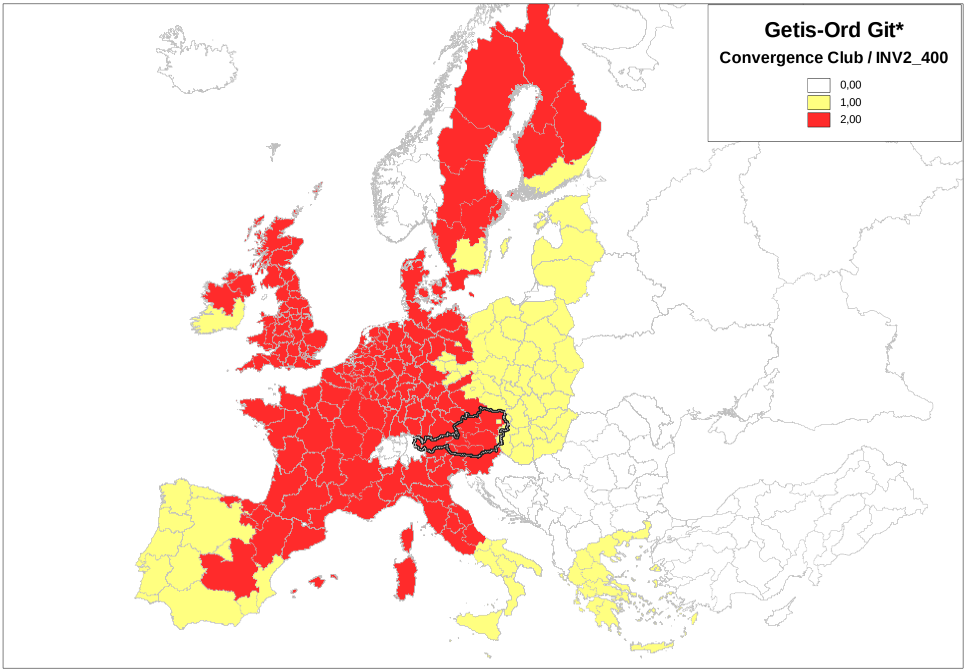
To check for spatial heterogeneity in the data a regime switching model is estimated. The previously calculated z-values of the Gi* statistic are used to identify the clubs, with every positive z-value belonging to club "A", and every negative z-value to club "B" [18].

[16] Computed as $cs = \left(-\log\left(1+\hat{\beta}t\right)/t\right)$.

[17] Computed as $\log(2)/cs$.

[18] Fischer and Stirböck (2004).

*Chart 2: Convergence Clubs Based on Git**



Source: Author's calculations.

The chart shows the two clubs identified by the Getis and Ord distance statistic based on the weight matrix "INV2_400". Slightly different clubs result for one of the other matrices. The classification seems to be quite reasonable: Regions with a relatively low income in 1995 are forming club "A", whereas mainly the old members of the EU-25 form club "B". It should be mentioned that identifying the clubs based on initial income, is only one way and maybe just the most obvious.[19] The diagnostics for spatial dependence of a least squares-estimation of the regime switching model are given in Table A.4 in the appendix section. Based on the "RMLag" test, again the SAR model specification is chosen. Table 4 consists of the estimation results:

[19] Niebuhr et al. (2005) focus on another approach that distinguishes between rural and urban regions based on population density.

Table 4: SAR Regime-Switching Model

Dependent Variable:	$\left(1/t\right)\log\left(y_{i,02}/y_{i,95}\right)$			
	Estimate	*Std. Error*	*t- value*	*Pr(>|t|)*
ρ	0.734773	0.064447	11.401133	0.000000
α_1	0.079586	0.027477	2.896462	0.003774
β_1	–0.007259	0.002808	–2.584266	0.009759
α_2	0.073150	0.022659	3.228424	0.001245
β_2	–0.006255	0.002259	–2.769184	0.005620
AIC / LOG.LIK	–1506.23 / 758.115			
TEST ON STRUCTURAL INSTABILITY FOR 2 REGIMES – CHOW TEST				
	DF	*Value*	*Prob.*	
Chow Test	2	4.531363	0.103759	
STABILITY OF INDIVIDUAL COEFFICIENTS				
	DF	*Value*	*Prob.*	
A_1	1	0.037881	0.845682	
B_2	1	0.083282	0.772898	

Source: Author's calculations.

The coefficient of the spatially lagged dependent variable is again positive and statistically different from zero. The β-coefficients for both clubs are negative pointing to a catching up process. They do not vary significantly from those of the former estimated SAR model based on the whole sample which indicates that we do not have club convergence in the EU-25. This is confirmed by running Chow tests. The tests for structural instability yield the conclusion that the regression as a whole and the individual coefficients do not vary significantly across the two regimes. Summing up I cannot detect a significant variance of the slope coefficient nor the functional relationship across the two regimes, while absolute convergence still holds for both convergence-clubs. In deviation to Fischer and Stirböck (2004) the chosen model specification is a spatial autoregressive regime-switching model with a homoskedastic error term. This difference might be caused by the different time period of analysis as well as by the smaller data set of this study[20]. The implied speed of convergence for club "A" is 0.7449% and for club "B" 0.6396% resulting into half-distances to steady states of approximately 93.05 and 108.38 years. The lack of significance concerning variation of relationship or variance indicates that the EU-25 regions are not characterized by two different clubs. Thus regions do not interact significantly more with a specific sub-group of the sample than with the rest of the EU-25.

[20] Fischer and Stirböck (2004) analyze regional convergence for the period of 1995-2000 including accession countries Bulgaria and Romania.

6.2 Growth Effects of Spillovers

The previous analyses showed that spatial dependencies are evident in the absolute convergence model. A possible conclusion could be the significant influence of regional spillovers on the convergence process. It seems reasonable to assume that spatial interaction of localities is highest within the regions of a country. To which extent does the detected spatial dependence stem from national factors and to which extent from regional spillover effects? National factors (or country effects) are considered as being the fact that regions forming a country share the same economic policies, legislation and institutions.[21] Quah (1996) draws attention to that question by analyzing income distributions. His conclusion is that regional spillovers matter more for the convergence process than national factors, which is in contrast to recent findings (based on a dummy variable approach) by Niebuhr et al. (2005).

For this purpose a special weight matrix "INV1_NAT" is constructed that displays within-country interaction. Here, regions are only allowed being neighbors of each other when they stem from the same country. I have re-estimated the convergence model including the 6 dummy variables starting again with the OLS specification. It is striking that this time all the Lagrange Multiplier specification tests point to the SER model as the specification fitting the data well. This means that, once controlled for national influences incorporated in the model by the specific weight matrix "INV1_NAT", the spatial dependence is of the nuisance form. It can be concluded that spillovers across regions are to a less extent influential to growth than national effects. Thus spatial dependence results only to a small part from spillovers. Table 5 summarizes the model.

Table 5: SER Model

Dependent Variable:	$(1/t)\log\left(y_{i,02}/y_{i,95}\right)$			
	Estimate	*Std. Error*	*z-value*	*Pr(>|z|)*
α	0.114821	0.023972	4.789819	0.000002
β	–0.006962	0.002535	–2.746861	0.006017
λ	0.694379	0.051955	13.365094	0.000000
Log.Lik.:	782.276000			
AIC:	–1548.550000			

Source: Author's calculations.

The coefficient of convergence speed does not deviate from the previous findings in section 5. Based on this model specification it can be concluded that rather country-specific-effects than spatial spillovers cause the spatial dependence of

[21] Niebuhr et al. (2005).

regional growth. This supports the findings of Niebuhr et al. (2005) and is thus in contrast with those of Quah (1996). The reason can be found in his definition of a neighbor. Quah considered only those regions as neighbors that are adjacent to each other, i.e. neighbors share a common border. Hence, in his sample of 78 regions, only 13 had neighbors belonging to another country. In this context this study differs considerably from Quah's research: The intra-country spatial correlation is compared with regional interaction, incorporated by weight matrices that allow for a multitude of neighbors.

7. Conclusions

This study analyzed absolute income convergence across EU-25 regions. The traditional OLS cross-sectional regression was the initial reference point. Exploratory spatial data analysis as well as several tests showed that spatial autocorrelation is present in the data. Depending on the specified weight matrix, in most instances spatial dependence turned out to be of substantive form pointing to biased OLS estimates. Hence, the already low "OLS-convergence rate" of 1.5% per year cannot be confirmed. In contrast, estimates based on spatial regressions lead to a lower annual rate ranging from 0.7% to 0.9%. Results are fairly robust to a wide range of possible misspecifications. In this study several weight matrices are used that allow for a wide range of spillovers. From an economic point of view the spatial autoregressive model bears important policy implications: It indicates a significant influence of regional spillover effects on convergence – a dynamic surrounding influences a region's growth performance. The framework of the two-club convergence model allows for examinations of distinct sample parts' behavior. The estimated pace of convergence for the two clubs lies again in the range of 0.7% to 0.9% per year. Since convergence rates of the two clubs differ only slightly, evidence for spatial heterogeneity is rather weak. The model showed no variance of the functional relationship across the two regimes. As before, a spatial autoregressive model is the final specification. Thus it can be concluded that the SAR model specification also holds for sub-samples of the data.

Besides, this study gives insights about the source of spatial autocorrelation. Estimating convergence with the intra-country weight matrix, spatial spillovers seem to be less effective. This means, once controlling for country effects, a large part of spatial autocorrelation vanishes. In line with Niebuhr et al. (2005) it might be concluded that most of the spatial autocorrelation is based on differences in national policies, legislation, tax-systems and other country-specific effects. These national factors play a more important role in determining growth than spillovers do.

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Appendix

I have constructed two different types of weight matrices, binary contiguity matrices and inverse distance matrixes, both using a distance cut-off point δ. Every region j, with $i \neq j$ that lies within this distance is considered a neighbor of region i and gets assigned a nonzero weight. Distance is calculated using great circle distance based on longitude-latitude data for every NUTS 2 capital city of the EU-25 assuming that the capital reflects a region's centre of economic activity. Formally this is given by:

$$w_{ij} = \begin{cases} 1/d_{ij}^{\alpha} & \text{if } d_{ij} \leq \delta \text{ for } i \neq j \\ 0 & \text{if } i = j \\ 0 & \text{if } d_{ij} > \delta \text{ for } i \neq j \end{cases} \tag{6}$$

The binary contiguity matrices "CON350" and "CON220" use weights $w_{ij}=1/d_{ij}$ with a threshold point at a distance of δ=350 miles (ca. 563 km) and δ =220 miles (ca. 350 km) respectively. Weight matrices based on inverse distances are the matrices "INV1_400" "INV2_400" and "INV2_220". The first one assigns a weight to every region lying in a 400 miles (ca. 643 km) distance band according to the inverse distance $w_{ij}=1/d_{ij}^{\alpha}$ with α=1. The second one resembles the same matrix, only differing in α being 2. The last one, "INV2_220" uses the squared, inverse distances, i.e. $w_{ij}=1/d_{ij}^{\alpha}$ (α=1) for a distance band of 220 miles. The "INV1_NAT" matrix was designed aiming to get insight of intra-country spillovers. It reflects spatial interaction of regions within a country assigning weights $w_{ij}=1/d_{ij}$ for each region $i \neq j$ with i and j from the same country (otherwise the weight is zero).

Table A1:

REGRESSION DIAGNOSTICS for SER Model			
Diagnostics for heteroskedasticity			
Test	DF	Value	Prob.
Breusch-Pagan Test	7	3.451172	0.840370
Spatial B-P test	7	3.451194	0.840368
DIAGNOSTICS FOR SPATIAL DEPENDENCE			
Weights matrix INV_400			
Test	DF	Value	Prob.
Spatial Error dependence	1	61.393642	0.000000
TEST ON COMMON FACTOR HYPOTHESIS			
Likelihood Ratio Test	7	29.363158	0.000124
Wald Test	7	30.032716	0.000094
LAGRANGE MULTIPLIER ON SPATIAL LAG DEPENDENCE			
INV2_400	1	5.961694	0.014620

Source: Author's calculations.

Table A2:

REGRESSION DIAGNOSTICS for SAR Model			
Diagnostics for heteroskedasticity			
Test	DF	Value	Prob.
Breusch-Pagan Test	7	4.979513	0.662464
Spatial B-P test	7	4.979530	0.662461
DIAGNOSTICS FOR SPATIAL DEPENDENCE			
Weights matrix INV2_400			
Test	DF	Value	Prob.
Spatial Lag dependence	1	70.187049	0.000000
LAGRANGE MULTIPLIER ON SPATIAL ERROR DEPENDENCE			
INV2_400	1	0.032505	0.856925

Source: Author's calculations.

Table A3:

REGRESSION DIAGNOSTICS for OLS Model			
Test on normality of errors			
Test	DF	Value	Prob.
Jarque-Bera	2	4.331083	0.114688
Diagnostics for heteroskedasticity			
Test	DF	Value	Prob.
Breusch-Pagan Test	7	3.163053	0.869520

DIAGNOSTICS FOR SPATIAL DEPENDENCE Weights matrix INV2_400			
Test	MI/DF	Value	Prob.
Moran's I (error)	0.281891	10.288409	0.000000
RLMerr	1	2.700637	0.100308
RLMLag	1	10.572667	0.001148
Lagrange Multiplier (SARMA)	2	105.706119	0.000000

Source: Author's calculations.

Table A4:

Diagnostics for Spatial Dependence			
Test	DF	Value	Prob.
Robust LM (error)	1	0.097765	0.754529
Robust LM (lag)	1	13.589435	0.000227

Source: Author's calculations.

Hungary, Slovakia and the Czech Republic: Longer-Term Growth Prospects

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1. Introduction

In 1937, Austria was not radically different, in terms of affluence, from either Hungary or Czechoslovakia. According to Maddison (1995) in that year the per capita (PPP) GDP in Hungary was at 80% of the Austrian level. The Czechoslovak GDP level was even higher, 90.7% of the Austrian. Bearing in mind that the Czech part of Czechoslovakia was much more developed than the Slovak part, Austria must have been actually poorer than the Czech lands in 1937. By 1995 the relative GDP positions had changed fundamentally. The Czech per capita GDP stood at 51% of the Austrian level, the Hungarian at 38% and the Slovak at 34.5% (Podkaminer and Hunya, 2005). Since then, however, the GDP gaps have been narrowing. By 2004 they stood at 57.7%, 50.3% and 43.0% respectively. Over the years 1995–2004 growth in the Czech Republic was faster than in Austria by an (implied) factor of 1.0138 (or by approximately 1.38 percentage points) per year. In Slovakia that factor equalled 1.0247 (or about 2.47 percentage points annually) and in Hungary 1.0316 (or 3.16 percentage points annually) respectively.

According to Maddison's recent (2002) judgement on the world's longer-term growth prospects, the per capita GDP in Western Europe will be rising by about 1.2% annually until 2015, while the per capita GDP in Eastern Europe (excluding the former USSR) will be rising by about 3%. The implied growth rate differential is about 1.78 percentage points annually. A mechanical application of these growth rates to the current (2004) per capita GDP levels of the countries considered suggests that by 2015, the Czech Republic will attain about 70% of the (then) Austrian level, Hungary 61% and Slovakia 52%.

The hypothesis of an approximately 1.8% growth differential (Eastern vs. Western Europe) is actually close to the assumption of a 2% growth differential which the wiiw has long been using in its 'catch-up' computations (see e.g.

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Podkaminer and Hunya, 2005). Of course, differentials of that order are not carved in stone. Various studies suggest different values for the future growth rates for the new EU Member States. Nonetheless, this work will provide some additional material suggesting that the three East European neighbours of Austria will continue their catching-up process at fairly moderate speeds.

2. The 'New Growth Theory' Approach

The prevailing approach to an assessment of longer-term growth prospects of emerging (i.e. 'less developed') economies is consistent with the 'new growth theory' (NGT; see, e.g., Barro and Sala-i-Martin, 1995). Unlike the traditional neoclassical growth accounting, the NGT allows for a number of 'soft' factors (e.g. pertaining to various institutional characteristics, quality of human capital etc.[2]) believed to be ultimate determinants of long-run economic growth. The rise of the NGT has probably much to do with the practical difficulties with the traditional neoclassical growth accounting (à la Robert Solow). The empirical estimates of the 'Solow residuals' do not show any regular trends over time, or space. Thus, even with reasonable assumptions concerning the trajectories of 'material inputs' (labour and capital) it is eventually rather difficult to be specific about the resulting growth paths. A way out is to relate the total factor productivity estimates to various 'institutional factors' – i.e. just the ones taken seriously in the NGT (see, e.g., Senhadji, 2000)[3].

Of course, there has been no 'pure' NGT: there is no theoretical model mathematically linking growth rates to a specific set of well-defined, measurable parameters. In practice the NGT researchers are free to define the variables and relationships they believe to be important. This stage of modelling is then followed

[2] Sometimes the growth theorists suggest to include even cultural factors, such as the population's religious beliefs (see Sala-i-Martin, 1997). More traditionally-minded NG theorists usually do not go that far (see Sachs and Warner, 1997).

[3] The traditional neoclassical growth theory, as well as its NGT versions, are rejected by a significant fraction of economists following the neo-Ricardian and/or post-Keynesian traditions (see, e.g., Pasinetti, 2000). They do not accept the idea of a macroeconomic production function. In a study by a leading 'structuralist' (Taylor and Rada, 2003) there is no place for the concept of total factor productivity. Instead, separate trends in labour and capital productivities are extrapolated from the past trends (with labour productivity being affected by the years of education, representing human capital formation). As far as Eastern Europe is concerned, the outcomes of the 'structuralist' model are generally consistent with those of most of the NGT approaches. In the long run (until 2030) the calculated per capita GDP growth rate in Eastern Europe is 3.2% per annum, against 1.8% assumed for the rich OECD countries. Maddison (2002) also suggests a 1.8% growth rate for the rich OECD countries, but with Western Europe's per capita GDP rising less, by 1.2%. In effect, Taylor and Rada's calculations support the conventional assumption of a 2 percentage points growth differential (Eastern vs. Western Europe).

by extensive econometric estimation and testing, usually with large cross-country time series sets of observations. It goes without saying that the eventual findings proposed by various researchers do differ, sometimes quite substantially (e.g. as far as the importance of particular factors is concerned). There is no consensus yet on the ‘best’ NGT model. Despite this, the models following the NGT appear to be preferred to more ‘mechanical’, hard-core, longer-term macro forecasting models for East European countries also for quite practical reasons. As documented by many authors (e.g. Berg et al., 1999, Campos and Coricelli, 2002, Fisher and Sahay, 2000, Havrylyshyn et al., 1998), the growth (actually decline) over the early transition years, and the ensuing recoveries in the mid-1990s, were dominated by radical institutional changes, abrupt alterations in the macroeconomic environment etc. The factors ‘explaining’ macro performance over much of the 1990s will not be playing any role in the future. By the same token the basic statistical data on the behaviour of the economies in question during the 1990s are at best of problematic value in specifying the behavioural equations which could be supposed to describe these economies’ future performance.

3. Early Attempts at Assessing the Longer-Term Growth Rates

From the large number of empirical NGT studies available already at the beginning of the 1990s, two concrete specifications have gained wider popularity: Barro’s (1991) and Levine-Renelt’s (1992). The Barro growth equation is as follows:

$$\text{p.c. GDP growth rate} = 0.302 - 0.0075Y + 0.025PRIM + 0.0305SEC - 0.119GOV$$

where Y° is the log of p.c. GDP in 1960 (at PPP); PRIM is the primary school enrolment rate; SEC is the secondary school enrolment rate; and GOV is the share of government consumption expenditure in GDP. The Levine-Renelt growth equation is as follows:

$$\text{p.c. GDP growth rate} = -0.83 - 0.35Y - 0.38POP + 3.17SEC + 17.5INV$$

where Y is p.c. GDP in 1960 divided by 1000 (at PPP); POP is the growth rate of population; and INV is the share of gross fixed investment in GDP.

Both growth equations were re-specified with the data for the European transition economies for the year 1995 and then used for calculating the longer-run growth rates (see Fischer et al., 1998). Table 1 reports the outcomes of these calculations, as well as of some hypothetical alternative scenarios.

Table 1: Per Capita GDP Growth Rates for the Czech Republic, Hungary and Slovakia Obtained from Barro and Levine-Renelt Equations

	Barro		Levine–Renelt	
	GOV(1995)	GOV=0.10	INV(1995)	INV=0.30
Czech Republic	4.24	5.47	4.66	4.48
Hungary	5.15	5.15	3.51	4.47
Slovakia	4.66	5.85	3.63	4.98

Source: Fischer et al. (1998).

The first 'Barro' column in table 1 gives the growth rates calculated under the assumption that the government consumption share is kept at the level of 1995 (estimated by the IMF at 0.20 in the Czech Republic and Slovakia and at 0.10 in Hungary)[4]. The second 'Barro' column gives the growth rates under the assumption of government consumption being kept at 10% of the GDP. The first 'Levine-Renelt' column gives the growth rates calculated under the assumption that the share of gross fixed investment is kept at the level of 1995 (estimated by the IMF at 0.31, 0.23 and 0.22 respectively[5]). The last column in table 1 gives the growth rates calculated under the assumption that INV is kept at 30% of the GDP.

The more comprehensive models proposed by Barro and Sala-i-Martin (1995) 'explain' the per capita GDP growth rate by adding to Barro's (1991) list of explanatory variables some additional ones such as life expectancy at birth, UNDP's Human Development Index, share of government spending on education in GDP, share of investment in GDP, the Heritage Foundation's economic instability indicator etc.

A concrete version of the Barro–Sala-i-Martin model was specified with data for the European transition economies available in 1998 and then run under alternative scenarios for the consecutive decades 2000–2010, 2010–2020, 2020–2030 and 2030–2040. The full description of that version (NOBE, 2000) is available on the internet. The growth estimates for the Czech Republic, Hungary and Slovakia, derived under a base scenario[6] (with neither too pessimistic nor too optimistic assumptions) are collected in table 2.

[4] The actual GOV shares for 1995 are close to 0.20 in the Czech Republic and Slovakia (0.199 and 0.205 respectively), but vastly different from 0.10 in Hungary (0.24). The proper 'Barro GOV(1995)' estimate for Hungary is 3.5% instead of the 5.15% projected.

[5] The actual INV shares for 1995 are 0.32, 0.19 and 0.25 respectively (see *wiiw Handbook of Statistics*). The proper 'Levine-Renelt' growth rates under the INV(1995) scenario are 4.85%, 2.81% and 4.16% respectively.

[6] The base scenario assumes, somewhat optimistically, that the investment shares will be converging (from the levels observed in 1997) to 30% in 2010 and then will be continually declining to 20% by the year 2040.

Table 2: Per Capita GDP Growth Rates Derived from a Barro–Sala-i-Martin Model, Base Scenario

	2000–2010	2010–2020	2020–2030	2030–2040
Czech Republic	4.0	4.7	3.7	2.9
Hungary	5.5	5.0	4.0	3.2
Slovakia	5.1	4.6	3.6	2.9

Source: NOBE (2000).

The average growth rates for the 2000–2020 period implied by table 2 are 4.3% for the Czech Republic, 5.2% for Hungary and 4.8% for Slovakia. These numbers happen to be similar to the estimates reported in table 1 (the 'Barro GOV(1995)' column). However, the estimates for the current decade (2000–2010) reported in table 2 do not look very realistic because so far (for the period 2000–2004) the actual growth rates appear significantly lower in the Czech Republic (2.9%) and in Hungary (3.6%). Only in Slovakia the observed growth rate (4.6%) appears to be close to the projected one.

A particular assumption behind the growth rates from table 2 is about the share of gross fixed investment reaching a peak of 30% in 2010. However, investment shares have so far not followed upward trends in the 2000s. On average the investment share is about 27.3% in the Czech Republic, 22.6% in Hungary and 24.6% in Slovakia – with very little variation over time. For that reason it makes sense to consider the outcomes of a 'low scenario' assuming the investment share to rise to 30% of the GDP only by the year 2020. (The 'low scenario' is also less optimistic on enrolment rates, life expectancy and political stability.) The outcomes of the 'low scenario' are found in table 3. As can be seen, the projected growth rates for 2000–2010 are much closer to the rates actually observed in recent years. This suggests that in the longer run (i.e. until about 2020) per capita GDP in the Czech Republic will be rising by 3.7–4.2%, in Hungary by 4.7–4.3%, and in Slovakia by 4.7–4.1%.

Table 3: Per Capita Growth Rates Derived from a Barro–Sala-i-Martin Model, 'Low' Scenario

	2000–2010	2010–2020	2020–2030	2030–2040
Czech Republic	3.7	4.2	3.3	2.5
Hungary	4.7	4.3	3.5	2.8
Slovakia	4.7	4.1	3.2	2.5

Source: NOBE (2000).

4. Recent Attempts at Assessing the Longer-Term Growth Rates

4.1 The Wagner-Hlouskova Study

The parameters of equations underlying the growth rate projections tend to be derived econometrically from large heterogeneous panels, with data on the past performance of many countries largely unrelated to Central and Eastern Europe (and to Europe generally). In a recent study by Wagner and Hlouskova (2005) the estimation is based on data for the 14 'old' EU Member States (excluding Luxembourg). The entire sample period 1960–2001 is divided into four ten-year sub-periods. With the overall set of 56 observations they estimate 18 versions of the growth rate equation. The dependent variable is the growth rate of per capita GDP. All versions include the log of the initial GDP level (at PPP), the average share of government consumption in GDP, and the average share of fixed investment among its explanatory variables. The specific versions differ by the additional explanatory variables included: primary school enrolment rate, ratio of foreign trade to GDP, share of exports in GDP, population growth rate. Besides, three dummies are included in some versions of the basic equation: (1) for the first decade 1960–1969; (2) for Ireland; (3) for Germany in the last decade (1990–2001). The adjusted R-squared for the versions of the equation range between 0.470 and 0.639 with only one version displaying a low 0.293 adjusted R-squared value.[7] Generally, the estimates of the constant term are the most significant (and large) items – with other parameter estimates consistent (at least as far as their signs are concerned) with the common 'theoretical' beliefs. Thus government consumption appears to be 'bad' for growth, while investment and education are 'good'. Interestingly, the parameter for the German dummy, included in two versions, turns out to be significant, but very small and – unexpectedly – positive. Being Germany in the last decade meant having 0.3 percentage points higher growth than explained by all other factors then at work. Being Ireland meant having growth higher by 1.2–1.5 percentage points in all periods. The parameter for the dummy for the first decade is highly significant and fairly high – which is not surprising as the 1960s were the last decade of the post-war 'golden age' of capitalism. In the first decade growth, as 'explained' by the model, would have been higher by 1.1–1.3 percentage points than in the remaining decades, with all other factors being equal.

[7] The properties of the residuals of the individual versions of the growth equation are not discussed in Wagner and Hlouskova. On the other hand the average (over all 18 versions, and individual countries) errors seem quite low. The highest average error calculated for the whole EU-14 is 0.3 percentage points (against an actual growth rate of 1.96%) in the second period. For the remaining three periods the average errors are much lower.

Wagner and Hlouskova consider seven specific scenarios for the East European countries. The scenarios differ by the magnitudes of the shares of gross fixed investment and of government consumption in the GDP. Overall, the investment shares assumed are quite high, as compared to the actual values observed in the early 2000s in Hungary. Their average (over the scenarios considered) is 26.1% – by far more than the recently recorded average of 22.9%. The government consumption shares considered are rather too low, for all three countries. The averages (over the scenarios) of the government consumption shares are 13.9% in the Czech Republic and Slovakia, and 12.6% in Hungary. Each of the 18 versions of the growth equation, specified with data for individual East European countries, is then run for each of the seven scenarios considered. In effect one obtains 126 growth rate projections for each country. For the three countries under consideration here, the distributions of those projections are given in table 4.

Table 4: Characteristics of the Distributions of the Growth Rates Projected (in %)

	Mean	**Std. Deviation**	**10%**	**90%**
Czech Republic	3.32	0.44	2.62	3.76
Hungary	3.29	0.40	2.68	3.75
Slovakia	3.33	0.42	2.73	3.83

Note: The 10% and 90% columns contain the first and ninth decile of the distribution of the projected growth rates.

Source: Wagner and Hlouskova (2005).

As can be seen, the Wagner-Hlouskova results paint a much less optimistic picture than the earlier studies. Moreover, if one revised the unreasonably low levels of government consumption underlying the scenarios considered, one would end up with even lower values for the means and deciles than the ones reported in table 4. If the average shares of government consumption in GDP are at a realistic 20%, then the means and deciles for all three countries will be lower by some 0.5 percentage points. Thus the average expected growth rates for all three countries would be about 2.8%. As the mean growth rate for the EU-14 derived similarly as the means reported in table 4 is about 2.14%, the growth differential would be small, about 0.6 percentage points per annum. Under such conditions the catch-up process would be very long indeed – a matter of hundreds of years.

4.2 The NOBE II Study

The Wagner-Hlouskova study (and the earlier studies referred to above) do not allow, at least explicitly, for the so-called beta-convergence (i.e. the convergence in income levels due to alleged advantages the poorer countries have on account of availability of capital and/or advanced technologies supplied by highly developed countries). The fact that the Wagner-Hlouskova study is concerned with growth equations estimated with data for a fairly homogeneous set of (predominantly highly developed) countries may explain why the resultant growth rate estimates for the new EU Member States are so low. The specific Wagner-Hlouskova equations are in fact incapable of capturing, even indirectly, the beta-convergence because there was very little scope for any significant beta-convergence in the EU-14 over the period 1960–2001. (True, the cohesion countries have been catching up with the remaining 11 countries, but within the latter homogeneous group convergence has been insignificant.)

It is generally assumed that beta-convergence actually takes place under suitably stable political and economic conditions. Under such conditions the parameter β, measuring the speed of convergence, is assessed (or assumed) to be about –2% (meaning that the per capita PPP GDP gap between the leading and the backward areas shrinks by about 2% per annum, at least in the longer run). Of course, it is essential to relate β to some relevant indicators empirically. The NOBE (2002) study (NOBE II henceforth) worked with 112 observed β (vs. the EU-15) for 26 countries (from Europe as well as the Americas, Africa and Asia) over four consecutive decades (1960s, 1970s, 1980s and 1990s); β was regressed on five variables (and eight dummies for some country/decade observations). The results of the regression analysis are shown in table 5.

Table 5: Speed of Convergence (β) 'Explained': Regression Results

Variable	Coefficient	Standard error	t-Statistics	p-value
Constant	1.334	0.38	3.50	0.00
Political stability index	–0.173	0.08	–2.08	0.04
Public spending on education (% GDP)	–0.133	0.06	–2.05	0.04
Change in relative telephone density	–0.057	0.01	–6.24	0.00
Gross domestic savings (% GDP)	–0.030	0.01	–2.70	0.01
Inflation rate	0.010	0.00	6.45	0.00

Note: The relative telephone density is the per capita number of fixed telephone lines relative to the average for the OECD countries.

Source: NOBE (2002).

As can be seen, all coefficients have 'correct' signs, and are all highly significant. (The political stability index ranges between 0 and 6; 0 stands for protracted wars, revolutions, collapse of the state, 6 stands for complete political stability, EU membership.) The overall fit is quite good (the adjusted R–squared is 0.792). Moreover, the explanatory variables are only weakly correlated (thus co-linearity is not a problem).

The equation for β can be used for assessing the future growth rates in the new EU Member States. More specifically, first one has to set some plausible scenarios on the future developments of factors determining the β parameters for the Czech

Republic, Hungary and Slovakia. The NOBE II study considers three scenarios ('low', 'base', and 'high'). The 'low' scenario assumes a political stability index equal to 5 for the years 2000-2010 (similarly as in 1995–2000) and equal to 5.5 for the years 2010–2020, in all three countries. In the remaining two scenarios the political stability index is assumed to equal 5.5 over the years 2000–2010 and 6 later on, in all three countries. In the 'low' scenario inflation is assumed to be 5% per annum in the first decade and 4% in the second. In the remaining scenarios inflation equals 4% in the first decade, followed by 2% in the second. The remaining characteristics of the scenarios considered are contained in table 6. The numerical values for the β parameters for the three scenarios are found in table 7.

Table 6: Characteristics of the NOBE II Scenarios

		actual	**low**		**base**		**high**	
		1995–00	**2000–10**	**2010–20**	**2000–10**	**2010–20**	**2000–10**	**2010–20**
Public spending on education	CZ	5.4	5.2	5.6	5.7	6.3	6.2	7.1
	HU	5.3	5.1	5.6	5.6	6.3	6.1	7.1
	SK	5.0	5.0	5.5	5.3	6.3	6.0	7.0
Relative telephone density	CZ	63.2	66.9	72.5	70.5	79.4	72.4	83.4
	HU	63.2	66.9	72.5	70.5	79.4	72.4	83.4
	SK	52.3	57.0	65.6	61.8	73.3	74.2	78.5
Gross domestic savings	CZ	28.1	26.6	25.8	29.1	29.5	30.6	31.8
	HU	28.2	26.6	25.8	29.1	29.5	30.6	31.8
	SK	25.2	25.1	25.0	27.6	28.8	29.1	31.0

Source: NOBE (2002).

Table 7: β Parameters (%) for the Three Scenarios

	low		**base**		**high**	
	2000–10	**2010–20**	**2000–10**	**2010–20**	**2000–10**	**2010–20**
Czech Republic	–1.2	–1.7	–2.0	–2.5	–2.6	–3.2
Hungary	–1.2	–1.7	–2.0	–2.5	–2.6	–3.2
Slovakia	–1.2	–1.7	–2.1	–2.6	–2.7	–3.4

Source: NOBE (2002).

The specific β parameters allow the computation of growth rates of per capita GDP. However, this requires additional assumptions on the per capita GDP growth rates in the EU-15. The NOBE II study models, quite extensively, the long-term growth for the EU-15 (and other highly developed OECD) countries. For our current purposes it is sufficient to know that the NOBE II study ends up with three scenarios of growth in the EU-15: 'base', 'low', and 'high'. The 'base' scenario stipulates 2.4% annual per capita GDP growth over 2000–2010, followed by 2.3% over 2010–2020. The 'high' scenario stipulates a 2.7% growth rate in either decade, while the 'low' scenario stipulates a 2% growth rate in the first decade, followed by a 1.7% rate in the second.[8] The results of the NOBE II study for our three countries are reported in tables 8 and 9.

Table 8: Per Capita GDP Growth Rates (%) in the NOBE II Study

	low		**base**		**high**	
	2000–10	**2010–20**	**2000–10**	**2010–20**	**2000–10**	**2010–20**
Czech Republic	2.7	2.5	3.6	3.3	4.2	3.9
Hungary	3.0	2.8	4.0	3.7	4.7	4.2
Slovakia	3.1	3.0	4.3	3.9	5.0	4.5
EU-15	2.0	1.7	2.4	2.3	2.7	2.7

Source: NOBE (2002).

Table 9: Per Capita GDP Levels Relative to the EU-15 (at Constant 1999 PPP)

		low		**base**		**high**		***actual***	
	2000	**2010**	**2020**	**2010**	**2020**	**2010**	**2020**	***2000***	***2004***
Czech Republic	60.0	64.4	69.9	67.4	74.7	69.4	77.9	*59.6*	*63.1*
Hungary	52.0	57.3	63.9	60.8	69.6	63.2	73.4	*48.2*	*52.4*
Slovakia	48.5	54.2	61.6	58.3	68.0	60.9	72.2	*42.0*	*47.4*
EU-15	100.0	100.0	100.0	100.0	100.0	100.0	100.0	*100.0*	*100.0*

Source: NOBE (2002) and authors' calculations (last two columns).

The first column of table 9 gives the initial values for the relative per capita GDP levels assumed in the NOBE II study for the year 2000. These values differ – in particular for Hungary and Slovakia – from the updated (actual) values for 2000, which are reported in the penultimate column of table 9. The last column of table 9 gives the most recent (2004) values of the relative per capita GDP levels in the three countries considered, expressed at constant 1999 PPP. (At current PPP the relative values in question were slightly different from the constant-PPP ones: in the Czech Republic they were at 58.5% in 2000 and 64.2% in 2004. The respective values for Hungary were 48.2% and 55.9%; for Slovakia 42.0% and 47.8%.)

As can be seen, the NOBE II study suggests growth rate differentials vs. the EU-15 distinctly higher than the Wagner-Hlouskova study. For the 2000–2010 decade the differentials range between about 0.7% and 1.5% for the Czech Republic, 1% and 2% for Hungary and 1.1% and 2.2% for Slovakia. For the 2010–2020 decade the differentials range between 0.8% and 1.2% for the Czech Republic, 1.1% and 1.4% for Hungary and 1.3% and 1.8% for Slovakia.

[8] The NOBE model for the highly developed OECD countries stipulates a per capita GDP growth rate in Austria ranging between 2.5% and 3.2% in the first decade and between 1.8% and 3% in the second decade.

5. Updating the NOBE II Calculations

5.1 Political Stability

The NOBE II model can be updated and run for the years 2005–2015. The most consequential revision is about the index of political stability. In all scenarios for 2005–2015 it is to be assumed that the political stability index equals 6 (and not 5.5 or even 5.0, as was assumed in some scenarios of the original NOBE II study). Besides, it makes sense to revise the numerical values for some other determinants of the β parameters, for instance, the inflation rate in the Czech Republic – which is highly unlikely to be 4% or 5% p.a. as was assumed in some scenarios of the original NOBE II study.

The three updated scenarios ('low', 'base' and 'high') for the decade 2005–2015 assume the shares of gross domestic savings in GDP to be the same as in the respective NOBE II scenarios for the years 2000–2010 (see table 6). The numerical values for public spending on education and for relative telephone density for the years 2005–2015 are assumed to be the averages of the respective values for the decades 2000–2010 and 2010–2020 (see table 6). Besides, the initial relative per capita GDP positions (for 2004) represent the current knowledge (and are taken from the last column of table 9).

The growth rates and relative per capita GDP positions allowing for the revisions just characterized are found in table 10.

Table 10: Per Capita GDP Growth Rates for the Years 2005–2015 and Relative per Capita GDP Positions at Constant 1999 PPP in 2015

	growth rates			relative positions			
						2015	
	low	base	high	2004	low	base	high
Czech Republic	2.8	3.6	4.1	63.1	68.7	71.3	73.2
Hungary	3.2	4.1	4.8	52.4	59.4	62.9	65.3
Slovakia	3.4	4.6	5.2	47.4	55.5	59.4	62.1
EU-15	2.0	2.4	2.7	100.0	100.0	100.0	100.0

Source: Authors' calculations.

As can be seen, the updates result in the growth rates for the years 2004–2015 being slightly higher than in the original NOBE II calculations for the years 2000–2010. Correspondingly, the growth rate differentials vs. the EU-15 appear to be somewhat higher. They range between 0.8% and 1.4% for the Czech Republic, 1.2% and 2% for Hungary, and 1.5% and 2.5% for Slovakia.

5.2 The Position versus Austria

At 1999 PPP the Czech per capita GDP was equal to 55.1% of the Austrian level, Hungary's to 46% and Slovakia's to 41.5% in 2004. Assuming future Austrian per capita GDP growth rates equal to those of the EU-15 (as in table 10) one can project the relative position vs. Austria of the three countries considered (see table 11).

Table 11: Per capita GDP in 1999 and 2004 and projections for 2015 (in EUR, at constant 1999 PPP)

			2015		
	1999	**2004**	**low**	**base**	**high**
Czech Republic	12139	14130	18586	20850	21984
Hungary	9707	11765	16637	18304	19704
Slovakia	8717	10643	15375	17555	18588
Austria	23445	25625	31881	33263	34351
	as % of the Austrian level				
Czech Republic	51.8	55.1	58.3	62.7	64.0
Hungary	41.4	46.0	52.2	56.0	57.4
Slovakia	37.2	41.5	48.3	52.8	54.1

Source: Authors' calculations.

Total GDP levels (allowing for the likely demographic changes) are reported in table 12.

Table 12: Total GDP at Constant 1999 PPP

				GDP (EUR billion)				
	Population (million)					2015		
	1999	**2004**	**2015**	**1999**	**2004**	**low**	**base**	**high**
Czech Republic	10.3	10.2	10.1	124.9	144.1	188	211	222
Hungary	10.1	10.1	9.8	97.7	118.8	163	179	193
Slovakia	5.4	5.4	5.4	47.1	57.5	83	95	100
Total	25.8	25.7	25.3	269.7	320.4	434	485	516
Austria	8.1	8.2	8.3	189.7	207	261	273	282

Note: The population projections for 2015 are taken from the UN forecast (UN, 2005).

Source: Authors' calculations.

As can be seen, the combined economic 'weights' of the three Austrian neighbours will be increasing relative to the Austrian economic 'weight'.

At constant PPP for more recent years, the position of the three countries vs. Austria is projected to be even more favourable. This is exemplified by table 13, with all relevant indicators expressed at constant 2004 PPP.

Table 13: Projected Positions vs. Austria at Constant 2004 PPP

		2015				2015		
	2004	**low**	**base**	**high**	**2004**	**low**	**base**	**high**
	per capita				**total (EUR billion)**			
Czech Republic	15647	21201	23088	24344	160	213	232	245
Hungary	13623	19264	21195	22816	138	189	208	224
Slovakia	11645	16822	19098	20338	63	91	103	110
Total					361	493	543	579
Austria	27104	33700	35183	36334	222	280	292	302
	as % of Austrian level							
Czech Republic	57.7	62.9	65.6	67.0				
Hungary	50.3	57.2	60.2	62.8				
Slovakia	43.0	49.9	54.3	56.0				

Source: Authors' calculations.

As can be seen, at constant 2004 PPP the three countries' positions vs. Austria are higher by 2–5 percentage points. These 'improvements', representing the effects of favourable changes in the structure of prices and quantities produced/consumed in the catching-up countries, must be expected to continue in the future as well. At current PPP of the year 2015 the positions of our three countries vs. Austria (and the whole EU-15) may well turn out to be higher than suggested by table 13 by several per cent. (The structural changes, in prices and quantities, improved the position of the Czech Republic vs. Austria by 4.7% over the years 1999–2004, with quantitative change adding 6.3%. For Hungary the respective components are 9.3% and 11.1%, for Slovakia 3.6% and 12%. It seems quite reasonable to expect the structural changes to produce effects of at least similar size over the period twice as long: 2004–2015.)

Also at current market prices and exchange rates the three countries have been catching up with Austria. This is yet another indication of the continuing structural change and price convergence. At current exchange rates the combined GDP of the three countries constituted about 60% of the Austrian GDP in 1999. By 2004, that ratio was 84%. By 2015 the combined GDP at current prices and exchange rates of the three countries will be significantly higher than the Austrian GDP. At the same time the relative per capita GDP at current prices/exchange rates will still be about twice as high in Austria than in the countries considered. (In 2004 the Austrian per capita GDP at current prices/exchange rates was about three times the Hungarian and Czech levels and about four times the Slovak level.)

This conclusion can be substantiated with an analysis of the relationships between per capita GDP levels (at PPP) and the levels of the exchange rate deviation index (ERDI=ER/PPP). For Europe it turns out that there is a strong link between the two items, with the ERDI for the individual countries equalling roughly the relative per capita PPP GDP level vs. the EU-15.[9] The per capita PPP GDP in the three countries considered will be attaining about 70% of the EU level in 2015. Hence their ERDI will be about 0.7. Thus relative to the EU-15 their per capita GDP at the exchange rate will be about 50%.

5.3 Investment and Foreign Trade

The NOBE II model does not explicitly allow for capital formation (investment) and for foreign trade developments. Indirectly though, it allows for both: one of the explanatory variables determining the speed-of-convergence parameter (beta) is the share of gross domestic saving in the GDP. Of course, gross domestic saving is the sum of two items: gross capital formation and balance of trade in goods and non-factor services (the national accounts category). The major advantage in having the 'saving' variable instead of having separate 'investment' and 'trade' (exports, imports, trade balance) variables is that more often than not investment and foreign trade prove to be highly correlated. Investment expansion often tends to be associated with an acceleration of imports and deteriorating trade balances. (Also, imports and exports tend to be highly correlated.) The inclusion of separate variables for investment, exports, imports and trade balance is therefore quite risky econometrically. The estimates derived from observations that include data for strongly correlated explanatory variables are, apparently, highly significant, and the model's goodness-of-fit is seemingly superior. In actual fact the estimates derived from models with multicollinear explanatory variables are of little value.

The projected GDP levels for 2015 (see tables 11 and 12) have been derived on specific assumptions concerning the future shares of gross domestic savings in the GDP (see table 6). It is reasonable to expect that in the long run the shares of gross domestic savings will be converging to the shares of capital formation (and of gross fixed capital formation in particular). This regularity is simply explained: no country can indefinitely continue to be a net borrower (or lender). Nonetheless, for extended periods of time the trade imbalances (deficits or surpluses) can be

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9 The relationship ERDI = c*GDP (where GDP is the per capita PPP GDP relative to the EU-15) has been tested econometrically with the data provided by the ECP projects. The (population-weighted) cross-country equations for individual years yield highly significant results. (For instance, for 1996 c = 0.994, with t-Statistics = 47.8 and adj. Rsq. = 0.982. For 1999 c = 1.008, with t-Statistics = 43.3 and adj. R sq. = 0.977. For 2001 c = 1.011, t-Statistics = 39.2, adj.Rsq. = 0.971.)

significant. In the Central European transition countries (excepting Slovenia) the trade deficits have been rather high for quite some time. This applied also to the Czech Republic, Slovakia and Hungary. However, recently things have been changing. The ratios of trade deficits to gross domestic savings are on the decline. The 12-year average (covering the years 1993–2004) for these ratios were 9.4% in the Czech Republic, 13.6% in Hungary and 18.8% in Slovakia. The averages for the last four years equal 6.9%, 12.4% and 11.4% respectively. Apparently, trade balances are losing importance as components of gross national savings. Capital formation seems to have been gaining importance accordingly. This regularity is captured econometrically by the following regression:

$$I/S = C(1) + C(2)TB$$

where I is the share of gross capital formation in GDP, S is the share of gross domestic saving, TB is the share of the trade balance, and C(1) and C(2) are estimated parameters. The estimation, with yearly data for the period 1997–2004, delivered parameters significant at 1% levels. In all three cases the C(1) parameter is close to 1 (0.999; 0.993; 0.993), indicating 'closeness' of domestic savings and gross capital formation, while the parameter C(2) equals -0.039 for the Czech Republic, -0.045 for Hungary, and -0.044 for Slovakia.

Assuming that the relationship between I/S and TB remains valid over the next 11 years, one can calculate the ranges of the shares of gross capital formation and of trade balances corresponding to the projected GDP figures for 2015 (see table 14.

Table 14 suggests that in the future the character of growth in the three countries will be changing. Foreign trade will cease to be their Achilles' heel. This has already been evidenced by the recent performance of the Czech Republic. High capital formation will be increasingly financed domestically – the trade deficits will be quite low. Thus, the countries considered will become similar to Slovenia where relatively high levels of capital formation have been associated with roughly balanced trade in goods and services. The transformation of the three countries (from being chronically in deficit vs. the rest of the world) seems quite likely in the light of their recent trade developments. The volumes of their exports and imports have been rising at double-digit speed, and this despite the ongoing strong real appreciation of their currencies and apparent loss of external competitiveness (i.e. very fast rise in unit labour costs).

Table 14: Shares of Trade Balance, Gross Capital Formation and Gross Domestic Savings in 2004 and 2015

	2004	2015		
		low	base	high
Czech Republic				
Trade balance	–0.3	–0.7	–0.3	–0.2
Gross capital formation	27.6	27.3	29.4	30.8
Gross domestic savings	27.3	26.6	29.1	30.6
Hungary				
Trade balance	–3	–1	–0.7	–0.6
Gross capital formation	24.2	27.6	29.8	31.2
Gross domestic savings	21.2	26.6	29.1	30.6
Slovakia				
Trade balance	–2.7	–0.7	–0.4	–0.3
Gross capital formation	26.3	25.8	28	29.4
Gross domestic savings	23.7	25.1	27.6	29.1

Source: Authors' calculations.

5.4 Foreign Direct Investment

Hungary, the Czech Republic and Slovakia have been significant recipients of FDI. By the end of 2004 the stock of inward FDI was about EUR 42.2 billion in Hungary, 41.4 billion in the Czech Republic, and 11.0 billion in Slovakia.[10] By comparison, the FDI stock in Austria (as reported by Eurostat) was about EUR 41.2 billion in 2002. In that year, the combined FDI stocks of Hungary, Slovakia and the Czech Republic equalled EUR 79.7 billion, according to the Eurostat source. (The latest wiiw estimate for end-2004 is EUR 96.6 billion.) In relative terms FDI is very high in all three countries investigated. In 2004 the ratio of the FDI stock to GDP (at the exchange rate) equalled 0.48 in the Czech Republic, 0.55 in Hungary and 0.33 in Slovakia. By comparison, the ratio for the EU-13 (excluding Ireland and Luxembourg, the countries with atypically high FDI/GDP ratios) equalled 0.35 in 2002 (and stood at 0.19 in Austria). Even cohesion countries such as Spain and Portugal had much lower FDI stock-to-GDP ratios (0.31 both).

There are several reasons for the unusually high FDI levels in the three countries. First, at the beginning of transition (in the early 1990s) their economies were almost entirely state-owned. During the privatization process large chunks of national (state-owned) property were sold to foreign parties. Of course, no comparable process has ever taken place in the 'old' EU countries. Second, in the

[10] See *wiiw Database on Foreign Direct Investment in Central, East and Southeast Europe. Opportunities for Acquisition and Outsourcing*, wiiw, May 2005.

'old' EU countries the national policy often tries to restrict foreign ownership in some firms or sectors considered 'strategically' important (infrastructure, banking etc.). In the transition countries the tendency for keeping FDI away from 'vital' sectors is much weaker. In effect the whole national commercial banking systems in the three countries investigated are actually foreign-owned/controlled. Besides, FDI is strongly attracted to some sectors (such as retail/wholesale trade) which are much less regulated than in the 'old' EU.[11] Third, the high FDI/GDP ratios reflect high deviations between the exchange rates and the purchasing power parities. If GDP is expressed in purchasing power parities (thus measuring the 'real' volumes of goods and services produced nationally), then the ratios of the stocks of FDI to GDP appeared, at end-2004, to be quite moderate: 0.259 in the Czech Republic, 0.322 in Hungary and 0.175 in Slovakia. By comparison, the same ratio equalled, in 2002, 0.264 in Germany, 0.267 in Spain, 0.249 in France, 0.20 in Austria, and 0.234 in Portugal. (Overall, the same ratio for the EU-13 equalled 0.358 in 2002.)

The intensity of the FDI inflows to the three countries under investigation is unlikely to rise further in the future. The privatization process is nearing its natural end as the supply of state-owned assets is drying out. Of course, the relatively low levels of wages (i.e. low GDP levels) will still be attracting some FDI – similarly as lower corporate tax rates and/or more liberal labour codes and other regulations. But these factors will be of diminishing importance. The ongoing GDP convergence will be eroding the wage advantages, while some sorts of EU-wide tax/legal harmonization is likely to undermine the non-wage advantages. Besides, already now the three countries examined compete with Romania, Ukraine and Turkey (not to mention China) where wages are much lower and regulations imposed on business activities much more lax. Thus it is to be expected that FDI seeking low-wage cost locations will be increasingly preferring more distant destinations.

Given the above considerations, it may be assumed that the ratio of the stock of FDI to GDP will be approaching a kind of saturation level in all three countries. We assume that this terminal level is 0.35 – corresponding to the average level observed in the EU-13 recently. Under this assumption it is possible to calculate the terminal stocks of FDI in the future (more specifically by the year 2015), depending on the estimated levels of GDP in 2015. Because the FDI stock to GDP ratio can be calculated in two ways, depending on whether GDP is calculated at exchange rates or at purchasing power parities (in either case the ratio for the EU-13 was about 0.35 recently), one can have two sets of estimates for the FDI stocks. Table 15 reports the estimated stocks of inward FDI in the Czech Republic, Hungary and Slovakia by the year 2015. These estimates are based on the GDP

[11] By end-2003 manufacturing accounted for only 42% of the FDI stock in the Czech Republic. Financial intermediation accounted for 16.8%, trade for 12.3%. In Hungary the respective shares were 45.8%, 10% and 9.8%, in Slovakia 38.5%, 22.4% and 12%.

volumes derived from the updated NOBE II model (see, e.g., table 13). The upper part of table 15 gives the values of total GDP in 2004 and in 2015, at 2004 PPPs (left-hand part) and at 2004 prices/exchange rates (right-hand part).

Below the upper part, there are estimates of the terminal stocks of FDI (in 2004 euro, at exchange rates). On the left-hand side there are estimates of the terminal stocks corresponding to the assumption that the GDP in the FDI stocks-to-GDP ratio is measured in PPPs. The right-hand side converts the denominator in that ratio using the exchange rates.

Finally, the lower part of table 15 gives the average yearly FDI inflows implied by the estimated magnitudes of the terminal ratios of the FDI to GDP. As can be seen, the convergence of the FDI stock-to-GDP ratio to the terminal value of 0.35 has different implications, depending on the way GDP is measured. With the GDP expressed at the exchange rates (which seems to be the traditional convention), the future FDI inflows would be quite small (especially in Hungary and under the 'low' growth scenario). Things look much better with the terminal ratio's denominator expressed in PPPs. Here the attainment of the terminal 0.35 ratios implies quite high inflows, even under the 'low growth' scenario.

Table 15: Stocks of Inward FDI in 2015

	2004	**2015**			**2004**	**2015**		
		low	**base**	**high**		**low**	**base**	**high**
	GDP (billion 2004 PPP euro)				GDP (billion 2004 euro)			
CZ	160	213	232	245	86.2	145	164	177
HU	138	189	208	224	80.7	111	129	145
SK	63	91	103	110	33.1	50	61	68
Total	361	493	543	579	200.0	306	354	390
	FDI stock (billion 2004 euro)				FDI stock (billion 2004 euro)			
CZ	41.4	74.6	81.2	85.8	41.4	51.2	57.9	62.8
HU	44.2	66.2	72.8	78.4	44.2	39.3	45.8	51.2
SK	11.0	31.9	36.1	38.5	11.0	17.7	21.4	23.9
Total	96.6	172.6	190.1	202.7	96.6	108.2	125.1	137.9
	Average yearly FDI inflow 2004–2015 (billion 2004 euro)							
CZ		3.0	3.6	4.0		0.8	1.4	1.9
HU		2.0	2.6	3.1		–0.5	0.1	0.6
SK		1.9	2.3	2.5		0.6	0.9	1.1
Total		6.9	8.5	9.6		0.9	2.5	3.6

Source: Authors' calculations.

6. Productivity Growth and Employment

6.1 Changes in the Structure of Value Added and Employment

A similar approach as described above for convergence in total GDP per capita can be applied in order to assess the speed of convergence at a more detailed sectoral level. Stehrer (2005) estimated the β-convergence parameter for labour productivity (value added per employee) for a sample of OECD countries and seven sectors (see tables below).[12] Similarly, the speed of convergence in value added shares has been estimated. Together with information on the initial productivity gaps and deviations from EU-15 average sectoral value added shares, one can simulate likely future developments with respect to the development of sectoral shares of value added and employment. Based on the estimates of the convergence parameters, the values reported in table 16 have been used in the calculations of the scenarios. The exogenous growth rate was proxied by the long-term sectoral value added per capita of the larger country group. These are also reported in table 16. According to these estimates, convergence is fastest in industry and in the services sectors transport, business and public services with a half time of convergence at around 20 years. The speed of convergence in value added shares is generally lower; the half-time is low in industry and public services. Using a convergence framework where the speed of adjustment depends on the deviation from the reference countries (in this case the EU-15) and using the empirically estimated parameters allows to investigate scenarios of value added and employment shares by industry for the next few years. In Stehrer (2005) a framework introduced by Verspagen (1991) was adopted for this research at the disaggregated level.

Table 16: Parameter Values used in Scenarios

	Productivity convergence			Convergence in value added shares		
	Exogenous	β -Coefficient	Half-time	Exogenous	β -Coefficient	Half-time
Agriculture	0.046	–0.020	35	–0.007	–0.012	58
Industry	0.034	–0.030	23	0.002	–0.039	18
Construction	0.011	–0.010	69	0.002	–0.011	63
Trade, repairs, hotels	0.015	–0.020	35	–0.001	–0.023	30
Transport	0.041	–0.035	20	–0.002	–0.023	30
Business services	0.000	–0.040	17	0.000	–0.016	43
Public services	0.019	–0.035	20	0.001	–0.039	18

Source: Authors' calculations.

Before presenting the most important results of the scenarios we show that there is a large potential for catching-up by industry despite the fact that these countries

[12] See also Bernard and Jones (1996) where estimates of convergence are provided for different sectors.

have already experienced rapid convergence to the EU-15 in terms of labour productivity, value added and employment structures since the beginning of transition (see tables 17[13], 16 and 17). Despite the progress attained so far these gaps are still sizeable and further dynamic convergence can be expected in the coming years.

Table 17: Productivity Levels in % of EU-15, 2002

	Agriculture[1)]	Industry	Construction	Trade, repairs and hotels	Transport	Business services	Public services	Total
Czech Republic	105.0	49.5	29.4	83.9	59.6	81.3	38.0	58.9
Hungary	78.0	49.9	57.4	52.6	49.5	79.7	59.0	57.9
Slovakia	76.6	40.8	33.7	73.8	58.1	90.2	62.6	57.4

Note: [1)] EU without Austria.

Source: Authors' calculations.

Table 18: Value Added Shares, 2002

	Agriculture	Industry	Construction	Trade, repairs and hotels	Transport	Business services	Public services	Total
Czech Republic	5.6	33.5	3.4	17.9	11.1	18.0	10.4	100
Hungary	5.5	30.3	5.4	12.3	9.7	18.7	18.1	100
Slovakia	5.4	27.8	3.7	15.6	10.4	18.0	19.1	100
EU-15	2.8	22.1	5.5	15.4	8.8	25.1	20.5	100

Source: Authors' calculations.

Table 19: Employment Shares, 2002

	Agriculture	Industry	Construction	Trade, repairs and hotels	Transport	Business services	Public services	Total
Czech Republic	4.8	30.7	8.9	16.6	7.7	7.7	23.6	100
Hungary	6.2	27.1	7.0	17.8	8.0	8.0	25.9	100
Slovakia	6.2	30.1	8.3	16.0	7.3	6.7	25.5	100
EU-15	5.3	16.9	7.1	19.5	6.2	15.1	30	100

Source: Authors' calculations.

With respect to sectoral productivity levels, the three countries are below the EU-15 averages in almost all sectors; the only exception is the agricultural sector of the Czech Republic, which may be explained by the large-scale production units in this country. The gaps are largest in industry and construction as well as transport, whereas they are smaller in agriculture, trade, repairs and hotels and business services. In terms of value added shares, the countries are above the EU-15 average

[13] Note that this table reports value added per employee in 1995 prices. Thus the figures – also for the total – differ from the ones reported above.

in particular in agriculture and industry and below the average in business and public services as well as transport. These two components are reflected by definition in the employment shares which are reported in table 19. The employment shares are again above the EU-15 average in agriculture and industry and quite below that average particularly in business services and less so in public services. Further, they are also lower in trade, repairs and hotels. For a detailed description of changes in employment structures see Landesmann, Vidovic and Ward (2004).

Using this information on the speed of convergence and the initial deviations from EU-15 means that one may calculate future changes of labour productivity and output structures under the assumption that these countries converge to the EU-15 over time. These two variables then also determine the structure of employment. In order to calculate the level of employment, a further assumption on total GDP growth is required. We summarize the most important findings of these calculations. For the methodology applied and more detailed results see Stehrer (2005).[14] Table 20 summarizes the projections with respect to value added shares, productivity levels compared to the EU-15 and employment shares.

The model shows a relatively slow adjustment with respect to value added shares which depends on the speed of convergence and the initial deviation from EU-15 shares. The most pronounced effects can be observed in industry, where the share declines by about 4 percentage points in the Czech Republic and by 2.5 percentage points in Hungary. Further, there is an increase in the share of the business and public services sectors. These are also those sectors that are characterized by the highest speed of convergence in value added shares and – in some cases – relatively large deviations from EU-15 shares in the initial period. Productivity is more dynamic as initial gaps are larger in most cases and the speed of convergence is higher in important sectors: agriculture, industry and the services sectors. In the Czech Republic the most important productivity increases occur in industry, transport and public services. For the other two countries (Hungary and the Slovak Republic) the growth rate of productivity is lower as the initial productivity level is closer to the EU-15.

[14] There are slight differences with respect to the numbers reported therein, as here we have used revised data.

Table 20: Results from Scenarios

Czech Republic

	Value added shares (in %)				Productivity (in % of EU-15)				Employment shares (in %)			
	2002	**2007**	**2012**	**2015**	**2002**	**2007**	**2012**	**2015**	**2002**	**2007**	**2012**	**2015**
Agriculture	5.6	5.3	5.0	4.8	105.0	104.5	104.0	103.8	4.8	4.3	3.8	3.5
Industry	33.5	31.8	30.4	29.6	49.5	54.6	59.4	62.1	30.7	26.6	23.2	21.3
Construction	3.4	3.6	3.8	3.9	29.4	31.2	33.0	34.1	8.9	10.0	11.0	11.5
Trade, Repair, Hotels	17.9	17.8	17.6	17.5	83.9	85.4	86.7	87.4	16.6	18.0	19.1	19.6
Transport	11.1	10.8	10.5	10.4	59.6	64.8	69.5	72.0	7.7	6.8	5.9	5.4
Business Services	18.0	18.7	19.4	19.7	81.3	84.4	87.1	88.4	7.7	9.2	10.8	11.8
Public Services	10.4	12.0	13.4	14.1	38.0	44.4	50.6	54.1	23.6	25.2	26.3	26.8

Hungary

	Value added shares (in %)				Productivity (in % of EU-15)				Employment shares (in %)			
	2002	**2007**	**2012**	**2015**	**2002**	**2007**	**2012**	**2015**	**2002**	**2007**	**2012**	**2015**
Agriculture	5.5	5.2	4.9	4.7	78.0	79.8	81.6	82.5	6.2	5.5	4.7	4.3
Industry	30.3	29.1	28.2	27.7	49.9	55.0	59.7	62.4	27.1	24.0	21.3	19.8
Construction	5.4	5.5	5.6	5.6	57.4	59.0	60.6	61.5	7.0	7.9	8.8	9.3
Trade, Repair and Hotels	12.3	12.7	13.0	13.1	52.6	56.0	59.1	61.0	17.8	19.3	20.4	21.0
Transport	9.7	9.6	9.4	9.3	49.5	55.4	60.9	64.0	8.0	6.9	5.9	5.4
Business Services	18.7	19.3	19.8	20.1	79.7	83.0	85.9	87.4	8.0	9.5	11.2	12.2
Public Services	18.1	18.8	19.3	19.5	59.0	64.2	69.0	71.6	25.9	27.0	27.7	28.0

Slovak Republic

	Value added shares (in %)				Productivity (in % of EU-15)				Employment shares (in %)			
	2002	**2007**	**2012**	**2015**	**2002**	**2007**	**2012**	**2015**	**2002**	**2007**	**2012**	**2015**
Agriculture	5.4	5.1	4.8	4.6	76.6	78.6	80.4	81.5	6.2	5.4	4.7	4.3
Industry	27.8	27.1	26.5	26.2	40.8	46.2	51.5	54.5	30.1	26.5	23.2	21.5
Construction	3.7	3.9	4.0	4.1	33.7	35.5	37.4	38.5	8.3	9.3	10.3	10.9
Trade, Repair and Hotels	15.6	15.6	15.6	15.6	73.8	75.9	77.9	79.1	16.0	17.5	18.7	19.3
Transport	10.4	10.2	9.9	9.8	58.1	63.4	68.2	70.9	7.3	6.4	5.6	5.2
Business Services	18.0	18.6	19.2	19.5	90.2	91.9	93.3	94.1	6.7	8.3	9.9	11.0
Public Services	19.1	19.5	19.9	20.1	62.6	67.5	71.9	74.3	25.5	26.6	27.5	27.8

Source: Authors' calculations.

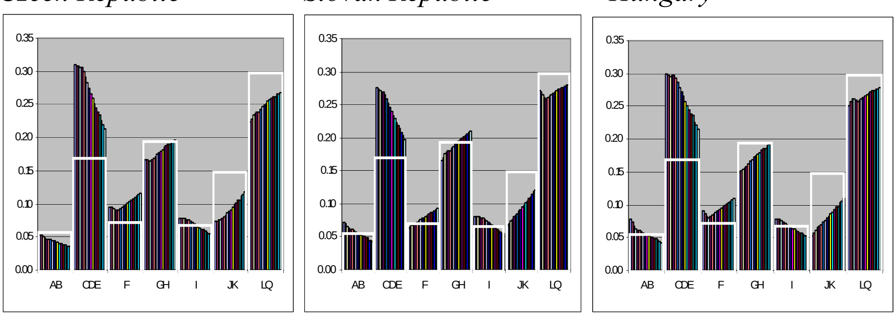
Summarizing, although the model implies a tendency towards the EU-15 in terms of productivity levels and value added shares, the deviations remain sizeable in the medium term. This would be even more relevant when accounting for potential specialization effects in the projections (for instance, one may expect a higher share of output in manufacturing due to automotive clusters in the Czech and Slovak Republics, or a lower share of public services in some countries); for caveats of the model and sensitivity analyses with respect to such issues see Stehrer (2005).

Let us now turn to the effects on employment levels and shares which result from the productivity and output dynamics. Chart 1 shows the resulting evolution of the employment shares by main sectors of the three economies (including historical data 1997–2002). In the individual country boxes, wide columns with white frames indicate the 2002 employment shares of the EU-15 while narrow columns show employment shares of the respective NMS in each individual year of the period 1997–2015.

Chart 1 reveals the common trends in employment shares. The most important trends are the declines in employment shares in industry, falling from about 30% to a level between 20% and 25%. Further, there will be increases in a number of service sectors which are underrepresented so far in terms of employment shares. This concerns in particular business services, where the deviations to the EU-15 are largest, as well as public services. Further the model also predicts rising shares in trade, repair and hotels in the three countries. Employment shares in transport will tend to fall over the period.

Chart 1: Employment Demand Scenarios by Sectors

Czech Republic *Slovak Republic* *Hungary*



Note: Agriculture (AB), Industry (CDE), Construction (F), Trade, repairs and hotels(GH), Transport (I), Business services (JK), Public services (LQ).

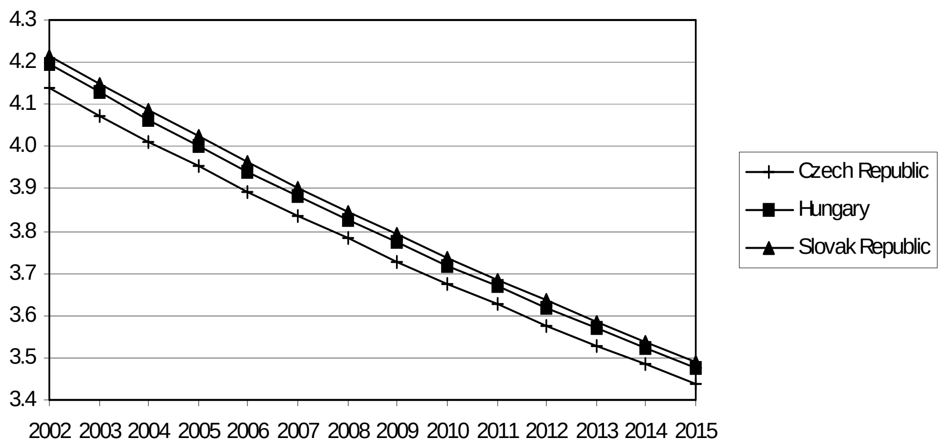
Source: Authors' calculations.

6.2 Productivity and GDP Growth versus Labour Demand

The results reported above do not tell us anything about the *level* of employment. Chart 2 shows those GDP growth rates in the NMS in individual years of the ten-year period which facilitate keeping the employment levels prevailing in 2002. These hypothetical growth rates are higher in the beginning mainly because of the productivity gap and are continuously falling over time for two reasons: first, the closing of the gap in productivity levels implies that the productivity growth rates become lower in general, and second, employment is shifting in the wake of

structural change. Thus the pressure on labour demand is reduced due to successful catching-up. On average, the hypothetical growth rates of GDP necessary to keep employment stationary is about 3.8–4% per year in all countries.
These can be compared with the growth rates for GDP per capita resulting from the NOBEII and the updated NOBEII study reported above. As population remains roughly constant in all three countries, the GDP per capita growth rates may be used as proxies for longer-term GDP growth rates. In the base scenario these growth rates are projected to be between 3.6% (Czech Republic) and 4.6% (Slovak Republic); in the 'high growth' scenario they range between 4.1% and 5.2%. For the latter scenario one could expect employment levels to be rising (Hungary, Slovak Republic) or to be almost stationary (Czech Republic). For the base scenario GDP growth would be too low for positive employment growth in the Czech Republic.

Chart 2: GDP Growth Rates Required to Keep Overall Employment Level Unchanged



Source: Authors' calculations.

On the other hand, it is interesting to look at the three countries' employment performance under the assumption of convergence in GDP per employee and different growth rates of GDP. According to the calculations above, we assume a GDP growth rate of 4% and 5%, respectively. For the second variable, we assume convergence parameters in GDP per employee of $\beta = -0.030$. This is in line with the econometric estimate of convergence for a larger group of countries. Table 21 presents the projections of employment levels for each of the two scenarios.

Table 21: Employment Forecasts (in ths.)

	Convergence parameter of GDP per employee : –0.030													
	GDP growth rate: 4% p.a.							GDP growth rate: 5% p.a.						
	Levels				2002 = 1			Levels				2002 = 1		
	2002	2007	2012	2015	2007	2012	2015	2002	2007	2012	2015	2007	2012	2015
CZ	4727	4737	4811	4884	1.002	1.018	1.033	4727	4970	5295	5531	1.051	1.120	1.170
HU	3859	3858	3910	3965	1.000	1.013	1.027	3859	4047	4303	4490	1.049	1.115	1.164
SK	2111	2108	2135	2164	0.999	1.011	1.025	2111	2212	2349	2450	1.048	1.113	1.161

Source: Authors' calculations.

In the first scenario (modest GDP growth) all three countries succeed in creating employment but only at very low rates. In the second scenario the GDP growth rate is assumed to be at 5% per year; one can see that this increase in the GDP growth rate of one percentage point has a quite strong effect on labour demand, and all countries show higher employment levels (about 10–12 percentage points higher compared to the first scenario) at the end of the simulation period than in 2002.

7. Conclusion

Summing up it can be stated that the longer-term perspectives for continued economic growth and structural change in the new EU Member States bordering Austria are good and that interesting perspectives for regional agglomeration effects – including Austria – can be expected.

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Structural Change in the CENTROPE Region

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1. Introduction

It is widely known that the structural characteristics of an economy belong to the most important indicators of a country''s or region's economic development. The shares of manufacturing, agriculture and services in total employment, as well as the shares of employment in different occupational and educational groups are closely correlated to aggregate indicators of wealth. It is also widely known that the economies of the former socialist Central and Eastern European Countries (CEEC) have faced substantial problems of reallocating resources from unproductive to more productive uses on their way to a closer integration into the world economy. They started their transition to market economies with an employment structure that was heavily centred on industrial (and in some countries also agricultural) employment, extremely large enterprises and an almost complete predominance of state owned firms. It thus comes as no surprise that these countries and their regions have experienced substantial structural change since the start of market oriented reforms.[2]

Structural change, however, is not only a phenomenon observed in transition economies. It also characterises most mature market economies. In this context, recent theoretical and empirical research (see *Rowthorn – Ramaswamy*, 1999; *Foellmi – Zweimüller*, 2002 and *Mesch*, 2005) identifies a number of supply and demand side factors such as technological change, international trade, differences in income elasticities, changing intermediary demand, outsourcing as well as institutional changes, which contribute to structural change and attempts to measure the relative contribution of these factors to structural change in both transition as well as market economies.

Our aim in this paper is to focus on characteristics and consequences of structural change in the CENTROPE region, a European cross-border region

[1] The authors would like to thank Martin Feldkircher, Gerhard Palme, Michael Peneder and Yvonne Wolfmayr for helpful comments. Andrea Grabmayer, Andrea Hartmann and Maria Thalhammer provided helpful research assistance.

[2] See *Boeri – Terrell* (2002), *Mickiewicz* (2001) and *Mickiewicz – Zalewska* (2001) for recent studies on structural change in the CEECs.

comprising areas from Austria, Hungary, Slovakia and the Czech Republic which was set up in 2003 by institutional arrangement[3]. In detail, the paper addresses three related issues:

1. We want to determine to what extent the sectoral structures of the eastern and western[4] part of CENTROPE differ from each other as well as from the remainder of the European Union and how these structural differences shape the growth perspectives of the region.
2. We try to measure the extent and direction of structural change from a European perspective and quantify the contribution of this structural change to productivity growth.
3. We want to find out how trade patterns for manufactured products have reacted to the new situation, whether specialisation or diversification is on the advance, and how comparative advantages develop in changing environments.

The reason for this focus is twofold. First, we are interested in the positive implications of structural change in the cross-border context. While a large literature on the potential impact of integration on new and old EU Member States exists, the regional implications of this integration process – in particular when it comes to cross-border regions at the former external border of the EU – are still under-researched. CENTROPE is a particularly interesting case study of integration since it comprises some of the most advanced regions of both the new and old Member States and may thus reflect the structural effects of EU integration particularly well. We thus augment the case study literature on border regions (see *Van Houtem*, 2000 for a survey) by focusing on this region. Second, our interest is rooted in the normative aspects of regional policy. To formulate policies for the CENTROPE region a clear understanding is needed of what are the characteristic structural features of the region, how they relate to economic developments and what can be expected from the future in terms of structural change in the region.

In order to achieve our goals the remainder of the paper is organised as follows: In the next section we shortly describe the data sources used. Section 3 highlights

[3] The constituting document of CENTROPE is the declaration of Kittsee which was signed by Vienna, Lower Austria, Burgenland, Bratislava, Trnava, Györ-Moson-Sopron, Southern Moravia, Brno, Eisenstadt, Györ, Sopron and St.Pölten. Our analysis extends on this definition by focusing on the set of NUTS 2 regions, in which these cities and NUTS 2 regions are included and by also including Southern Bohemia as is customary in the analytic literature on CENTROPE (see *Palme – Feldkircher*, 2005 *Krajasits - Neuteufl - Steiner*, 2003). We thus consider the Austrian provinces of Vienna, Lower Austria and Burgenland, Southern Moravia and Southern Bohemia in the Czech Republic, Bratislava and Western Slovakia in Slovakia as well as Western Transdanubia in Hungary.

[4] In what has become a common use of language we refer to the new Member States regions (countries) of CENTROPE as the eastern part and denote Austria as the western part, even though some regions of the new Member States are located more to the west than the Austrian regions.

the main structural characteristics of the region. We show that CENTROPE is characterised by internal structural disparities that may be considered as typical for the enlarged EU. In particular regions of the new Member States are still more industrialised and have lower productivities than EU-15 regions. We also show that CENTROPE is in a favourable position relative to other cross-border – regions, due to its strong urban core and a lack of problems of mono-industrialisation and extremely peripheral agricultural areas. In section 4 we then focus on structural change and its contribution to productivity growth. We find that structural change at the sectoral level has been particularly pronounced in the eastern parts of CENTROPE but that this change has only modestly contributed to productivity growth. The primary sources of productivity growth in CENTROPE as well as in other EU regions were productivity changes within sectors. Section 5 analyses the foreign trade patterns of the CENTROPE countries by identifying a rapid catching up process in terms of exports and trade balances and document the rapid structural change in (particularly the eastern parts of) CENTROPE to more skill- and technology intensive activities. Section 6 documents that structural change in CENTROPE countries surpassed that in the EU-15. Trade patterns of the CENTROPE countries broadened in this process, as traditional specialisations eroded and an export structure more similar to that of the EU-15 arose. Section 7, finally, summarises the results and draws some policy conclusions.

2. The Data

The data we use stem from two sources. First, we use Eurostat data for employment and gross value added from the Regio Database at both the 2 and 3 digit level of the Nomenclature of Units for Territorial Statistics Classification (NUTS) to analyse the sectoral structure at the regional level. Apart from potential problems arising from differences in national statistical systems, these data suffer from missing data problems and a low level of sectoral disaggregation. For instance when focusing on the NUTS 3 level we have information on three sectors (agriculture, manufacturing and services) for the years 1995 to 2001. Even at this low level of disaggregation we miss data on France, the Netherlands and Cyprus for 2001 and on France, the Netherlands, Cyprus, Poland, Greece, Estonia, Slovenia and Latvia when comparing data between 1995 and 2001. At the NUTS 2 level, by contrast, information on Gross Value Added (GVA) and employment on 15 broad sectors of the economy is available, but only for 14 countries of the enlarged EU. Excluding missing data thus leaves us with a data set for regional GVA and employment in three sectors and 1078 NUTS 3 regions from 22 EU Member States in 2001, which reduces to 948 regions when comparing structural change between 1995 and 2001. Alternatively, on NUTS 2 level we have data for a slightly more detailed structural breakdown (15 sectors) for 180 regions from 14 countries of the EU-25.

We use these data to gauge regional structural change in CENTROPE. Concerns about the problems of their low sectoral disaggregation, however, lead us to also use trade data from the UN World Trade data base. While these data are only available at a national level, they comprise sectoral information at a very disaggregated (NACE 3 and NACE 4) level. This allows a much more detailed analysis of structural change in the manufacturing sector of CENTROPE, including the use of sectoral typologies to depict trends in factor intensity, use of human capital and quality orientation.

3. The Sectoral Structure of the CENTROPE Region: Evidence from Regional Data

Focusing first on NUTS 3 regions, data suggest that the CENTROPE region is not only characterised by significant disparities in terms of economic development (see *Palme – Feldkircher*, 2005), but also in terms of sectoral specialisation. The eastern part of CENTROPE is characterised by a substantially higher share of manufacturing in both employment and GVA, while service sectors tend to be underrepresented (table 1). Compared to the EU-25 as well as the old and new Member States some interesting characteristics of the CENTROPE region arise. In particular the share of agriculture is substantially lower in the new member state regions of CENTROPE than in other new member state regions, while the service sector share is higher. In the Austrian part of CENTROPE, too, the service sector share is higher relative to the average old member state, while the manufacturing share is lower.

Table 1: Economic Structure in CENTROPE and the EU (NUTS 3, 2001)

	EU	CENTROPE	Old Member States		New Member States	
			Total	CENTROPE	Total	CENTROPE
Employment						
Agriculture	6.23	5.13	4.07	3.95	17.56	5.80
Manufacturing	26.99	31.86	26.31	21.25	30.56	37.98
Services	66.79	63.02	69.62	74.80	51.88	56.22
GVA						
Agriculture	2.10	2.81	1.99	1.95	4.03	5.08
Manufacturing	28.02	28.23	27.77	24.31	32.34	38.66
Services	69.87	68.96	70.23	73.74	63.63	56.26

Note: The table reports average employment and GVA shares of 1078 NUTS 3 regions in % for 2001. Data on France, the Netherlands and Cyprus are not included.

Source: Eurostat, Austrian Institute of Economic Research.

Table 2: Economic Structure in the CENTROPE Region (NUTS 2, 2001)

	Employment			GVA		
	Total	of this old Member States	of this new Member States	Total	of this old Member States	of this new Member States
Agriculture	4.9	4.0	5.8	2.5	2.4	2.8
Mining and quarrying	0.3	0.2	0.5	0.3	0.6	0.5
Manufacturing	21.0	13.3	28.4	17.2	16.2	18.9
Electricity, gas and water supply	1.3	0.9	1.7	2.8	2.8	2.6
Construction	7.1	6.8	7.3	6.6	6.7	6.2
Trade	15.4	16.2	14.6	14.7	15.8	13.5
Hotels and restaurants	4.0	4.4	3.6	2.6	2.5	2.9
Transport	7.3	8.0	6.8	8.6	8.3	8.2
Financial intermediation	2.6	3.6	1.6	5.8	5.4	5.0
Real estate, renting & business activities	10.7	13.7	7.8	17.5	17.5	13.4
Public administration and defence	7.1	8.0	6.3	6.8	6.9	6.6
Education	6.0	5.5	6.5	4.9	5.1	4.9
Health and social work	7.5	9.5	5.6	5.1	5.0	5.3
Other community, social, personal service activities	4.5	5.6	3.5	4.5	4.6	4.0
Activities of households	0.1	0.2	0.0	0.2	0.2	0.4

Note: The table reports employment and GVA shares in % for NUTS 2 regions in 2001.

Source: Eurostat.

When moving to NUTS 2 level data (table 2) we find that the lower orientation of the new Member States regions of CENTROPE on services applies to almost all service sectors[5], but is most pronounced in real estate and business services. This points to particular structural deficits in these activities. Finally, NUTS 2 level data suggest that one of the CENTROPE region's main characteristics is its sectoral diversity (chart 1). At the level of 15 broad sectors the CENTROPE region is less specialised than the average EU-15 region, and is characterised by a relatively diversified structure.[6]

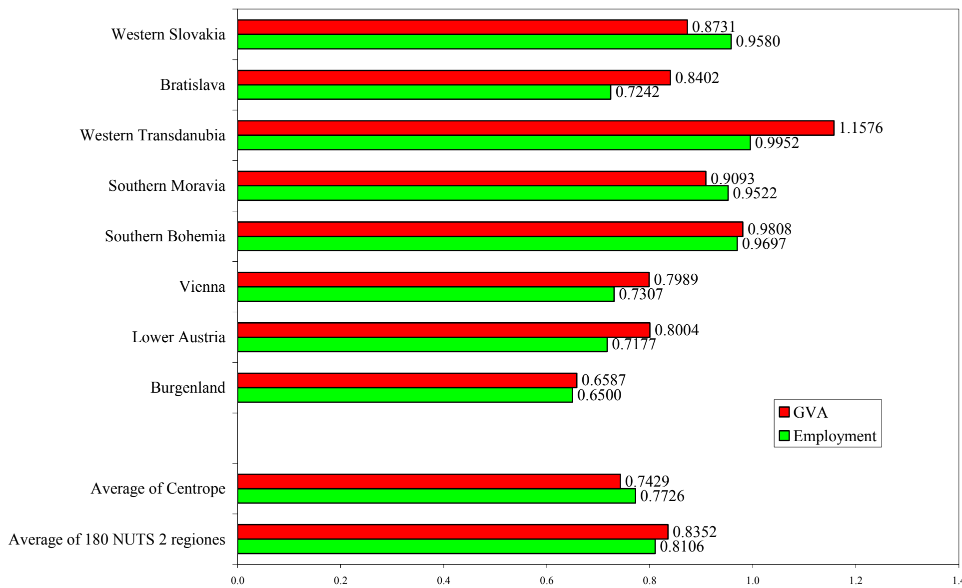
These results are indicative of the overall situation of the CENTROPE. On the one hand the CENTROPE region is characterised by substantial internal regional disparities, which reflect the typical (historically determined) differences between

[5] The only exceptions are education with respect to employment and health and social services with respect to GVA. Both sectors, however, belong to the non-market services, where employment shares are heavily influenced by national institutions. These exceptions may therefore in part reflect institutional rather than economic differences between countries.

[6] This diverse structure is a result of the substantial structural differences within the region and is also documented at a more detailed level by *Krajasits – Neuteufl – Steiner* (2003), who consider this as one of the region's main attractions as a location for production.

old and new Member States. On the other hand compared to the latter CENTROPE is comprised of a set of more "modern" (i.e. more service oriented and less agricultural) regions, which is especially true for Vienna and Bratislava as well as fast growing regions in Western Hungary.

Chart 1: Specialisation in CENTROPE and the EU-25



Note: The table reports Herfindahl Indices for employment and GVA in 15 NACE groups in 2001.

Source: Eurostat, Austrian Institute of Economic Research..

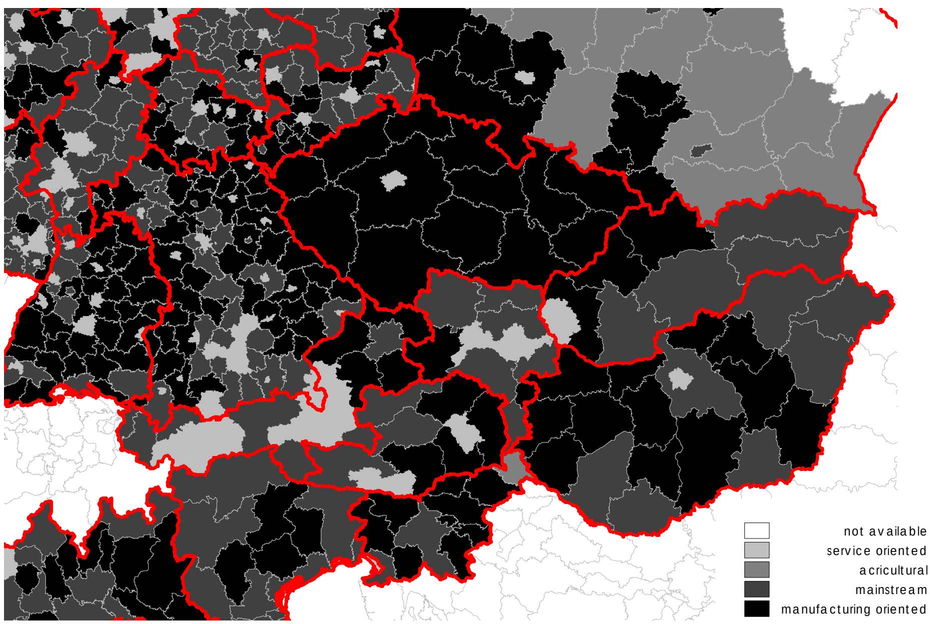
3.1. Regional Types in CENTROPE

“These general findings should, however, not mask the substantial heterogeneity among the regions of CENTROPE. Performing a cluster analysis on regional employment shares at the NUTS 3 level of the EU in total we find that the regions of CENTROPE can be grouped into three out of four EU clusters (see table 3 and chart 2).

- “Industrial regions”: The majority of the new member state regions belong to a cluster, which is characterised by high shares of manufacturing employment and GVA as well as a rather low productivity level. Apart from the bulk of the regions in the new Member States this industrial cluster also covers some smaller NUTS 3 regions, in particular in Eastern Germany. In the Austrian part of CENTROPE two regions (Mittelburgenland and Mostviertel-Eisenwurzen) belong to this cluster.

- "Mainstream regions": Most of the Austrian CENTROPE regions belong to a cluster of regions sharing an intermediate importance of industrial production. The cluster encompasses the largest part of the European NUTS 3 regions (in total 428), especially a large set of regions in Italy, Germany and Spain. It therefore may be referred to as "mainstream". Aside from the lower share of industrial employment the cluster is also characterised by a higher labour productivity than the first one.

Chart 2: Regional Types in the CENTROPE Countries



Note: Results of a Cluster analysis conducted on 1.078 EU NUTS 3 regions.

Source: Eurostat, Austrian Institute of Economic Research.

- "Service oriented regions": The capital cities of Bratislava and Vienna and a large part of their surroundings are grouped into a cluster of "service oriented regions". In the wider European context the cluster comprises 325 mostly urban and suburban regions.[7] Apart from a high share of service employment this cluster also has the highest average productivity among all regional types.

[7] For instance in Austria most capital cities of the 9 provinces as well as their surrounding NUTS 3 regions fall into this category.

- “Agricultural regions”: Last but not least, a total of 86 EU regions share an outstanding role of agriculture in their economic base, which goes along with a small services sector and low productivities. While regions from the eastern and southern EU periphery cluster here, none of the regions of CENTROPE fall in this rather problematic category.

Table 3: Descriptive Statistics on Clusters Identified at the EU Level

	Agricultural Regions	Service Regions	Mainstream Regions	Industrial Regions
Number of regions from ...				
Old member States	51	322	397	188
of this in CENTROPE	0	3	6	2
New Member States	35	3	31	44
of this in CENTROPE	0	1	1	9
Total	86	325	428	232
Average employment share in ...				
Agriculture	34.9	2.7	6.3	6.1
Manufacturing	21.2	20.1	29.7	41.3
Services	43.9	77.2	64.0	52.7
Average GVA Share in ...				
Agriculture	11.9	1.8	3.9	3.3
Manufacturing	24.6	23.0	30.7	41.4
Services	63.5	75.3	65.4	55.3
Average Productivity[1]) in...				
Agriculture	7,809	24,142	25,572	21,148
Manufacturing	22,143	52,404	43,475	39,432
Services	28,448	44,748	42,254	40,407

Note: The table reports cluster means for 1.078 NUTS 3 regions. Data on French, Dutch and Cyprus regions are not included.
[1]) Productivity = GVA/Employee.

Source: Eurostat, Austrian Institute of Economic Research.

Overall, these results reconfirm the earlier findings suggesting that CENTROPE may be characterised as a region with substantial structural disparities, which parallel those found in the enlarged EU in general. There are, however, a number of structural features which may lead one to expect better conditions for growth and catching up in productivity than in other cross-border regions at the former external border of the EU. In particular the region can claim a strong urban core, consisting of the “twin cities” of Vienna and Bratislava and their surroundings. Furthermore, the CENTROPE – in contrast to many of the southern European as well as east Polish regions – has no lagging regions with a high share of agricultural employment. In addition the results suggest that in addition to the East-West dichotonomy a second albeit less pronounced divide exists within the region, distinguishing urban regions and a number of (from a European perspective) industrial regions.

3.2. Structural Preconditions for Employment Growth

This raises the question to what degree the sectoral structure of the region is conducive for growth and what share of the healthy growth performance of the region – and in particular of its eastern parts – is due to a favourable sectoral structure. To address this issue we perform a shift share analysis of regional GVA and employment growth for all EU NUTS 2 regions for which data were available.[8] The starting point of this analysis is that for any given economic indicator (e.g. GVA and employment) the difference in growth rates between the regional (x_i) and the EU level (x_{EU}) can be written as

(1) $$x_i - x_{EU} = \sum_j (s_{ij} x_{jEU} - s_{jEU} x_{jEU}) - \sum_j (s_{ij} x_{jEU} - s_{ij} x_{ij})$$

where s_{ij} and s_{jEU} denote the shares of sector j in region i and in the EU and x_{ij} and x_{jEU} are the sectoral growth rates of sector j in region i and in the EU, respectively. The right hand side of equation (1) thus decomposes growth into two components:

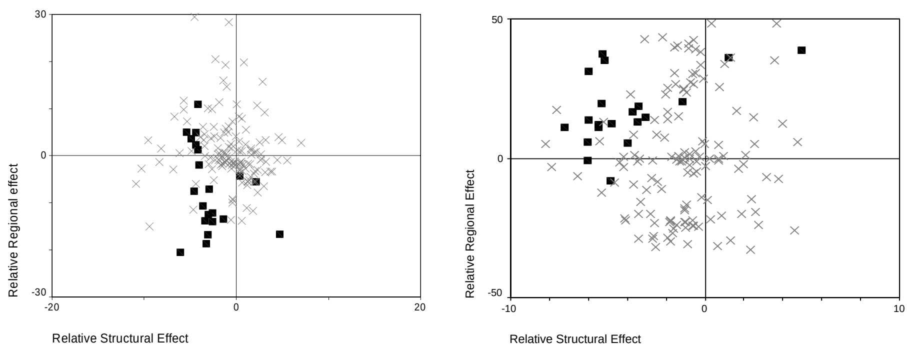
- The first term ($\sum_j (s_{ij} - s_{jEU}) x_{jEU}$) measures the growth differential between region i and the EU that would have resulted if all sectors had grown with the EU-wide sectoral growth rate. Thus, if a region has (relative to the EU) a large share of sectors with high EU-wide growth rates, this factor would be positive. By contrast, if there is a disproportionately large regional share of (at the EU level) slow-performing sectors, this factor will be negative. Thus, the term denotes a structural effect on regional growth.
- The second term on the other hand denotes a regional effect to growth. If it is positive (negative), this indicates that the average sector in a region is growing faster (slower) than in the EU. This fact could be traced to differences in regional development potentials (e.g. in geographical location, infrastructure or economic policy), but (in our case) also to a general catching up process of lagging regions, which encompasses all sectors.

This work horse method of regional economics has been frequently used in the literature on regional development. For transition economies *Traistaru – Wolf* (2003) in their analysis for Bulgaria, Hungary, Poland, Romania, Slovakia and Slovenia showed that in 1990 to 2000 regional effects were the dominant drivers of regional employment growth, explaining over 90% of the variation in regional growth rates. For Austria *Mayerhofer – Palme (2001)* and *Mayerhofer – Huber*

[8] We use NUTS 2 digit data in this decomposition on account of its greater sectoral breakdown.

(2005) performed a Shift-Share-Analysis at the provincial level. According to their results the Austrian part of CENTROPE is characterised by relatively inhomogeneous developments. For Vienna they identified a positive structural effect, accompanied by a negative regional effect. By contrast, for Burgenland they depicted structural disadvantages combined with a highly positive regional effect. However, all these studies focus on regional developments relative to the national average. Hence, we extend this evidence by focusing on regional growth relative to the EU-wide benchmark.

Chart 3: Structural and Regional Effects on GVA and Employment Growth of the Old and New EU Member States



Employment GVA

Note: The table reports results of a shift share analysis for employment and GVA of the NUTS 2 regions in 14 EU Member States, 1995–2001
X-Regions of old Member States;
■ – Regions of new Member States.

Source: Eurostat, Austrian Institute of Economic Research.

Chart 3 presents results for all regions in our data set. As can be seen, the regions of the new Member States of the EU show negative structural effects, thus suggesting that these regions entered the observation period with an employment and GVA structure that was not conducive to growth. The only regions in the new Member States that profited from a high concentration of sectors with a high EU-wide employment growth were the capital cities of Budapest, Prague und Bratislava. In terms of GVA growth only Budapest und Prague profited from a favourable sectoral structure.

By contrast, the regional effect is mostly positive for GVA growth but mostly negative for employment growth in the new Member States' regions. The only regions which have a negative regional effect with respect to GVA growth in the new Member States are Northern and Central Moravia, while for employment growth positive regional effects are found in only 6 Hungarian NUTS 2 regions.

Thus the majority of the new member state regions achieved more rapid GVA growth within sectors in 1995 – 2001. The rapid productivity catch up that occurred in these countries, however, precluded a positive regional effect with respect to employment growth.

Table 4: Structural and Regional Effects on Growth in the CENTROPE Region

	Employment Growth			GVA Growth		
	Growth-differential	Structural effect	Regional effect	Growth-differential	Structural effect	Regional effect
Burgenland	+ 1.2	–3.4	+ 4.6	– 4.1	–3.4	– 0.7
Lower Austria	– 3.2	–2.3	– 0.9	– 5.7	–2.7	– 3.1
Vienna	– 3.5	+3.0	– 6.5	– 8.9	+2.4	–11.3
Southern Bohemia	–14.7	–2.6	–12.1	+ 5.6	–5.5	+11.1
Southern Moravia	–14.9	–1.4	–13.5	+ 9.5	–3.5	+13.0
Western Transdanubia	– 2.9	–4.2	+ 1.3	+29.9	–5.2	+35.1
Bratislava	– 3.4	+2.1	– 5.5	+19.1	–1.2	+20.2
Western Slovakia	–12.1	–4.6	– 7.5	+ 3.9	–7.2	+11.1

Note: The table reports results of a shift share analysis for employment and GVA on EU NUTS 2 regions, 15 sectors, 1995–2001 in percentage points.

Source: Eurostat, Austrian Institute of Economic Research.

Considering the results of this analysis for the NUTS 2 regions of CENTROPE in detail (table 4) we find some striking similarities between the Austrian and new member state regions of CENTROPE. All of the regions in the new Member States (with exception of Bratislava) are characterised by a negative structural effect in both GVA and employment growth, while the regional effect is positive for GVA growth but negative (with the exception of Western Transdanubia) for employment growth. Somewhat more surprisingly, similar results apply to the majority of the Austrian regions in CENTROPE. In particular both employment and GVA growth in the Austrian regions (with the exception of Vienna) is burdened by a sectoral structure not conducive to regional growth. Furthermore, the regional effect is positive for employment growth in Burgenland only.[9]

[9] The Burgenland is somewhat of an outlier in Austrian regional development with exceptionally high employment and GVA growth throughout the 1990's. This may be attributed to a combination of eligibility for structural funds, relocation of economic activity from Vienna, opening of Eastern Europe and a general catch-up process of this least developed region of Austria (see *Huber*, 2005 for details).

4. Structural Change and Productivity Growth

4.1 The Extent and Direction of Structural Change

In 1995 thus most of the regions of CENTROPE (except its urban areas) were characterised by sectoral structures which did not encourage growth. The high growth in the new member state regions of CENTROPE primarily resulted from productivity catch up. This in turn implies that growth in the region was in general not very employment intensive.

Table 5: Extent and Direction of Structural Change in CENTROPE and the EU (1995 – 2001)

	EU	CENTROPE	Old Member states		New Member States	
			Total	CENTROPE	Total	CENTROPE
	Change in employment shares in percentage points (NUTS 3 level, 3 sectors)					
Agriculture	–1.09	–2.16	–0.87	–1.13	–2.84	–2.66
Manufacturing	–2.25	–2.16	–2.35	–4.50	–0.38	–0.47
Services	+3.34	+4.31	+3.23	+5.63	+3.22	+3.13
	Change in GVA shares in percentage points (NUTS 3 level. 3 sectors)					
Agriculture	–0.49	–0.57	–0.48	–0.46	–1.70	–1.80
Manufacturing	–2.70	–1.25	–2.74	–0.74	–2.33	–2.24
Services	+3.20	+1.82	+3.22	+1.20	+4.02	+4.03
	Turbulence Index (NUTS 3 level. 3 sectors)					
Employment	0.043	0.044	0.042	0.044	0.056	0.046
GVA	0.042	0.044	0.042	0.021	0.052	0.058
	Turbulence Index (NUTS 2 level. 15 sectors)					
Employment	0.062	0.061	0.063	0.063	0.072	0.067
GVA	0.064	0.062	0.060	0.052	0.069	0.073

Note: Data on France, the Netherlands Cyprus, Estonia, Poland, Lithuania, Slovenia and Greece are excluded due to missing data problems. The turbulence indicator is calculated as $1/2\Sigma_i|s_{it}-s_{it-1}|$ *with* s_{it} (s_{it-1}) *the sectoral employment (GVA) share of a region at time t (t-1).*

Source: Eurostat, Austrian Institute of Economic Research.

Unfavourable structural preconditions, however, do not last forever: The CENTROPE region experienced substantial structural change in the last decade. In table 5 we show changes in sectoral GVA and employment shares and the turbulence index as an indicator of the speed of structural change[10] for our NUTS 3 and NUTS 2 level data. While according to these results CENTROPE in total hardly differs from the average of the EU in terms of the speed of structural

[10] This indicator is defined as $\frac{1}{2}\Sigma_i|s_{it}-s_{it-1}|$ where s_{it} (s_{it-1}) are the shares of sector i in total employment (GVA) of a region in period t (t-1). The indicator takes on a maximum of 1 (for total structural change) and a minimum of 0 (no structural change).

change, there are some important differences between its' western and eastern parts. Structural change in terms of GVA was particularly pronounced in the eastern part of CENTROPE. By contrast, the change of the employment structure in the new member state regions was somewhat slower in the second half of the 1990s than in the regions of other new Member States. By contrast, the Austrian parts of CENTROPE differed from overall EU regions by a substantially slower structural change in GVA.

Furthermore in the CENTROPE region – as well as in the rest of the EU – the predominant tendency was tertiarisation and deindustrialisation. This tertiarisation was somewhat stronger in terms of the GVA in the new member state regions of CENTROPE but somewhat weaker (than at least in the Austrian CENTROPE regions) in terms of employment. In addition, the eastern parts of CENTROPE as well as the new member state regions in total were marked by a substantially more pronounced de-agrarisation in employment and GVA than the regions in the old Member States (due to a higher share of agricultural employment in 1995). However, a more detailed analysis at the level of individual NUTS 3 regions (see *Huber – Mayerhofer*, 2006) suggests that the share of agriculture in employment and GVA declined in all new Member States' regions of CENTROPE. This is important because recent research (*Mickiewicz – Zalewska*, 2001) has shown that in a number of countries and regions transition was associated with a tendency of re-agrarisation – an indicator of unsuccessful reforms as it was associated with declining income levels and a predominance of subsistence farming. Against this background, the direction of industrial change in the eastern part of CENTROPE can be taken as another indication of a successful transition of the region, which is without doubt more developed than many other (agricultural) regions in the new Member States. In the Austrian regions of CENTROPE by contrast the employment share in manufacturing declined more rapidly than in the eastern parts of CENTROPE, but GVA shares reduced less rapidly. This indicates a substantial relative productivity growth in manufacturing in the western part of CENTROPE.

4.2 The Contribution of Structural Change to Productivity Growth

While this evidence indicates substantial changes in relative productivities, it does not give an answer to the question of how structural change contributed to productivity growth in CENTROPE. To address this issue we shift our analysis from the NUTS 3 to the NUTS 2 level data base – which provides more detailed sectoral information – and once more perform a shift share decomposition of growth in the CENTROPE region. We follow *Fagerberg* (2000), *Timmer – Szirmai* (2000) *Peneder* (2003) and *Havlik* (2005) by taking into consideration that the change in total productivity (P_{it}) in a region i at time t can be described as a weighted average of changes of sectoral productivities, whereby the weights are the employment shares (S_{ijt}) of sector j in region i in year t. More formally total productivity in region i can thus be written as:

(2)
$$\Delta P_{iT} = \sum_j P_{ij2001} S_{ij2001} - \sum_j P_{ij1995} S_{ij1995}$$

with Δ the difference operator. As shown in the cited literature, this can be rearranged to the following expression for total productivity growth:

(3)
$$\begin{aligned}\Delta P_{i1995/2003} &= \{\textstyle\sum_j P_{ij1995}(S_{ij2001} - S_{ij1995})\} \\ &+ \{\textstyle\sum_j (P_{ij2001} - P_{ij1995})(S_{ij2001} - S_{ij1995})\} \\ &- \{\textstyle\sum_j (P_{ij2001} - P_{ij1995}) S_{ij1995}\}\end{aligned}$$

The three terms on the right hand side of equation 3 have economically interesting interpretations:

- The first term ($\sum_j P_{ij1995}(S_{ij2001} - S_{ij1995})$) measures the so called 'static structural change effect'. It is positive (negative), if sectoral employment shares in a region increase in sectors with a high (low) average productivity level. It thus provides information on the relevance of the so called "structural bonus hypothesis" (see *Fagerberg*, 2000), which states that in the course of economic development sectors with high productivities also increase their employment shares.
- The second term ($\sum_j (P_{ij2001} - P_{ij1995})(S_{ij2001} - S_{ij1995})$) is referred to as the 'dynamic structural change effect'. It is positive, if sectors with above average productivity growth also expand their employment shares disproportionately but negative, if – as often claimed in the literature (e.g. by *Baumol*, 1967, who refers to this as the "structural burden hypothesis") – sectors with high productivity growth have lower than average employment growth.
- The third term ($\sum_k (P_{ik2001} - P_{ik1995}) S_{ik1995}$), finally, represents an '(intra-) sectoral growth effect': It measures the hypothetical productivity increase in a region that would have resulted if the sectoral employment structure had remained unchanged in the observation period.

In table 6 we show the results of this decomposition. As can be seen the sectoral growth effect contributes around 90% to total labour productivity growth. Thus, even if the sectoral employment structure among the 15 sectors in our NUTS 2 data base had remained unchanged in 1995 – 2001, productivity growth would have been only 10% lower in the regions than actually observed. Obviously, the overwhelming part of productivity growth resulted from increased productivity *within* sectors rather than from higher employment growth in sectors performing particularly well in terms of productivity growth.

While this result is in line with recent findings at a national level (*Fagerberg,* 2000; *Timmer – Szirmai,* 2000; *Peneder,* 2003 or *Havlik,* 2005), this is not the case for our result that the dynamic structural change effect is negative for all regions. This finding is, however, consistent with *Baumol*'s (1967) conjecture that sectors with higher productivity growth expand employment less rapidly than sectors with lower productivity growth (the 'structural burden hypothesis'). The static structural change effect, however, is positive and larger than the negative dynamic structural change effect. Therefore, sectors characterised by a higher productivity in 1995 also showed higher employment growth and thus contributed to a productivity catch up in the CENTROPE region.

Table 6: Contribution of Shift Share Components to Productivity Growth

	EU	CENTROPE	Old Member States		New Member States	
			Total	CENTROPE	Total	CENTROPE
			Static Structural Change			
Total	+ 7.95	+22.20	+ 7.88	+ 49.36	+ 8.99	+ 6.42
Agriculture	– 2.71	– 6.36	– 2.71	– 11.61	– 2.67	– 3.31
Manufacturing	– 5.22	–16.56	– 5.43	– 40.92	– 2.17	– 2.41
Services	+15.88	+45.13	+16.02	+101.89	+13.83	+12.14
			Dynamic Structural Change			
Total	– 3.40	–15.65	–3.34	–39.93	– 4.23	– 1.54
Agriculture	– 0.89	– 2.23	–0.83	– 2.13	– 1.83	– 2.28
Manufacturing	– 3.01	– 5.60	–3.02	–12.61	– 2.93	– 1.52
Services	+ 0.51	– 7.82	+0.51	–25.18	+ 0.53	+ 2.26
			(Intra-)Sectoral Growth			
Total	+95.44	+93.45	+95.45	+90.56	+95.24	+95.12
Agriculture	+ 3.57	+ 7.35	+ 3.42	+ 7.66	+ 5.84	+ 7.17
Manufacturing	+30.49	+52.64	+29.98	+78.26	+38.06	+37.75
Services	+61.38	+33.45	+62.06	+ 4.64	+51.34	+50.20
			Total Structural Change			
Total	+ 4.55	+ 6.55	+ 4.54	+ 9.43	+ 4.76	+ 4.88
Agriculture	– 3.60	– 8.59	– 3.54	– 13.74	– 4.50	– 5.59
Manufacturing	– 8.23	–22.16	– 8.45	– 53.53	– 5.10	– 3.93
Services	+16.39	+37.31	+16.53	+ 76.71	+14.36	+14.40

Note: The table reports shares of total productivity growth 1995–2001 in %, unweighted means of NUTS 2 regions in 14 EU Member States. Productivity is measured as GVA (in euro at current exchange rates) per employee.

Source: Eurostat, Austrian Institute of Economic Research.

In terms of the regional variation of the individual effects (table 7) we see that the primary difference between Austrian and new Member States' regions of CENTROPE is that the dynamic structural change effect is particularly negative – both relative to the new as well as the old Member States – in the former. A closer analysis makes clear that this phenomenon is primarily due to employment and productivity shifts in the service sector. Obviously, service sectors with a high productivity growth showed a lower employment growth. This particularity in Austrian regions may be a consequence of a number of important liberalisation measures which occurred in particular in (highly productive) service sectors in recent years (e.g. liberalisation of the telecommunication sector, mergers and acquisitions in financial services).

Table 7: Contribution of Shift Share Components to Productivity Growth

	Burgen-land	Lower Austria	Vienna	Southern Bohemia	Southern Moravia	West-Trans-danubia	Bratis-lava	Western Slovakia
				Static Structural Change				
Total	+ 80.69	+ 35.18	+ 33.37	– 1.06	– 2.26	+14.83	+13.96	+ 4.27
Agriculture	– 22.85	– 13.32	– 0.50	– 3.92	– 2.13	– 4.22	– 1.51	– 5.47
Manufacturing	– 24.55	– 59.41	– 40.53	– 0.75	– 1.64	– 1.13	– 3.21	– 6.00
Services	+128.09	+107.92	+ 74.39	+ 3.61	+ 1.51	+20.18	+18.68	+15.73
				Dynamic Structural Change				
Total	– 57.97	– 32.73	– 29.95	+ 0.53	– 1.68	– 7.39	+ 1.85	– 0.84
Agriculture	– 5.07	– 1.51	– 0.08	– 2.48	– 1.43	– 1.15	– 1.04	– 6.49
Manufacturing	– 8.76	– 17.48	– 12.12	+ 2.15	– 0.49	– 4.98	– 2.27	– 1.52
Services	– 44.14	– 13.74	– 17.75	+ 0.86	+ 0.24	– 1.26	+ 5.16	+ 7.17
				(Intra-)Sectoral Growth				
Total	+77.28	+ 97.55	+96.58	+100.54	+103.95	+ 92.56	+ 84.20	+96.57
Agriculture	+16.51	+ 7.02	+ 0.49	+ 9.24	+ 7.28	+ 3.44	+ 2.10	+16.99
Manufacturing	+70.53	+120.71	+51.45	+ 46.05	+ 40.97	+ 54.12	+15.81	+33.13
Services	– 9.77	– 30.18	+44.64	+ 45.25	+ 55.70	+ 34.99	+66.28	+46.46
				Structural Change				
Total	+22.72	+ 2.45	+ 3.42	– 0.53	– 3.94	+ 7.44	+15.81	+ 3.43
Agriculture	– 27.92	– 14.83	– 0.58	– 6.40	– 3.56	– 5.37	– 2.55	– 11.96
Manufacturing	– 33.31	– 76.89	–52.65	+ 1.40	– 2.13	– 6.11	– 5.48	– 7.52
Services	+83.95	+ 94.18	+56.64	+ 4.47	+ 1.75	+18.92	+23.84	+22.90

Note: The table reports shares of total productivity growth 1995–2001 in %, unweighted means of NUTS 2 regions in 14 EU Member States Productivity = GVA (in Euro at current exchange rates) per employee.

Source: Eurostat, Austrian Institute of Economic Research.

Furthermore table 7 shows that among the Austrian CENTROPE regions Burgenland is somewhat of a special case. Here the contribution of the static structural change effect to total productivity growth was the largest among all regions. Thus in Burgenland, which combines a low development level relative to the Austrian average and a rapid catching up process, the employment structure is clearly moving towards more productive sectors. At the other extreme, in the Czech Regions (Southern Moravia and Southern Bohemia) the static structural change effect is slightly negative. This indicates that in these regions employment increased primarily in sectors with a low productivity in 1995. In addition, in

Southern Moravia the dynamic structural change effect is also negative, while in Southern Bohemia it is positive but very small. The Czech regions of CENTROPE would thus have shown a (by between 0.5% and 4%) higher productivity growth, if no structural change had occurred at all. In Bratislava and Western Transdanubia, by contrast, sectors which had a high productivity already in 1995 also expanded their employment disproportionately (positive static structural change effect), thus contributing to productivity catch-up. In addition, Bratislava also belongs to one of the few regions in CENTROPE where the dynamic structural change effect is positive, due to a high employment growth in service sectors with high productivity growth.

In consequence the contribution of structural change in employment to productivity growth (which was particularly high in the new Member States regions in the late 1990's) was rather modest. In most regions structural change (both dynamic and static) contributed less than 10% to total productivity growth, and there are only a few significant differences between new and old member state regions in this respect. We find, however, that the contribution of structural change to productivity growth was particularly high in Bratislava and Burgenland, while in the Czech Regions productivity increases were hampered by a structural change to sectors with low initial productivity levels.

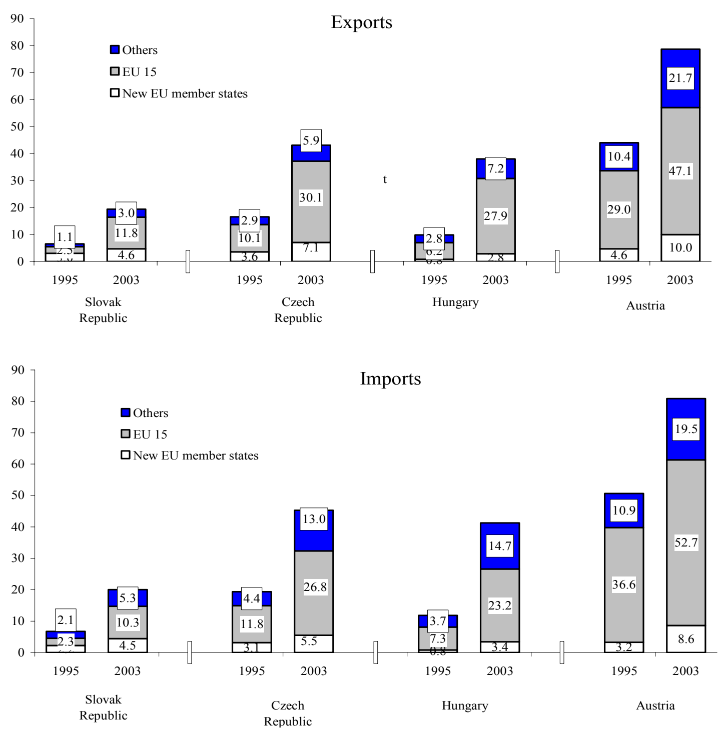
5. Competitiveness and Structural Change in CENTROPE's Manufacturing Sector: Evidence from Foreign Trade Statistics

To sum up, our results indicate that the CENTROPE region is a typical border region at the economic divide between old and new EU Member States, with marked differences between its sub-regions. The region is advantaged in its development perspectives compared to other areas in the new integration space due to its strong urban core and a lack of peripheral and rural areas. On the other hand, structural preconditions were not conducive to growth and structural change contributed only little to productivity growth to date. All these results however, stem from a rather aggregated data base (15 sectors), putting the analysis to the risk of misleading conclusions due to a substantial heterogeneity of individual industries within sectors.

To overcome this weakness at least partially we in the following focus on a rather disaggregated database on world trade set up by the UN. By analysing the evolutions of trade patterns of the CENTROPE countries at a national level, we are able to gain deeper insights into specialisation and structural change in the region's manufacturing sector. We identify the comparative advantages of CENTROPE's goods producing sector, analyse changes in trade and (as a consequence) production patterns, identify recent trends in terms of specialisation and diversity and ask if the integration of very unequal trade partners is reflected in the speed of change.

First of all, UN world trade data provide ample evidence that integration of the CENTROPE countries into world trade proceeded rapidly in recent years (chart 4). Exports of manufactured goods from the CENTROPE Countries to the rest of the world more than doubled between 1995 and 2003. Austrian exports increased by 80%, but exports of the eastern CENTROPE countries tripled. The new EU Member States of CENTROPE succeeded especially at the European internal market, where they achieved impressive gains in market shares. Overall, the share of the CENTROPE countries in total EU-25 imports increased from 3.9% in 1995 to 5.4% in 2003, with Hungary (from 0,4% to 1,2%) and the Czech Republic (from 0,9% to 1,4%) achieving the largest improvements. As a consequence the openness of the new Member States of CENTROPE with respect to the EU is now larger than that of the average EU country: In 2003 Hungary exported 73% of its exports to the old EU Member States, while the Czech Republic stood at 69.8% and Slovakia at 60.8%.

Chart 4: Foreign Trade of CENTROPE Countries (in billion euro)



Source: UN-World Trade Data Base, Austrian Institute of Economic Research.

While this rise in exports indicates that the CENTROPE countries' strive for competitiveness was rather successful, this is even more true when looking at exports and imports of these countries simultaneously. The trade balance improved from EUR –7.64 billion to + 6.73 billion vis-à-vis the EU-25 and from EUR –6.00 billion to +1.67 billion vis-à-vis the rest of the world between 1995 and 2003. While improvements can be seen in all countries, Hungary and the Czech Republic clearly stand out vis-à-vis the EU-25, while Austria was especially successful vis-à-vis the rest of the world.
Looking at a broad sectoral dimension, these impressive results were realized on the basis of rather different trade patterns. In general, the export portfolio of the CENTROPE differs considerably from that of the old EU Member States: Arising strengths in electrical and optical equipment and transport equipment complement more traditional (but shrinking) specialisations in basic and fabricated metal products, wood and wood products as well as pulp, paper and paper products in recent years. On the other hand export shares in chemicals and plastic products, refined petroleum products and (recently) food products were comparatively small. Within CENTROPE different supply patterns coexist, whereby specialisations are more complementary than rival and not always in line with theoretical expectations: For instance trade increases in the last decade were strongly focused on electronics and optics in Hungary and the Czech Republic and on transport vehicles in Slovakia, Hungary and the Czech Republic. This implies that by 2003 the eastern CENTROPE countries were more specialised on these core areas of the technology sector than Austria. By contrast, this most developed country of CENTROPE holds strong (and stable) specialisations in wood products, paper and textiles. Thus, in contrast to economic theory which would predict that low labour costs will lead to a predominance of labour intensive industries in the new Member States of CENTROPE, actual trade patterns suggest a more technology oriented trade structure in these countries than in Austria.

When moving to a sectorally more disaggregated level of individual industries and analysing these trade data by using a series of typologies of industries developed in Peneder (2001, 2002) and Aiginger (1997) (see table 8), however, a somewhat more differentiated picture emerges. Grouping industries according to their factor intensity[11], we find that all CENTROPE countries are somewhat more specialised in labour intensive industries and (with the exception of Hungary) in

[11] This typology (taken from *Pender*, 2002) groups NACE 3-digit industries into, capital, marketing, technology and labour intensive industries according to their factor inputs. A fifth group comprising industries without a dominant factor input is denoted as traditional industries.

Table 8: Export Structure of CENTROPE Countries (Share of Total Exports with the Rest of the World in %)

	Slovakia		Czech Republic		Hungary		Austria		CENTROPE Countries		EU-15	
	1995	2003	1995	2003	1995	2003	1995	2003	1995	2003	1995	2003
Factor intensity												
Traditional industries	25.6	21.2	30.2	30.2	22.0	20.1	30.7	28.0	29.2	26.1	23.5	21.7
Capital intensive	39.6	26.5	24.6	19.5	20.1	13.2	21.5	17.9	23.5	18.2	20.9	19.5
Marketing intensiv	9.5	7.5	12.1	9.2	21.8	8.5	10.9	13.1	12.3	10.6	14.5	12.8
Technology intensive	10.4	29.3	16.9	30.0	19.1	50.1	24.4	29.5	21.0	34.0	32.1	38.0
Labour intensive	14.9	15.4	16.2	11.1	17.1	8.1	12.4	11.5	14.0	11.1	9.1	7.9
Skill intensity												
Low qualification	44.8	26.5	38.4	23.7	46.3	18.7	27.6	24.4	33.5	23.2	27.8	23.2
Medium qualification/ blue collar	18.1	40.2	24.2	30.5	14.4	24.5	25.4	28.0	23.3	29.2	21.1	22.3
Medium qualification/ white collar	27.4	24.3	24.1	25.7	29.4	41.0	28.4	26.7	27.5	29.2	29.8	30.8
High qualification	9.8	9.1	13.2	20.2	9.9	15.8	18.6	20.9	15.7	18.3	21.2	23.6
Quality in competition												
low	48.2	29.1	38.0	27.7	36.2	26.0	29.9	25.3	33.8	26.4	24.8	22.3
medium	26.4	27.8	26.5	33.2	29.4	29.3	30.8	29.2	29.4	30.1	30.0	28.3
high	25.5	43.1	35.5	39.1	34.3	44.7	39.4	45.5	36.8	43.5	45.2	49.4

Source: UN – World Trade Data base, Austrian Institute of Economic Research. Highlighted values denote export shares that exceed those of the EU-15.

traditional industries than the EU-15. In addition, the Czech Republic and Slovakia still hold a specialisation in capital intensive industries. Similarly, concerning human capital intensity[1], high export shares in industries with low and medium skilled blue collar qualifications are rather ubiquitous and dominate export structures in all countries but Hungary even in 2003. Finally, an analysis of the trade patterns by the role quality plays in product market competition[2] completes this evidence: Again we find that both the new Member States of CENTROPE as well as Austria are specialised in sectors, where quality competition plays a minor or at best intermediate role for market success.

Table 8, however, also documents a striking up-grading of the supply structures in the eastern CENTROPE countries in general and in Hungary in particular: Export shares in labour and capital intensive industries declined in part dramatically in 1995–2003, this as a rule in favour of technology intensive industries, whose export shares rapidly approached to western standards in Slovakia and the Czech Republic and already exceed this benchmark in Hungary. Similar trends can be seen in human capital intensity and product quality: Export shares in low-skill industries more than halved in Hungary and declined by 40% in Slovakia and the Czech Republic within only eight years. In 2003, about 40% to 45% of eastern CENTROPE's exports to the world were in a segment with high quality competition.

While the new Member States of CENTROPE thus experienced a rapid change of exports to more "modern", technology and skill intensive activities, trade patterns of Austria only partially reflect the comparative advantages of a highly developed industrial country. Also here structural change to technology and (foremost) marketing intensive activities is under way, but the speed of this change is considerably lower. As a result, Austria's export portfolio was not more sophisticated than that of the eastern countries of CENTROPE in 2003, although income and therefore wage levels were incomparably higher.

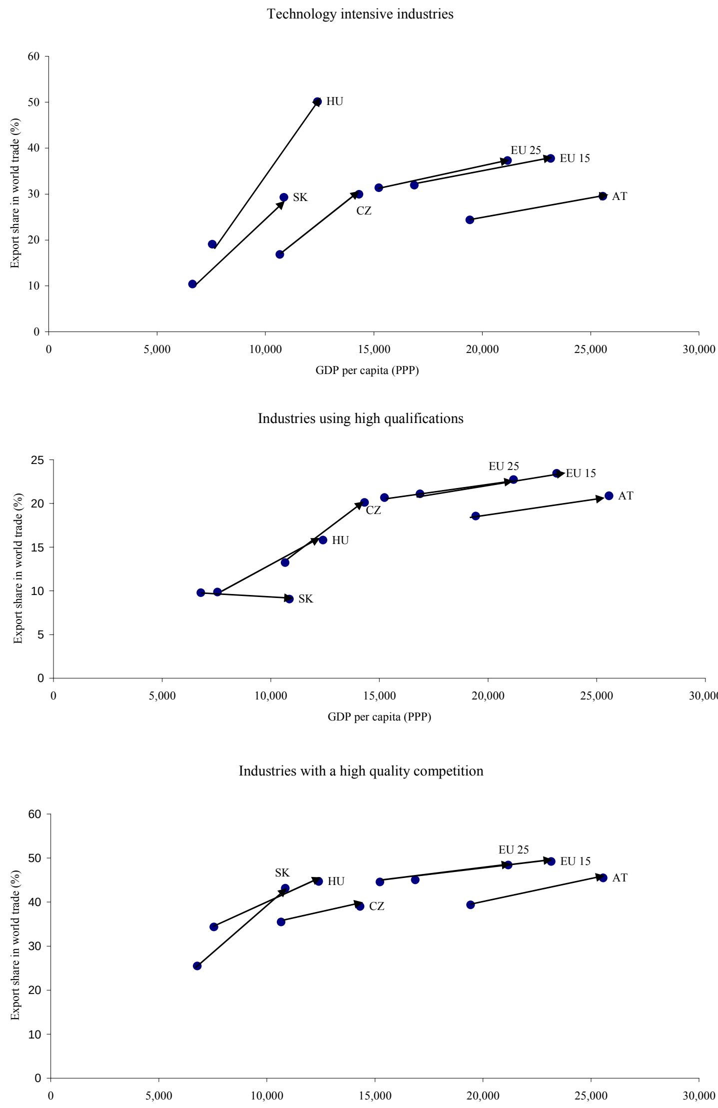
Chart 5 underlines these deficits in Austria's structural competitiveness by plotting export shares in the most sophisticated industry groups against the economic development levels of the countries observed. We see a steep development of technology intensive and skill intensive activities in the new EU Member States of CENTROPE, which in the end leads to remarkably high export shares in the respective industries – at least if one takes the comparably low levels of economic development in these countries into account. On the other hand, there is no significant catching up of Austria in a sectoral dimension: Evolutions here more or less follow the flatter development patterns of the EU-25, albeit export

[1] This typology from *Peneder* (2001) groups industries into four groups (low skill, medium skill blue collar, medium skill white collar and high skill) according to the qualification of workers employed in these industries.

[2] This typology due to *Aiginger* (1997) considers price differentials within industries to determine the role of quality (and alternatively price) in product market competition.

shares in sophisticated (especially technology intensive) industries are comparably low in Austria given the high GDP per Capita of this western part of CENTROPE.

Chart 5: Evolutions in the Export Shares of the Most Sophisticated Industry Groups (Exports to the Rest of the World and GDP per Capita (PPP), 1995 and 2003)



Source: UN – World Trade Database, Eurostat, Austrian Institute of Economic Research.

Table 9: Export-Unit-Values by Industry Types (Price (EUR) per kg in Trade with the Rest of the World)

	Slovakia		Czech Republic		Hungary		Austria		CENTROPE Countries		EU-15		EU 25	
	1995	2003	1995	2003	1995	2003	1995	2003	1995	2003	1995	2003	1995	2003
Factor intensity														
Traditional industries	0.95	1.98	1.30	2.24	2.15	3.58	3.34	3.76	2.13	2.94	3.79	4.01	3.55	3.78
Capital intensive	0.28	0.40	0.31	0.59	0.40	0.65	0.82	0.80	0.47	0.62	0.56	0.65	0.53	0.63
Marketing intensive	0.75	1.20	1.03	0.66	1.33	1.90	4.66	4.04	1.20	1.15	1.44	1.57	1.39	1.50
Technology intensive	3.07	8.70	4.70	10.53	5.69	19.18	12.86	17.34	8.50	14.43	12.09	13.94	11.77	13.67
Labour intensive	0.65	1.41	0.73	1.19	2.00	1.96	1.01	0.96	0.94	1.16	2.01	2.05	1.77	1.78
SkilI intensity														
Low qualification	0.34	0.54	0.48	0.58	0.86	1.12	1.31	1.22	0.73	0.85	1.10	1.14	1.03	1.09
Medium qualification/ blue collar	0.71	2.86	1.18	2.52	2.26	5.07	3.20	3.31	1.43	2.52	3.71	4.25	3.24	3.71
Medium qualification/ white collar	0.59	0.72	0.65	1.31	0.98	2.55	1.52	1.72	1.05	1.57	1.06	1.26	1.03	1.24
High qualification	3.17	5.45	3.44	8.80	4.33	11.93	10.44	15.00	6.84	11.35	14.43	15.82	13.63	15.04
Competition in quality														
Low	0.30	0.45	0.36	0.66	0.59	1.08	1.22	1.15	0.54	0.73	0.66	0.76	0.62	0.73
Medium	0.88	1.63	1.31	2.48	1.94	3.68	2.40	2.55	1.63	2.37	2.28	2.35	2.19	2.30
High	1.52	4.93	2.16	2.10	3.10	9.36	6.61	6.90	3.76	4.53	5.48	6.47	5.21	6.12

Source: UN-World Trade data base, Austrian Institute of Economic Research.

Interestingly, hence, Austria's high performance in export values and trade balances vis a vis the EU and the world alike goes hand in hand with marked deficits in it's economic structure. This constitutes a "structure – performance – paradox" (*Peneder*, 2003a), which may however be explained by intra-sectoral improvements in skills, technology and quality. Indeed, our analysis so far only considered structural change at an inter-sectoral level by studying changes to other (more or less technology-, skill- and quality intensive) industries. However, structural change may also be intra-sectoral in nature in the sense that firms move to higher quality and price segments within a specific industry.

A comparison of the export prices obtained by the CENTROPE countries in world trade (table 9) indicates that this may indeed explain at least parts of the Austrian performance puzzle. According to UN trade data unit values of Austrian exports (EUR 2.0 per kilogram on average) exceeded the CENTROPE average (EUR 1.7) as well as the average of the EU 25 (EUR 1.8) in 2003. As one can see, Austrian export prices were higher than those of the CENTROPE in almost all industry types, with advantages particularly pronounced in marketing- and technology intensive industries. Unit values of the eastern CENTROPE countries, by contrast, also improved substantially (and especially in the industries mentioned), but remained well below both the EU-25 and the CENTROPE average. Once again an important exception is Hungarian exports. Here unit values in 2003 exceeded the EU average in a number of particularly technology intensive products after a marked catching up in the second half of the 1990's and the beginning of the new century.

To sum up, our results reveal a remarkable sectoral catching up process in eastern CENTROPE countries' manufacturing, albeit starting from a specialisation in medium and low tech sectors. Austria's economic structure, on the other hand, proceeds only slowly to more sophisticated industries, but Austrian firms were able to occupy higher positions at the quality ladder within industries. Market share losses to the eastern CENTROPE countries therefore could be avoided – in spite of an unfavourable specialisation on mid-tech and mid-skill industries – by an orientation to more quality (and therefore price) intensive segments within these industries. If such a specialisation is sustainable, however, is an open question. As table 9 reveals, Austria's price advantages in less sophisticated industries are eroding rapidly – obviously it's particularly hard to keep up quality advantages in technology and skill extensive industries over time.

6. Persistence and Change: On the Evolutions of CENTROPE's Trade Patterns

While these results indicate a remarkable up-grading of (at least eastern) CENTROPE's economic structure from an unfavourable (low-tech, low-skill) position in the mid 1990s and a slower structural change in Austria, where the favourable competitive position is rooted primarily in higher quality products, they so far only rely on an analysis of some telling but broad typologies of industries. In the following, we extend on these results on the speed and direction of structural change by analysing the evolutions of the whole distribution of the set of (120) NACE 3 digit industries observable in our data base. In this way, we are also able to elaborate on the question, whether the increased integration into international trade led to more specialisation or (by an erosion of "old" comparative advantages) to a somewhat more diversified industrial structure.

As a first step, in table 10 we display both the so called index of compositional structural change[1] as a measure of the speed of change in CENTROPE countries world trade patterns, and the index of specialisation, which indicates the deviation of the trade structure in the individual countries from a benchmark structure (here the EU-25). By this we first of all are able to confirm our previous results on the speed of change. Indeed, foreign trade structures of the new Member States of CENTROPE changed more rapidly than those of Austria, while the latter in turn changed its trade orientation much more rapidly than the "old" EU Member States in our observation period. In fact, integration put some pressure on the border countries to restructure and modernise, and this led to a comparably strong adjustment in industrial structures. As the index of specialisation indicates, these adjustments resulted in a convergence of CENTROPE's export structure to that of the EU-25 – export orientations in nearly all CENTROPE countries (except the Czech Republic) moved to industries, which also determine the trade patterns of the other EU Member States.

Table 10: Indicators of Structural Change and Trade Orientation in the CENTROPE Countries

	Index of Compositional Structural Change			Index of Specialisation	
	1995–1999	1999–2003	1995–2003	1995	2003
Hungary	0.360	0.195	0.411	0.363	0.317
Slovakia	0.294	0.149	0.378	0.367	0.367
Czech Republic	0.194	0.148	0.280	0.285	0.298
Austria	0.094	0.072	0.138	0.222	0.214
CENTROPE	0.151	0.082	0.197	0.206	0.190
EU-15	0.060	0.053	0.081	0.012	0.017

Source: UN – World Trade data base, Austrian Institute of Economic Research.

[1] This indicator is defined as $\frac{1}{T}\sum_j \left|s_{ijt+T} - s_{ijt}\right|$ with s_{ijt} the share of an industry j in country i in total exports at time t. Without structural change the indicator takes on a value of zero, higher structural change is indicated by higher values.

In principle, this process of structural change can be understood as a result of counteracting forces of persistence and change. On the one hand the comparative advantages of the CENTROPE countries have changed due to improved access to technologies, learning processes and foreign direct investments, characterizing the transition process and the broader process of globalisation alike. This fosters the development of new specialisations in integration, be they complementary or totally independent from former ones (*Fagerberg*, 1988; *Verspagen*, 1993). On the other hand specialisation – in particular in the face of increasing returns to scale – is self re-enforcing in nature, as industry-specific knowledge cannot easily be transferred between regions. This persistence in 'technological trajectories' (*Dosi et al.*, 1990) may lead to "sticky" trade structures. Furthermore, the strength of these forces may differ in different phases of development. While for most developed countries with well established innovation systems persistence should be dominant, in the context of the substantial change in technologies which is incorporated in transition substantial changes in economic structures may occur.

To test this hypothesis somewhat more formally we follow *Amendola – Guerrieri – Padoan* (1991), *Dalum – Villumsen* (1996) and *Guerrieri – Iammarino* (2003) and estimate for each country a Galtonian regression of the form

(4) $$\mathrm{B}_{ij}^{t} = \alpha + \beta * B_{ij}^{t-1} + \varepsilon_{ij}^{t}$$

with *B* a vector of Balassa-indices for the individual NACE 3 digit industries[2] (j) in country (i), and *t, t-1* the years 1995 and 2003. We thus estimate the correlation between the specialisation patterns in the initial and the final year of our observation period[3]. In consequence the extimated regression coefficient ($\hat{\beta}$) is a measure of the persistence in trade structure, whereby four potential outcomes are possible:

- If $\hat{\beta}$=1, tendencies of persistence dominate tendencies of change and the trade patterns remain unchanged.
- If $\hat{\beta}$>1, the country under consideration increasingly specialises on industries which already dominate it's trade structure, while industries where trade has

[2] The Balassa-Index for a (NACE 3 digit) industry j in country i is $B_{ij} = s_{ij} \big/ s_i^{EU25}$ with s for export shares. A value > 1 denotes a relative specialisation in the industry, while values < 1 apply for industries with a smaller export activity compared to the EU-25.

[3] A problem in implementing the model was that it requires a bivariate normal distribution while the Balassa Index – which can take on values from 0 to ∞ and has a (weighted) mean of 1 – is non-normal by construction. Preliminary tests indicated that the distribution of our dependent variable was skewed and leptokurtic for all countries, and the null of normally distributed values had to be rejected on the basis of a Jarque-Bera-test. We thus transformed the original indicator to a symmetric Balassa index of the form $SB_{ij} = \left(B_{ij} - 1 \big/ B_{ij} + 1\right)$ which fulfils the normality assumption underlying our method.

been weak previously reduce their export shares further. In this case, therefore, existing specialisations strengthen along the lines of the cumulative change argument ("β-specialisation"; *Dahlum – Villumsen*, 1996).

- If $\hat{\beta}$<1, industries with an initially weak export performance (on average) improve their position in foreign trade in the course of the period observed, while strong export industries loose ground. This would thus indicate a „regression towards the mean“ (*Galton*, 1889). In this case specialisations loose in importance and give way to a more broad based, diversified export structure ("β-de-specialisation"; *Dahlum – Villumsen*, 1996).
- If finally $\hat{\beta}$<0, specialisation patterns reverse completely and initially strong export industries turn into weak ones and vice versa. Here forces of persistence play no essential role and trade patterns revaluate totally.

Table 11: Evolutions in Trade Specialisation in CENTROPE Countries

	$\hat{\alpha}$	$\hat{\beta}$	$t_{\beta>0}$	*Wald-F-Test* *(H_o:β=1)*
Total trade				
Slovakia	–0.121	+0.715	12.45***	24.68***
Czech Republic	–0.071	+0.729	11.65***	18.84***
Hungary	–0.193	+0.666	11.25***	31.86***
Austria	–0.010	+0.808	16.89***	16.07***
CENTROPE Countries	–0.047	+0.785	17.07***	21.81***
CEEC	–0.046	+0.732	13.64***	24.90***
EU-15	+0.001	+1.006	28.18***	0.03
Manufacturing trade				
Slovakia	–0.097	+0.751	11.12***	13.57***
Czech Republic	–0.056	+0.702	10.19***	18.69***
Hungary	–0.182	+0.568	7.56***	33.05***
Austria	+0.019	+0.700	13.10***	31.56***
CENTROPE Countries	–0.026	+0.742	15.03***	27.44***
CEEC	–0.024	+0.713	11.75***	22.29***
EU-15	–0.001	+1.055	17.24***	0.80

Note: The table reports the results of a Galtonian regression analysis on Balassa-indices, NACE 3 digit level, 1995–2003.

Source: UN – World trade data base, Austrian Institute of Economic Research.

The results of estimating equation 4 for the CENTROPE countries and the EU-15 are displayed in table 11. According to these results the hypothesis of a complete reversal of the sectoral structure of trade can be rejected at conventional levels of significance. All $\hat{\beta}$-coefficients are larger than 0 at the 1% confidence interval. Furthermore, results from a Wald test indicate that for the EU-15 the hypothesis $\hat{\beta}$=1 cannot be rejected, while for all countries of CENTROPE this is the case.

Hence, while in the old EU-15 Member States persistence in trade patterns dominated in 1995–2003, all CENTROPE countries experienced substantial change in export structures. In particular, in line with our previous analysis, Hungarian exports changed impressively and exceeded the speed of structural change of export structure in the CEECs in total. By contrast, in the Czech Republic and Slovakia changes in export structures were comparable to the CEECs, while in Austria structural change was substantially slower in total trade, but only slightly slower in trade in manufactures. A $\hat{\beta}<1$ for all CENTROPE countries furthermore suggests that trade patterns in the CENTROPE countries are moving in the direction of (β-)de-specialisation: Initially dominant export sectors loose in importance, while smaller sectors are gaining.

A statistically significant result of β <1 (and therefore "β – despecialisaton" in the sense of a regression of the Balassa-index to the mean), however, is only a necessary, but not a sufficient condition that also "σ – despecialisation" (in the sense of a shrinking variance in the distribution of the Balassa -indices) occured. As shown by *Hart* (1976) the relationship between β- und σ – specialisation can be represented by the equation $\sigma_t^2 / \sigma_{t-1}^2 = \beta^2 / \rho^2$ where σ^2_t is the variance of the a-Indices at time t and ρ is the correlation between the Ballassa-Indices for two different points in time. For values of $\hat{\beta}$ between 0 and 1 as in the case of the CENTROPE countries, β may be larger than ρ. This would imply that the changes in the relative position of individual industries dominate the tendency of a regression to the mean, so that the variance of the Balassa-index actually increases. In this case, therefore, decreasing β – specialisation would go hand in hand with increasing σ – specialisation.

To test for this possibility, table 12 together with a measure for the change in the variance of the Balassa-indices reports further indicators to detail the evolutions in the Balassa-indices' distribution. The Pearson correlation coefficient ρ measures the mobility of the individual industries within the whole distribution, whereby a high value indicates little change in the importance of individual industries in the trade structure and vice versa. Hence (1- ρ) measures a 'mobility effect' in the sense of changes in the distribution of Balassa values. This effect must not be confused with the 'regression effect' (1-β), which tests if (initially) strong export industries loose or gain in importance over time.

The results suggest that in 1995–2003 a decline in CENTROPE countries β – specialisation was indeed associated by a decline in σ – specialisation ($\sigma_t/\sigma_{t-1} < 1$). Moreover, the results reconfirm our previous findings concerning the speed of change: The Pearson correlation coefficient, which measures the stability of individual industries within the whole distribution, is clearly lower in CENTROPE countries compared to the EU-15, which confirms a higher structural turbulence of these countries in integration. Concerning the mobility effect, we see that changes in the role of individual industries were particularly large in Hungarian manufacturing, followed by the Czech and Slovak republics. In Austria changes in the ranking of export industries were less pronounced, but clearly higher than in the "old" EU Member States. Finally, the regression of the industries to the mean (the 'regression effect') is uniformly larger in CENTROPE than changes in the ranking of industries in exports (the 'mobility effect'). This causes the variance of the Balassa indices to shrink in all countries. The comparatively strong structural change in these countries therefore led to a weakening of initial trade specialisations and a more diversified export structure in the CENTROPE countries due to both statistical concepts.

Table 12: Evolutions in the CENTROPE Countries Trade Structures

	$\hat{\rho}$	'regression effect' (1-β)	'mobility effect' (1-p)	σ_t / σ_{t-1}
Total trade				
Slovakia	*0.755*	*0.285*	*0.245*	*0.947*
Czech Republic	*0.733*	*0.271*	*0.267*	*0.994*
Hungary	*0.721*	*0.334*	*0.279*	*0.924*
Austria	*0.842*	*0.192*	*0.158*	*0.960*
CENTROPE Countries	*0.845*	*0.215*	*0.155*	*0.923*
CEEC	*0.784*	*0.268*	*0.216*	*0.934*
EU-15	*0.934*	*–0.006*	*0.066*	*1.078*
Manufacturing trade				
Slovakia	*0.755*	*0.249*	*0.245*	*0.994*
Czech Republic	*0.726*	*0.298*	*0.274*	*0.967*
Hungary	*0.617*	*0.432*	*0.383*	*0.921*
Austria	*0.805*	*0.300*	*0.195*	*0.869*
CENTROPE Countries	*0.842*	*0.258*	*0.158*	*0.881*
CEEC	*0.773*	*0.287*	*0.227*	*0.923*
EU-15	*0.873*	*0.055*	*0.127*	*1.208*

Note: The table reports the results of a Galtonian regression analysis on Balassa-indices, NACE 3 digit level, 1995–2003.

Source: UN – World Trade data base, Austrian Institute of Economic Research.

Eastern CENTROPE countries are thus rapidly developing in the direction of more human capital and technology intensive exports which, however, are still traded at relatively low price. In this process, strong traditional specialisations are lost, so that in general a decrease in export specialisation can be seen in all countries. This structural change was not limited to the new Member States of the CENTROPE, however. Austria's trade patterns were also subject to substantial structural change, but economic structure remained more centred on medium-tech and medium-skill products in which the competitiveness of the Austrian suppliers is primarily based on intra-industry advantages in quality (and therefore higher export prices). Here too, the export base broadened substantially in the last decade, with traditional specialisations eroding substantially, being replaced by a more diversified export structure.

7. Conclusions

This paper elaborates on the industrial structure of the CENTROPE region and its evolution in recent years. Based on regional data for GVA and employment as well as national data on foreign trade we find that:

1. CENTROPE is a region with substantial structural disparities, which parallel those found in the enlarged EU in general. There are, however, a number of structural features of the region implying better conditions for growth and catching up in productivity than in other cross-border regions located at the former external border of the EU. In particular the region can claim a strong urban core, comprising the "twin cities" of Vienna and Bratislava as well as their surroundings. Furthermore, the region – in contrast to many other areas at the southern and eastern periphery of the EU – lacks problems of mono-industrialisation and extremely peripheral rural areas.
2. Despite these advantages a shift share analysis indicates that the regions of CENTROPE in the mid 1990s were characterised by a sectoral structure which encourages neither GVA nor employment growth. The high GVA growth in the eastern regions of CENTROPE mostly emerged within sectors and was due to productivity catch up. Hence growth in the region was in general not very employment intensive – a fact that also applies to Vienna as the most developed region within CENTROPE.
3. The CENTROPE region – in particular its eastern parts – has undergone substantial structural change in the last decade, with deindustrialisation and tertiarisation as the predominant tendency. The shares of agriculture in employment and GVA declined in all eastern regions of CENTROPE. In the light of recent findings, which associate rising shares of agricultural employment in transition economies with a failure of political reforms, this indicates a successful transition in the new Member States regions of CENTROPE. Indeed, these regions are more developed than many other regions in the new EU Member States.
4. Structural change in employment played only a minor role in productivity growth – which was particularly high in the new Member States regions in the late 1990's. In most regions of CENTROPE (both dynamic and static) structural change contributed less than 10% to total productivity growth, which is comparable to the rest of the EU. However, this contribution was higher in Bratislava and Burgenland, while in the Czech regions productivity increases

were even hampered by structural change, as employment in sectors with low initial productivity levels grew more rapidly.

5. Export data provide evidence of a rapid catching up process of the new Member States in CENTROPE. In all of these countries export shares to the EU increased dramatically, the balance of trade improved and the structure of trade moved rapidly to more ‘modern’, technology- and skill – intensive activities in the last decade. Relative to these spectacular improvements, Austria’s export portfolio, while also showing some up-grading, proceeded only slowly to more sophisticated industries. As a result, in 2003 Austria’s trade structure was not more sophisticated than that of the eastern countries of CENTROPE, while income and therefore wage levels were incomparably higher.
6. Despite the substantial improvements in competitiveness in the CENTROPE in general and the eastern parts of CENTROPE in particular, export statistics still indicate that CENTROPE tends to be specialised in mid-tech and mid-skill industries. The only outlier is Hungary where technology intensive industries play an important role, while Austria’s trade patterns, on the other hand, only partially reflect the comparative advantages of a highly developed industrial country. However, Austrian firms were able to occupy higher positions on the quality ladder within industries. Market share losses therefore could be avoided – in spite of an unfavourable specialisation on mid-tech industries – by an orientation towards more quality (and therefore price) intensive segments within industries.
7. In comparison to the “old” EU member countries all CENTROPE countries experienced a strong adjustment of their industrial structures in the last decade, which points to a substantial pressure to rationalise and modernise in the integration process. During these adjustments CENTROPE’s export structure converged gradually to that of the EU-25. Furthermore, we find ample evidence that integration did not lead to further specialisation, but to a substantial broadening of the export base. Traditional specialisations eroded substantially as comparative advantages changed in the course of the transition process, giving way to a more diversified export structure.

From the point of view of regional policy, our results indicate that the CENTROPE region is characterised by a very heterogeneous economic structure, arising from different specialities and comparative advantages in its sub-regions. Structural change is considerable and uniformly oriented towards more skill- and technology-intensive industries throughout CENTROPE. As a consequence, it is not a specialisation in one or a few "leading" sectors that will be the formula to success in the CENTROPE region, but a clever combination of the different but complementary comparative advantages existing there. This does not preclude opportunities for Cluster initiatives along strengths in sub-regions and –sectors, e.g. financial and business services in the urban core or electronics, transport equipment and (in the north) wood products in its surroundings. However, specific advantages in the region do not arise from sectoral, but functional specialisation: The diversity of locational advantages and the huge differentials in wage costs within short distance make the region especially attractive for strategies of vertical working division in the form of border crossing producer networks. Economic policy should therefore concentrate on attempts to optimize the framework conditions for inter-firm and inter-governmental cooperation in the new cross-border setting.

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A Preliminary Overview of the Possible Importance of Financial Markets for the Development of the CENTROPE Region

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1. Introduction

This article attempts to provide a preliminary overview of the possible importance of financial markets for the development of the CENTROPE region (also known as the Central European Region) and the role of the Austrian banking system in this connection.

Section 2 provides an overview of the theoretical basis and the empirical manifestations of the connection between the development of the financial system and the evolution of the real economy. Wide-ranging literature is available on the *finance-led* theory, proving that development in the financial markets has a positive effect on economic growth. The empirical section commences with a brief presentation of the Bertelsmann Foundation's Transformation Index, which describes the complex political/economic interrelationships upon which this connection is based. This is followed by a description of the *gap analysis*, which takes advantage of the fact that the development of financial markets goes hand in hand with real economic performance, in order to estimate the potential of the financial market in the Central European Region. The results of this analysis show that the CENTROPE region has substantial potential for growth in the financial sector.

Section 3, an overview of the financial systems in the Central European Region, shows that Austrian banks, through direct investments, have seized the opportunity provided by the CENTROPE region. Expanding their domestic markets into Central and Eastern Europe enabled Austrian banks to take advantage of scale effects in the financial sector, while, at the same time, the entry of Austrian companies into these markets was facilitated by the presence of Austrian banks. Despite the resulting high credit exposure in the CENTROPE countries, the stress tests conducted by the Oesterreichische Nationalbank (OeNB) and the Austrian Financial Market Authority (FMA) show that the Austrian banking system has made sufficient provisions for times of crisis. Inversely, however, the presence of Austrian banks in Slovakia, the Czech Republic and Hungary may cause problems for the financial sector in the host countries. For this reason, we will touch briefly on regulatory policy to show that the CENTROPE countries satisfy relatively high regulatory standards, not least because of the substantial presence of foreign (primarily Austrian) banks.

2. Connection between the Financial System and Economic Growth

2.1 Theoretical Considerations: Scale Effects Play a Role

We start with a summary of literature regarding the connection between the level of development of the financial system and the overall real economic conditions. In the standard model of perfect competition, there is no room for the financial system. Imperfections in the market and transaction costs are central to the relationship between the financial system and economic growth. The main focus is placed on theories that represent a finance-led thesis and prove that the development of financial markets has a positive effect on growth. Agglomeration effects and scale economies play an important role in the development of financial markets. Drawing on relevant literature, it can be seen that the positive correlation between finance and growth is produced by a complex political/economic process. An empirical manifestation of this correlation can be seen in the Bertelsmann Transformation Index (BTI), which is briefly discussed in section 2.2.1. The five criteria for political transformation and the seven criteria for economic transformation are presented in the annex.

Levine (1996) argues that the connection between finance and growth is primarily caused by imperfections in the market. Information and transaction costs are the main reasons for the emergence of financial markets for which the standard competition model makes no allowance. The basic functions of financial markets – savings mobilization, ensuring resource allocation and exerting external corporate control, facilitating risk management, easing the exchange of goods and services, and hedging contracts – support capital accumulation and technological innovation and thus influence economic growth. This also includes the positive role of the financial sector in corporate governance.

Furthermore, Levine also shows that the general level of economic development and typical indicators of financial market performance go hand in hand.

In his article on the connection between the financial sector and economic growth, Bisignano (2003) stresses that the contribution of the financial sector to economic growth consists of a credible obligation of the state to offer the public good that contributes to reducing transaction costs by *providing and enforcing a regulatory framework***.** This means a sound system of corporate governance, an efficient financial market supervisory authority, financial transparency and a system of enforceable contracts and functioning arbitration and bankruptcy procedures. “The potential contribution of the financial sector to economic growth increasingly appeared to depend on what Douglas C. North stressed in his work on institutional structure and change in economic history: the credible commitment of the state to ‘provide the public good of a set of rules and their enforcement designed to lower transaction costs’.” (Bisignano, 2003, p. 295).

The empirical analysis of the connection between the financial system and economic growth is difficult insofar as the previously mentioned functions fulfilled by developed financial markets are certainly convincing from an intuitive point of view, but are difficult to assess in quantitative terms. Credit volume, as well as market size and liquidity, are the most commonly used indicators, but they provide, at best, an initial indication of the state of development of a country’s financial market (see also Levine, 2003). Or, as Eugene N. White (2003) aptly says: “As contemporary research on the connection between finance and growth has discovered, many of the clues to growth are not found in the statistics but in the laws, regulations, and customs that govern economic activity.”

It follows that the development of an economy, particularly in terms of the connection between financial systems and growth, must be seen as an interplay between economic competition, financial companies and the regulatory procedures imposed and implemented by government authorities. “Political authority and markets can be regarded as analytical parts of an integrated ensemble of governance, the *state-market-condominium***.** Change occurs simultaneously through the process of economic competition among firms on the one hand, and policy and regulatory processes mediated by the institutions of the state, on the other.” (Underhill, 2004, p. 21).

This political/economic connection is well depicted by the Bertelsmann Transformation Index (BTI). As it includes both economic and political indicators, the BTI seems particularly suited to providing initial insight into the relationship between the financial systems of Slovakia, the Czech Republic and Hungary and the development of economic growth in this region. The BTI results for Slovakia, the Czech Republic and Hungary will therefore be discussed in the following section (2.2.1.).

The theory of development economics underscores the positive impact of the financial system on the general development of national economies. The importance of the financial system for the development of the market economy is particularly stressed by institutions concerned with development policy. The German Development Bank (KfW), which, on behalf of the federal government and the Laender promotes the German economy and acts as a development bank for transformation and developing countries, is now placing particular emphasis on the importance of the financial sector for economic development policy. Similarly, the German Federal Ministry for Economic Cooperation and Development describes the financial system as the (or at least one of the) key elements for its development strategy.

Therefore, a number of important empirical and theoretical works that follow this finance-led theory, namely that the financial markets are instrumental in fostering general growth, will be discussed in closer detail.

According to Beck et al. (2004), the development of the financial system accelerates economic growth by removing growth constraints, *especially for small, dynamic companies*. The paper also empirically confirms that financial development lowers transaction costs and informational barriers.

In an EU Economic Paper, Giannetti et al. (2002) estimate the positive impact of financial market integration and the development of financial markets in Europe on the growth of value added in the manufacturing industry at almost one percentage point per annum, between 0.75% and 0.94% depending on the scenario used. It is primarily *small and medium-sized enterprises* that benefit from financial market integration as they are affected far more strongly by local imperfections in the financial markets than are larger companies. Because of their larger area of activity, it is easier for larger companies to overcome local financial market imperfections, and they are therefore less affected by underdeveloped financial markets.

Wörgötter (SUERF Seminar, "The Future for Private Banking in the New EU Member States of Central and Eastern Europe," June 2005) finds the lack of financial market integration, characterized by the lack of pan-European financial systems and institutions and thus the *failure to take advantage of scale effects*, as an important reason for the weak European growth rates. The importance of scale effects within the financial sector is also evident from an internal OeNB study on regional economic concepts (Schuh, 2004). By increasing the volume of loans granted to *small and medium-sized enterprises* in the EU new Member States, which is relatively low at present, the catch-up process of these countries could be accelerated.

Rousseau and Sylla (2001) attempt to underpin the finance-led hypothesis with a theoretical economic analysis by combining two strands of research in economic history, namely the impact of financial developments on economic growth and financial globalization. They argue, based on a historical survey, that financial development was the cause of real economic development and that financial development goes hand in hand with integration into the global financial market and the international trade system. "The results, when combined with the evidence presented from historical case studies of the Dutch Republic, England, the U.S., France, Germany and Japan over the past three centuries, suggest that the economic growth and increasing globalization of the Atlantic economies might indeed have been ‚finance-led'." (Rousseau and Sylla, 2001, p. 39). Both the historical and the theoretical economic analyses also show that this connection must be embedded in a comprehensive institutional context in order to be successful (see Bisignano, Underhill and Douglas North above). This again underscores the necessity for a comprehensive political and economic analysis.

In an inversion of the finance-led argument, the level of development of the financial system can also be viewed as an indicator for the existence of factors that form the basis for economic growth, such as a stable and achievable regulatory and legal system. This circumstance results in foreign investors starting to show an interest in this kind of market. The proportion of foreign investors in the financial sector can thus also indicate a country's existing and potential economic growth. In this connection, it is not surprising that a strong correlation exists between the probability of joining the EU and the market share of international banks. "An interesting picture is provided by the examination according to country groups. Whilst the market shares of international banks in the new EU Member States is relatively high, they decrease step-by-step the less EU enlargement fantasies exist." (Banking Market in CEE, 2004).

Irrespective of the actual causal direction, empirical findings show that real economic development and the degree of financial intermediation progress at the same rate. Economic growth and the development of the financial system go hand in hand (see section 2.2.2., Credit Gap Analysis). At the same time, financial deepening coincides with increased complexity in the financial system. In a more complex financial system, however, scale effects play an important role. According to Cesare Calari, vice president of the Financial Sector of the World Bank, the new Member States are a clear example of this fact. As the financial markets in the individual countries are too small, the scale effects are used by foreign subsidiaries and branches (Conference on European Economic Integration, 2005).

With reference to the following discussion, it should be noted that the functional approach is preferable when investigating the connection between the financial system and economic growth in literature (see Levine, 1996; Blommestein and Schich, 2003), as, over time, the functions fulfilled by the financial system are more stable than those of institutions (this term is frequently used to denote banks). The financial system (for example, in Rousseau and Sylla, 2001) is, however, defined very comprehensively:

1. sound public finances and efficient public debt management;
2. stable monetary arrangements;
3. a diversified banking system;
4. an efficient central bank to stabilize domestic and international finances;
5. a well-functioning securities market.

Nevertheless the main section of this paper will concentrate on the banking system within the financial sector, following an overview of the political and social environment. The reason for this approach lies in the fact that this study primarily describes the importance of the financial systems in the individual countries on the basis of the works produced by the OeNB.

A further limitation results from the theoretical deliberations outlined above. Comparisons with developed countries can only ever have limited meaning. This is because development progresses differently in different countries, depending on the institutional framework, and because technological development means that Eastern European financial systems are developing in a fundamentally changed environment.

2.2 Empirical Manifestations of the Connection between Finance and Growth

2.2.1 The Bertelsmann Transformation Index Places the CENTROPE Region in an Advanced Position in Terms of Democracy and Market Economy.

The Bertelsmann Transformation Index (BTI) appears to be well suited to empirically model the complex political and economic context in which the connection between finance and economic growth develops. The countries within the CENTROPE region rank at the very top of the BTI.

The Bertelsmann Foundation subjects 116 countries to an exhaustive analysis of the transformation process toward a market-based democracy. Five political and seven economic criteria are evaluated on the basis of a point scale from one to five, with five being the best rating. The unweighted average of the ratings for the five political and the seven economic criteria provides the scores for the dimensions *political transformation* and *economic transformation*. The Status Index represents the average total of the results for *political transformation* and *economic transformation*.

The annex sets out the 12 criteria used by the Bertelsmann Foundation and contains Internet links to the detailed reports for the CENTROPE countries.

The countries that were investigated within the project "The Future of the Central European Region” (Slovakia, the Czech Republic, and Hungary) are at the top of the rankings. Hungary leads the table with 9.7 of 10 possible points. The only sectors in which Hungary did not receive the highest point score were currency and price stability, as well as sustainability (environmental and research and development). Slovakia and the Czech Republic are in second place, together with Lithuania and Slovenia. This puts them in front of Poland, which ranks seventh, and also in front of Chile and South Korea, poster countries for the market economy, which follow in eighth place. Bulgaria and Romania, both participating in the next round of enlargement, are listed in 18th and 21st place respectively, and Turkey comes in at 25th place.

2.2.2 Credit Gap Analysis

Commercial banks use an approach commonly referred to as *gap analysis* to evaluate market potential. In countries with lower per capita income, the ratios of the banking and financial markets in relation to GDP are typically lower than those for more highly developed industrialized nations. Because an assimilation of the degree of financial intermediation can be expected as the real economy converges, above-average growth is also likely to occur in the financial sector (see Arpa et al., 2005).

The following table compares the key financial indicators of the CENTROPE countries with those of the euro area and the eight new Member States (NMS) from Central and Eastern Europe as at the end of 2004.

Table 1: Indicators of Financial Intermediation in CENTROPE

	EU-12 % of GDP	**NMS-8 % of GDP**	CZ **% of GDP**	HU **% of GDP**	SK **% of GDP**	AT **% of GDP**
Banking assets (1)	**283**	**83**	98.4	84.5	90.0	277.7
o/w: domestic loans total	170	50	57.0	60.2	53.5	151.5
o/w: domestic loans to the corporate sector	50	22	19.7	30.8	19.7	46.8
o/w: domestic debt securities	42	16	15.2	13.0	24.9	15.2
o/w: domestic equity securities	13	1	0.7	1.3	0.4	3.6
Domestic debt securities (2) (outstanding nominal value)	**119**	**44**	56.4	62.1	38.1	130.4
o/w: issued by non-financial corporate sector	17	3	3.6	0.9	2.4	8.6
Domestic equity securities (3) (market capitalization)	**58**	**28**	37.1	26.3	10.9	26.9
Memorandum item:	*EU-15 % of banking assets*	*NMS-10 % of banking assets*				
Share of bank assets held by foreign banks	*13*	*68*	96.0	83.3	96.3	–

Source: OeNB.

The ratio of total banking assets and total domestic loans to GDP in the CENTROPE countries is approximately one-third of the ratio in the euro area. In the personal loan sector, the discrepancy is even greater. At 7% of GDP, their share is substantially lower than the ratio of 49% in the euro area (see Financial Stability

Report 8, p. 35). This market segment experienced in the recent past high growth rates.

Bond issues relative to GDP are around one-half of the euro area average in Hungary and the Czech Republic and approximately one-third of the euro area average in Slovakia, with public sector bonds dominating in all three countries. The level of debt securities issued by non-financial corporations in these countries is substantially lower: 0,9% of the GDP for Hungary, 2,4% for Slovakia and 3,6% for the Czech Republic. This means 5% of the European average for Hungary, 14% for Slovakia, and 21% for the Czech Republic. Market capitalization in these countries is also considerably below the European average.

Based on the studies carried out by Bank Austria Creditanstalt (BA-CA), the gap analysis is further extended to include credit levels in Central and Eastern Europe. The results gained clearly show that the Central European Region has significant potential for market development.

High nominal growth rates in the CEE countries and the convergence of their degrees of financial intermediation lead to expectations of strong growth in the banking sector. BA-CA carried out a gap analysis in this connection and is anticipating a credit growth rate of 14% per annum over the next ten years in this region. The Czech Republic and Slovakia achieve almost exactly the average gap, while the gap for Hungary is slightly below average. This analysis can also be interpreted as an empirical manifestation of the connection between growth and development shown in section 2, because it presumes that the degree of financial intermediation is positively correlated with rising per capita income.

An analogous situation exists on the assets side. Assets in general, and particularly higher value asset items, such as life insurance, mutual funds and pension plans, are underdeveloped in comparison to income. While in 2004 the share of managed assets (life insurance, pension and investment funds and deposits) in total income came to 126% in the euro area and 109% in Austria, this figure was 52% in the Czech Republic, 41% in Hungary, and 35% in Slovakia (see Bank Austria Creditanstalt, April 2005, p. 6). A higher rate of income growth and an increase in the ratio of fund products to GDP represents a double opportunity for growth. As a result, the volume of managed assets in the CENTROPE countries grew substantially more strongly than in Austria and the euro area: in the period from 2001 to 2004, the volume of life insurances and pension funds rose by 110% in Hungary, 57% in the Czech Republic, and 92% in Slovakia, which is substantially faster than in Austria (19%) and in the euro area (20%). The same applies for fund assets (Bank Austria Creditanstalt, April 2005, p. 7).

Given this background, Central and Eastern Europe in general and the Central European Region in particular can be seen as the main growth market for Austrian banks. This is also equally or even more true for Southeastern Europe.

3. Summary of Financial Systems in the Central European Region

The CENTROPE region is considered to be particularly attractive for foreign direct investment (FDI) as this region is characterized by an excellent level of political/economic maturity, as shown by the Bertelsmann Transformation Index discussed above, and simultaneously has great growth potential (Podkaminer/Stehrer 2005).

Following Slovenia, the Czech Republic, Hungary and Slovakia are the most highly developed countries in Central and Eastern Europe. According to WIFO calculations (Palme, 2005), the 2004 GDP per capita at purchasing power parity reached 70.3% of the EU-25 level in the Czech Republic, followed by Hungary and Slovakia at 61.1% and 52.0% respectively. The wealth of Central Europe as a whole, expressed by the weighted average of all four countries of the CENTROPE Region, was 85.7% of the EU-25 level in 2004.

Table 2: Wealth of the CENTROPE Region in Comparison to the Surrounding Regions

	2002 GDP per capita at PPP (EU-25 = 100)		
Central European regions			
CENTROPE (8)	18,507		87.4
outside CENTROPE (16)	13,726		64.8
Significance[1)]		0.172	
Central European regions			
Austria (5)	24,304		114.8
CEEC-3 (19)	12,955		61.2
Significance[2)]		0.002	
Central European regions			
Austria (5)	24,817		117.2
CEEC-3 (19)	14,721		69.5
Significance[3)]		0.126	

Source: Eurostat, WIFO calculations. Figures in parentheses indicate the number of regions. [1)]Probability of error for the significance of the differences between CENTROPE regions and Central European regions outside CENTROPE (comparison of averages). [2)]Probability of error for the significance of the differences between Central European regions in Austria and the CEEC-3 (comparison of averages). [3)]Probability of error for the significance of the differences between CENTROPE regions in Austria and the CEEC-3 (comparison of averages).

Source: Palme (2005).

However, the level of wealth in the CENTROPE regions is still higher than in the surrounding regions of the four CENTROPE countries, as is shown in the table above, which compares the gross domestic product at purchasing power parities in the CENTROPE region and the regions surrounding it.

At the same time, the CENTROPE region is a dynamic growth center that is undergoing a gradual process of convergence. In a study commissioned by the OeNB, the Vienna Institute for International Economic Studies (wiiw) evaluated the growth prospects of the Central European countries where the CENTROPE region is located (Podkaminer and Stehrer, 2005). The annual growth differentials versus the EU-15 for the next 10 years (2005–2015) range between 0.8% and 1.4% for the Czech Republic, between 1.2% and 2% for Hungary, and between 1.5% and 2.5% for Slovakia. The resultant convergence of per capita income in these countries as compared to Austria is illustrated below.

Table 3: Projected Positions versus Austria at Constant 2004 PPP

			2015				2015	
	2004	low	base	high	2004	low	base	high
		per capita				total (EUR billion)		
Czech Republic	15647	21201	23088	24344	160	213	232	245
Hungary	13623	19264	21195	22816	138	189	208	224
Slovakia	11645	16822	19098	20338	63	91	103	110
Total					361	493	543	579
Austria	27104	33700	35183	36334	222	280	292	302
		as % of Austrian level						
Czech Republic	57.7	62.9	65.6	67.0				
Hungary	50.3	57.2	60.2	62.8				
Slovakia	43.0	49.9	54.3	56.0				

Source: wiiw (2005).

It is therefore not surprising that, in terms of FDI, the situation is particularly favorable for the regions constituting CENTROPE. The *Centre for Economics and Business Research (CEBR)* in London produced an investment index for 223 EU regions in January 2005 evaluating growth prospects, market potential, qualification level and *access to EU subsidies* for each region. The table of the most economically attractive of these 223 EU regions is led by 15 regions in post-communist states. These 15 include five Czech, four Hungarian and four Slovak regions. Greater Prague heads the list with 178% of the EU average. Central Hungary (Budapest), at 172%, and Bratislava (168%) occupy second and third place, followed by Western Danubia (161%) and Eastern Slovakia (160%) in seventh and eighth places respectively.

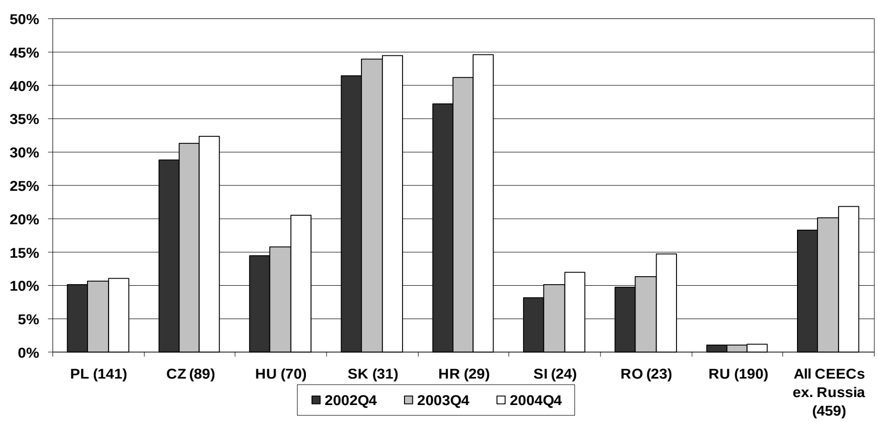
The Austrian CENTROPE regions, on the other hand, are positioned lower down the scale: Lower Austria is in 106th place at 95% and Vienna ranks 115th at 93% of the EU average (Schausberger, 2005). In this comparison it must, however, also be taken into account that the relatively poor results for the Austrian regions can be explained to a great extent by EU subsidies to which they are no longer entitled.

Austrian banks appear to have recognized this region's great potential for future development and growth. This is reflected in the volume of direct investments that Austrian banks are channeling into the Central European Region, thus also creating an important prerequisite for the access of Austrian companies to this region.

3.1 FDI – Austria Strongly Represented in the Financial Sector

The economic importance and growth potential of the region surrounding Vienna and Bratislava can be aptly illustrated by depicting the movement of FDI. Hungary had attracted the highest volume of FDI until the end of 2003, when it was overtaken by Poland. In terms of per capita FDI, the Czech Republic was the leader, followed by Hungary.

Chart 1: Market Share of All Austrian Banking Subsidiaries in Central and Eastern Europe



Note: Figures in parentheses are the total assets of the aggregate banking system in the relevant countries in EUR billion. PL=Poland, CZ=Czech Republic, HU=Hungary, SK=Slovakia, HR=Croatia, SI=Slovenia, RO=Romania, RU=Russian Federation.

Source: OeNB, Financial Stability Report No. 9.

3.1.1 Slovakia

Slovakia's initial position was less favorable than those of its immediate neighbors Hungary and the Czech Republic. Before the collapse of communism and the subsequent political and economic transition, investments primarily went into capital-intensive industries, such as arms manufacture, whose trading relations were largely concentrated on Comecon countries. The restructuring process correspondingly turned out to be very painful and was not helped along by the government after the peaceful separation from the Czech Republic. Given these circumstances, Slovakia's success from 1999 onward seems all the more impressive. With a per capita GDP at purchasing power parities of EUR 11,645 in 2004, Slovakia ranks around 25% behind the Czech Republic and almost 15% behind Hungary (Podkaminer and Stehrer, 2005).

High economic potential, a well-qualified labor force and, especially in the western part of the country, a robust infrastructure – all these factors make Slovakia particularly attractive for foreign investors. Since 2000, the level of FDI has experienced a marked increase. According to the International Investment Position, the level of FDI equaled EUR 10.5 billion at the end of 2004. This puts the per capita FDI at more than 50% higher than Poland's. The lion's share of capital inflows went to the industrial and financial sectors. The automotive and steel industries also account for a large part of FDI, with 80% of the total FDI being channeled into the western part of the country (Bratislava, Tencin and Nitra), the Slovak CENTROPE region. At the end of 2003, Austria was the third-largest foreign investor with a market share of 14%, following Germany (24%) and the Netherlands (17%).

The disproportionately high share of FDI in the financial sector is a result of the fact that this sector only accounts for approximately 2% of all employees in Slovakia, but attracts 23% of all foreign investments.

Austria is by far the largest investor in the Slovakian banking sector, controlling approximately 45% of the balance sheet total (third quarter of 2004). At present, five Austrian banks are operating in the Slovak Republic.

3.1.2 The Czech Republic

The Czech Republic is characterized by a comparatively modern industry and a low level of foreign debt. With a per capita GDP at purchasing power parities of EUR 15,647 in 2004, the Czech Republic stood at 57.7% of the Austrian per capita income (Podkaminer and Stehrer, 2005).

The high level of foreign interest in the Czech Republic as an industrial location is reflected in foreign investments, which totaled EUR 37 billion for the years 1993 to 2003. This means that the Czech Republic outperformed Hungary in terms of foreign per capita investment. According to the International Investment Position, however, the Czech Republic comes in behind Hungary (EUR 41.4 billion versus EUR 44.2 billion).

At the end of 2003, Austria was third in the ranking of FDI with a market share of just over 10%, following Germany (31.3%) and the Netherlands (18.4%).

However, Austria's position in the Czech financial sector is well above average, with Austrian banks accounting for a market share of approximately 33%.

3.1.3 Hungary

With a per capita GDP at purchasing power parities of EUR 13,623 in 2004, Hungary achieved slightly more than 50% of the Austrian per capita income (Podkaminer and Stehrer, 2005). In Central and Eastern Europe, Hungary is surpassed only by the Czech Republic and Slovenia. Its favorable geographical location makes Hungary a bridgehead for transit trade between east and west. The country's assets include a highly qualified stock of human resources and a modern telecommunications infrastructure, developed to a level that is above average by Eastern European standards.

Since the beginning of the country's opening to the west, Hungary posted inflows of EUR 31 billion in FDI. This is equivalent to EUR 3,100 per inhabitant, a figure that is only exceeded by the Czech Republic. According to the International Investment Position, however, the stock of FDI came to EUR 44.2 billion at the end of 2004, surpassed by only one of the other new Member State, Poland (EUR 48 billion). Per capita FDI in Hungary (almost EUR 4,400), however, stood at almost four times the level achieved by Poland (EUR 1,200).

The region of Central Hungary – the area surrounding Budapest – accounts for two-thirds of total FDI. Western Transdanubia, which is part of the CENTROPE region, also enjoys above-average benefits from FDI, with a particularly high FDI concentration in the district of Györ-Moson-Sopron, also located in the CENTROPE region. A number of multinational corporations, such as Audi, General Motors, General Electric and Philips, have established operations in this region, which is in closest vicinity to Vienna.

Western Transdanubia is considered the second-most developed region, with a well-qualified labor force and a number of highly developed industries: mechanical engineering, light industry and food processing. As noted above, the district of Györ-Moson-Sopron holds a strong attraction for foreign capital. Surpassed only by Central Hungary, which includes the capital city of Budapest and the district of Pest. Western Transdanubia has the second highest number of joint venture companies in Hungary.

Following Germany (31.1%) and the Netherlands (14.7%), Austria is the third-largest direct investor in Hungary with a market share of 11.7%, but is the leader in terms of FDI per capita. In the banking sector, Austrian banks control over one-fifth of the balance sheet total.

In summary, it can be said that the Austrian banks fulfill their function as a central sector for the development of a growth cluster in the CENTROPE region in an exemplary manner. The high degree of interconnection in the region's banking market could, however, entail a certain risk of contagious effects for the individual national banking systems in the event of financial crises. Because of the Austrian banks' credit exposure in the CENTROPE region, this issue is therefore first investigated from the Austrian point of view and then from that of the neighboring countries.

3.2 Credit Exposure of the Austrian Banking System to Countries in the Central European Region

The important role of the financial systems in neighboring countries is also evidenced by the fact that the IMF's *Financial Sector Assessment Program* highlights the profitability of the Eastern European banking sector, because of the concentration of Austrian bank investments in this region, as the primary challenge for Austrian banks.

Banks' margins in the CEECs would be expected to narrow with greater market access and the resulting increase in competition. At the same time, the lower degree of intermediation would create business opportunities, thus contributing to banks' profits (see gap analysis). According to the IMF, the Austrian banks are well aware of these challenges and know that this situation requires continued monitoring and vigilance.

3.2.1 Austrian Banks well equipped to Withstand Crises in Neighboring Countries

In section 4.2 of their paper analyzing the stress tests for the Austrian banking sector, Boss et al. (2004) investigate the effects of shocks caused by adverse macroeconomic and market conditions in the Eastern European countries. They come to the conclusion that even a combination of both shocks would not lead to serious problems for the Austrian banking system because the overall capitalization level is sufficient to withstand considerable shocks. These results are confirmed by Financial Stability Reports 7 and 8.

3.2.2 Special Responsibility for Austria's Financial Market Authority?

Inversely, because of the significant role of Austrian banks in the CEECs, problems in the Austrian banking sector could have a serious impact on the financial systems in the host countries. Austrian banks account for a market share of 45% in the Slovakian banking sector. The market share in the Czech Republic and Hungary is 33% and 20% respectively. This kind of asymmetric risk distribution caused the

ECB to consider increased coordination and information exchange between home- and host-country supervisory authorities.

"A foreign branch in the new Member States may have systemic importance in the host country even though it only represents a relatively modest share of the group's total operations. In this case, a potential conflict may emerge between home country control in micro-prudential supervision and host country responsibility in safeguarding financial stability. This highlights the need for enhanced coordination and information-sharing between host and home supervisory authorities. Bilateral agreements between national authorities can alleviate the information asymmetry problem and the increasing number of Memoranda of Understanding between NMS and EU-15 authorities in recent years may be seen as an encouraging sign in this respect." (ECB, 2005, p. 7).

Does the expansion of Austrian banks' domestic market into Central and Eastern Europe in general and the Central European Region in particular imply that these banks and the Austrian Financial Market Authority bear a special responsibility for ensuring the stability of the financial markets in the host countries? This certainly requires diplomatic instinct as these countries, given their historical experience, could possibly interpret any moves in this direction as unwarranted paternalism.

The analysis of the financial market stability of these countries gains an additional dimension in the convergence process discussed in section 2.2.2. (Credit Gap Analysis). It is difficult to distinguish empirically whether strong growth in credit volumes is based on structural convergence in financial intermediation or whether it is driven by a cyclical credit boom. An overly relaxed monetary and financial supervisory policy could foster excessive credit growth. On the other hand, an excessively restrictive policy could hamper the process of convergence in financial intermediation and thus impede the real economic convergence process.

We can thus conclude that the questions regarding the connection between macrofinancial stability and microeconomic supervision and the division of responsibility for regulation and supervision are of particular interest to the authorities in the Central European Region (see Srejber, 2005). Provided the authorities in these countries cooperate in an exemplary manner, it should be possible to avoid any potential conflicts of interest (Vesala, 2005).

The governor of the OeNB, Dr. Liebscher, expressed similar sentiments in his opening statement at the *Conference on European Economic Integration* (November 14 and 15, 2005) in his contention that financial market integration across borders results in a growing need for cooperation among supervisory authorities, as large financial institutions may be subject to foreign control: "The cross-border character of financial integration and the emergence of large, potentially systemically relevant entities under host country jurisdiction require cooperation between national supervisory agencies to ensure an effective exchange of information both from a home country and a host country perspective."

In this connection, an advantage that should not be underestimated is rooted precisely in the fact that banks from Germany, Italy and Austria dominate the financial market in the CENTROPE region. This – according to an important conclusion reached at the SUERF seminar of June 2005 – would cause these countries' regulatory frameworks and supervisory practices to be imported into the host countries.

Annex : The Bertelsmann Transformation Index to a Market Economy Democracy

The Bertelsmann Foundation's Transformation Index compares 116 countries in terms of their strategies to effect a transformation toward a democratic market economy. Democratic and economic structures are rated on a point scale from one to five, with five being the best rating.

Criteria for Political Transformation

- Stateness
- Political participation
- Rule of law
- Stability of democratic institutions
- Political and social integration

Criteria for Economic Transformation

- Level of socioeconomic development
- Organization of the market and competition
- Currency and price stability
- Private property
- Welfare regime
- Economic performance
- Sustainability

Link to the ranking list with points assigned to the individual criteria:
http://bti2003.bertelsmann-transformation-index.de/fileadmin/pdf/BTI-Tabelle.pdf

Description of the individual criteria:
http://bti2003.bertelsmann-transformation-index.de/fileadmin/pdf/BERT_Criteria_Indicato_ENGL.pdf

Detailed country report for Slovakia:
http://www.bertelsmann-transformation-index.de/174.0.html

Detailed country report for the Czech Republic:
http://www.bertelsmann-transformation-index.de/172.0.html

Detailed country report for Hungary:
http://www.bertelsmann-transformation-index.de/171.0.html?&0=&type=98

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Banknote Migration in the CENTROPE Region

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1. Introduction

The objectives of central banks within the framework of the European System of Central Banks (ESCB) are well defined and aligned to the assignment of the European Central Bank (ECB). Every central bank has to adjust its activities due to its specific environment which is determined and influenced by the size and vitality of the economy as well as by the competitive position and structure of the financial market. Of course, structural shifts have an impact on the decision making processes in central banks.

The Oesterreichische Nationalbank (OeNB) has been facing four major shifts of its political and economic environment within the last decade. In 1995 Austria joined the European Union, in 1999 Austria was a founding member state of the European Monetary Union, in 2002 the euro cash was introduced and in 2004 the enlargement of the European Union by ten countries (four of them having a common border with Austria) took place. All of these historical events represented an important challenge for the OeNB, and in all four cases the OeNB adjusted to the new framework by:

- focusing on the economic analysis of Central and Eastern European countries,
- successfully introducing the euro cash,
- setting a new focus on the analysis of Southeastern European countries,
- providing technical assistance in euro changeover matters especially to neighboring countries (for example: twinning projects with Hungary and Slovakia) and
- providing technical assistance in all areas to Central, Eastern and Southeastern European countries as well as CIS countries.

With the enlargement of the European Union the neighboring countries of Austria moved closer.

From a regional point of view there is another important issue in this respect. Nowhere in Europe there are two capital cities so close to each other like Vienna and Bratislava (55 km bee-line) forming a transnational economic region. The enlargement opened the floor for close cooperation between Austria and Slovakia and especially between the two cities Vienna and Bratislava.

The potentials for cooperation are enormous. In order to analyze the possible common issues, possibilities and challenges the idea of "CENTROPE – Central European Region" was born. The initiative was created by the Federation of Austrian Industry in 1997. "CENTROPE" covers more than the Vienna and Bratislava region; it includes north-western parts of Hungary and southern parts of the Czech Republic as well. The region has a population of about 7 million representing thus an important European metropolitan area.

2. Role of the Euro Outside the Euro Area

Foreign cash or foreign currency-denominated bank deposits are important financial assets for residents of many countries, especially with developing or emerging markets. After the introduction of the euro cash, holdings of euro banknotes and euro-denominated bank deposits have become increasingly important. The rise in the euro exchange rate since 2002 has enhanced the image of the currency outside the euro area. The euro is indeed an international currency today.

Foreign holders of euro banknotes benefit from their holdings as they acquire an asset that is liquid, secure and stable in value. These characteristics are often unavailable in their own country's currency, especially during and after periods of turmoil. In some non-euro area countries, the euro has even gained the position of a common medium of exchange.

The ESCB benefits from currency holdings outside the euro area by the so-called seigniorage. Seigniorage benefits are realized from the interest earned on the asset counterpart to the ECB liability for the currency in circulation. The ECB issues non-interest bearing obligations (i.e. banknotes and coins) and then uses the proceeds to acquire interest bearing assets. As euro currency in circulation has been increasing in response to the growing trust into the euro, interest earnings have also been increasing.

However, there are costs of external euro circulation. These costs originate mainly from expenses for the physical handling of cash (issue, sorting process, repatriation, re-issuing, destroying, and authentication procedures). It is a challenge and a responsibility of the ECB and the National Central Banks (NCBs) of the ESCB to ensure the integrity of the euro. It is an inviting target for counterfeiters, as it is a globally used currency.

According to a survey conducted by the European Commission aiming to build up a better picture of the role of the euro as a private means of payment and exchange, the international perception of the euro has been strengthening continuously in all regions of the world over 2003 (European Commission, 2004). The survey analyses three main aspects of the euro: the possibility of exchanging euro cash; the use of euro cash for payments; and public attitudes towards the euro. The results of the survey revealed that in general euro cash can be exchanged more easily. There are no major difficulties in selling euro cash for local currency.

Problems were encountered only outside of tourist areas and major cities particularly in Central American countries. It is, however, more challenging to obtain euros. Again in the Americas, but also in certain parts of Africa and Asia difficulties emerged. Of course, the closer you come to the euro area, the easier it is to exchange. Limits on holdings and on the exchange of foreign currencies were mainly found in Africa and Asia, where restrictions on the import of foreign currency and on the amounts held by individuals were imposed.

The possibility to pay with euro cash remains largely restricted to tourist areas. The display of prices in euro is even less widespread and mostly restricted to European non-euro area countries. However, it is common use in some countries to display prices in euro for high value items.

The public awareness of the euro improved significantly in all regions. Many respondents of the survey attributed the improvements of public awareness to the euro exchange rate appreciation against the U.S. dollar. The familiarity of the general public with the euro is still very low in the Americas or in Asia, though. Due to economic links to the EU the business sectors are in general much more familiar with the euro than the public.

In the euro area neighboring countries the euro is the most important foreign currency. According to the quarterly survey conducted by the Oesterreichische Nationalbank in Croatia, Hungary, the Czech Republic, Slovenia and Slovakia the estimated amount of euro that circulated in these countries increased constantly since 2002. However, it has not reached the total amount of the constituent currencies prior to the cash changeover yet as there has been a substantial decline by about one third in the joint demand for Deutsche mark and Austrian schilling before the introduction of euro cash. The survey revealed that an average of about 71% of the respondents exchanged their Deutsche mark holdings for euro, 21% for local currencies, 4% for U.S. dollars, 1% for Swiss francs, and 2% for other currencies. The projections for the demand for U.S. dollars show a downward trend over the period from 2000 to 2004, with U.S. dollar demand in late 2004 being about half of the demand in 2000.

Most of the respondents of the survey consider the euro as a stable currency. Even among holders of U.S. dollars the euro is seen as more stable than the U.S. dollar (Stix, 2005).

The confidence in the local currencies has increased in these countries over the past years due to stability-oriented economic policies. This would imply that euro cash holdings might decrease, but as economic links to the euro area are strengthening continuously and as all of these countries follow their path to the adoption of the euro[1], the future role of the euro is expected to increase further.

[1] According to the national euro changeover plans Slovenia intends to introduce the euro as a legal tender in January 2007, Slovakia in 2009, the Czech Republic and Hungary in 2010 (possibly in 2009). Croatia is not a member of the European Union, thus, there is no

3. Banknote Migration

3.1 Determining Factors

The amount of banknotes in circulation is determined by the size of the population, the economic performance (Gross domestic product – GDP and Gross regional product – GRP), the level of income, the branch network of the commercial banks and the preferences for specific means of payment (cash and non-cash) in a country.

In order to highlight the CENTROPE regions, it seems necessary to show them in their context and to explain their position within their territories.

Table 1: General Data CENTROPE Region (Absolute Values)

Country	Region	Area (km²)	Population (2003)	GDP/GRP (mio. EUR)	GDP/capita EUR
Czech Rep.	Jihočeský	10,057	625,541	4,135	13,052
	Jihomoravský	7,066	1,122,570	7,811	13,722
	Czech Rep.	**78,867**	**10,211,455**	**75,824**	**14,660**
Hungary	Győr-Moson-Sopron	4,208	440,000	3,502	14,584
	Vas	3,336	267,000	1,794	12,240
	Hungary	**93,029**	**10,142,400**	**68,891**	**12,402**
Austria	Burgenland	3,965	277,400	4,959	17,900
	Lower Austria	19,178	1,554,000	33,422	21,600
	Vienna	415	1,553,700	57,141	36,800
	Austria	**83,871**	**8,117,800**	**212,511**	**26,500**
Slovakia	Bratislavský	2,052	599,787	6,694	26,109
	Trnavský	4,147	552,014	2,597	11,183
	Slovakia	**49,034**	**5,380,053**	**25,730**	**11,328**

Source: National statistical offices.

The regions that are part of CENTROPE contribute an important share of GDP of their respective countries. As Bratislava and Vienna – the capital cities of Slovakia and Austria – belong to CENTROPE, it is evident, that the share of CENTROPE is significantly high in those two countries. In Austria about 45% of GDP derive from Vienna, Lower Austria and Burgenland with about 27% deriving only from

national euro changeover plan yet. However, the survey revealed that 90% of the Croatian respondents reckon on the euro introduction, the majority of them expecting it beyond the turn of the decade.

Vienna. In Slovakia the picture is similar, as the economically most powerful regions, Bratislavský and Trnavský, belong to CENTROPE contributing about 36% to the Slovak GDP. The CENTROPE regions of the Czech Republic, Jihočeský and Jihomoravský, account for about 16% of the Czech GDP. The Hungarian CENTROPE regions, Győr-Moson-Sopron and Vas, contribute about 8% to the Hungarian GDP.

In addition to the size of the population and the economic performance, the wages and the productivity play an important role in the demand for banknotes. The CENTROPE region has substantial disparities in wage and productivity levels. The average wages in Austria are 6 to 7 times higher than in the neighboring EU countries. However, the CENTROPE regions do not belong to the "low-wage regions" in their respective country except for some border regions in Austria and the Czech Republic.

The general factors are determining the circulation of banknotes in a specific country. However, the number of banknotes in circulation is also determined by the number of issued denominations, their value as well as by the value of the denominations put into circulation via automated teller machines (ATMs).

Analysis of data from the Currency Information System (CIS) and sample studies of some euro area NCBs revealed that if one country issues a specific denomination via ATMs and its neighboring country does not issue it via ATMs, the denomination in question does, however, appear in the sample of the not-issuing country. Austria, for example, has rarely issued the 50 euro banknote via its ATMs for some time[2]. Germany and Italy, its neighboring euro area countries, do issue this denomination. However, the 50 euro banknote has a relatively high share in the denomination split of the returned banknotes in Austria.

In addition, the sample studies made it clear that higher denominations migrated more than lower denominations. That would explain that the 50 euro banknote is more common in Austria than the 20 euro banknote even though both denominations are rarely issued via ATMs.

Another important aspect in analyzing banknote migration is the circulation itself. It defines the potentials for migration by limiting the amount of money.
Focusing on the banknote migration in CENTROPE, it is necessary to find a tool for evaluating the regional cash in circulation.

In line with the Quantity Theory of Money there is a linear relation between the GDP and the cash in circulation. By using the available data on the Gross regional product (GRP), it is possible to calculate the hypothetic regional cash in circulation.

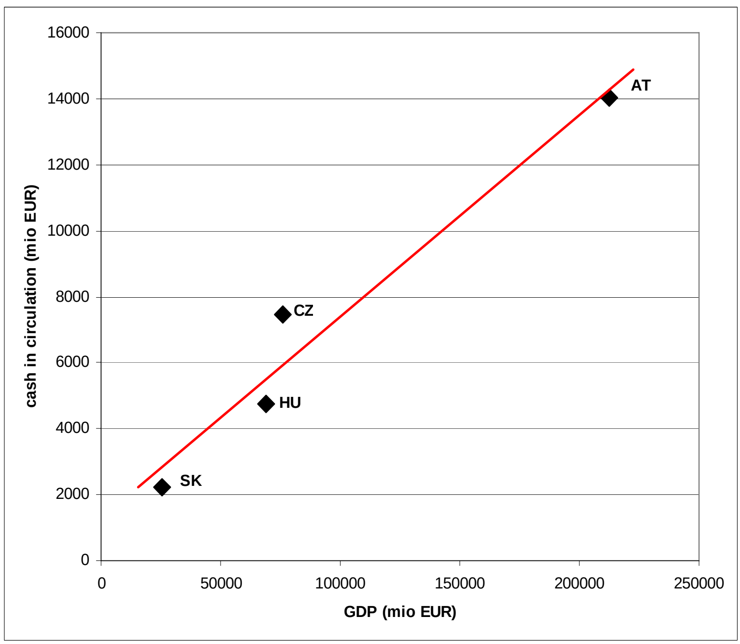
[2] Recently, Austrian ATMs are filled with 50 euro banknotes as well. Before only ATMs with four cassettes located in self service areas were filled with this denomination.

Table 2: Banknote Circulation[3]

	2000		2001		2002		2003		2004	
	Mio. Pieces	Mio. EUR	Mio. Pieces	Mio. EUR	Mio. Pieces	Mio. EUR	Mio. Pieces	Mio. EUR	Mio. Pieces	Mio. EUR
CZ	n.a.	5,621	n.a.	6,495	257	6,820	270	7,468	282	8,643
HU	n.a.	3,550	216	4,510	226	4,766	245	5,452	241	5,756
AT[4]	461	14,033	369	10,319	-	-	-	-	-	-
SK	118	1,699	129	2,094	132	2,223	138	2,446	146	2,775

Source: Česká národní banka, Magyar Nemzeti Bank, OeNB, Národna banka Slovenska.

Chart 1: Gross Domestic Product in Relation to Cash in Circulation (Linear Relation)[5]



Source: Author's calculations.

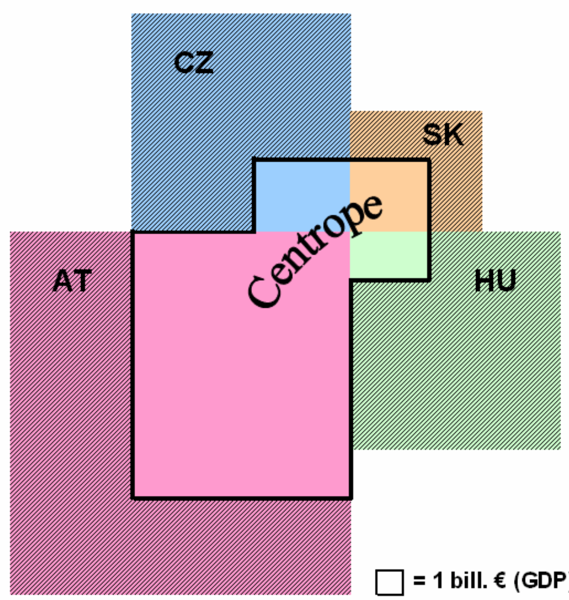
[3] The euro values are calculated on the basis of the respective exchange rates at the end of the period.
[4] Since the introduction of the euro (2002) a logistical circulation of cash is available only.
[5] Czech Republic: GDP and cash in circulation: 2003. Slovakia and Hungary: GDP and cash in circulation: 2002. Austria: GDP: 2001, cash in circulation: 2000, as in 2001 Austria was already preparing the cash changeover, the cash in circulation (in Austrian schillings) decreased substantially at the end of 2001. This would have distorted the result.

Table 3: Hypothetic Regional Cash in Circulation

		GDP (GRP) (mio. EUR)	Hypothetical regional cash in circulation (mio. EUR)
Czech Republic (2003)	Jihočeský	4,135	407
	Jihomoravský	7,811	769
Hungary (2002)	Győr-Moson-Sopron	3,502	242
	Vas	1,794	124
Austria (2001)	Burgenland	4,959	327
	Lower Austria	33,422	2,207
	Vienna	57,141	3,773
Slovakia (2002)	Bratislavský	6,694	578
	Trnavský	2,597	224
CENTROPE		**122,055**	**8,651**

Source: Author's calculations.

Chart 2: Size of GDP (Cash in Circulation) in Relation to the Share of CENTROPE



Source: Author's calculations.

Almost one third of the total GDP of all four countries (Czech Republic, Hungary, Austria and Slovakia) is produced in CENTROPE. Accordingly about one third of the total amount of cash in those countries is circulating in CENTROPE.

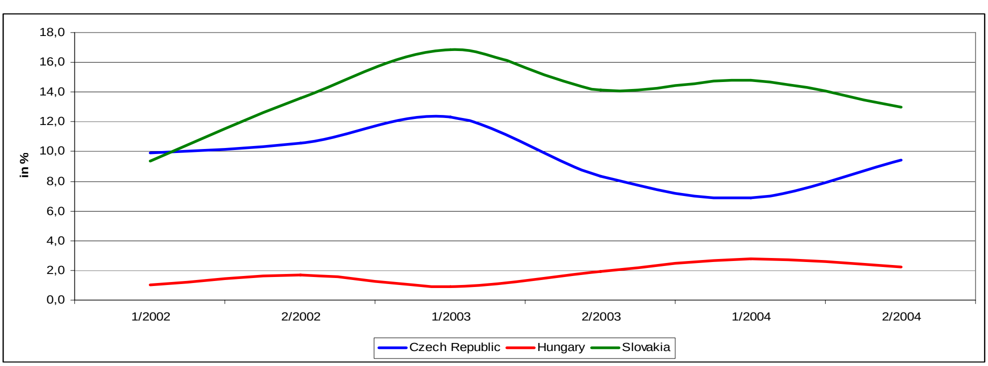
Another important aspect is the fact of euro cash holdings. They play an essential role in the determination of banknote migration. In general, people use currency holdings for their daily transactions, for hoarding purposes, for precautionary reasons and for speculative operations. As a matter of fact, cash is an anonymous medium of circulation. Thus, it is used for illegal purposes (shadow economy) as well. These reasons apply to home and foreign currency holdings (Fischer et al., 2004).

In addition, several factors have an impact on foreign currency holdings. The decision of an individual agent to hold foreign currencies depends on:

- the economic and political situation in the home country as well as in the foreign country (or group of countries),
- seasonal variations (summer holidays, bonus payments or expenditures for Christmas),
- transaction costs for the exchange of home to foreign currency,
- financial innovations (electronic money, payments via internet),
- socio-economic factors (age, sex, education, urbanization, unemployment etc.),
- exchange rate developments (between the home and the respective foreign currency as well as among foreign currencies) and
- interest rates.

Restrictions to currency holdings and currency transfers may also affect the decision. However, the Czech Republic, Hungary and Slovakia are already members of the European Union, they are directly linked to the euro area and have, thus, no such restrictions.

Chart 3: Euro Cash Holdings in Percent of Total Circulation



Source: Stix (2005).

Cash is traveling. Tourists want to be supplied with banknotes in order to be able to spend them abroad, they withdraw them at ATMs in the destination country and they bring back their surplus (banknotes and coins they did not spend during their stay) to their own country.

The number of Czech, Hungarian and Slovak tourists in Austria and Austrian tourists in the Czech Republic, in Hungary and in Slovakia should provide an indication of the amount of money spent on either side (euro area and non-euro area country).

In addition to the amount of cash in circulation, the currency holdings and the tourist movements, the contribution of labor force migration has to be considered. Austria has a long common border to the Czech Republic, Hungary and Slovakia. Due to the higher income levels, Austria is attractive to workers and employees from the new Member States. In the framework of the EU enlargement in 2004, a couple of studies and analyses have been made in order to describe possible (daily) labor force migration scenarios. A compilation of studies made by the Austrian Ministry of Economics and Labor indicates that in 1999 there were about 5,000 people migrating daily from the Czech Republic, Slovakia or Hungary to Austria. Estimations revealed a potential daily migration of about 76,000 people until 2012[6].

In order to be able to measure currency flows abroad, the United States Treasury Department proposed different methods (United States Treasury Department, 2003). A common approach is the so-called biometric method. It is often used by biologists trying to estimate the size of a large animal population, when only a small part can be seen at any one time. Pieces of currency (banknotes and coins) are comparable to a large population. By capturing a sample, marking them, releasing them, and capturing another sample later, the unknown general population can be estimated. The basic idea is that the share of marked items in the general population equals the share of marked items in the recaptured sample.

The U.S. authorities adapted this approach in order to estimate the U.S. currency circulation abroad. They combined two kinds of information. On one hand they use the data from Federal Reserve Cash Offices on currency shipments to and from local banks. On the other hand they knew that most of the USD 100 shipments handled by the Federal Reserve Bank of New York are to and from foreign banks. Thus, New York's shipments are earmarked. The ratio of the shipments to and from foreign banks and the total shipments corresponds to the ratio of the internal circulation within the United States and the circulation abroad.

[6] Including Slovenia. Source: Ministry of Economics and Labor of the Republic of Austria, 2002.

3.2 Cash Circle Flow Model (As-Is Analysis)

The basic assumption in the cash circle flow model is that the net banknote migration can be calculated as the sum of the balances between banknote exports and banknote imports of a particular country i (1).

(1) $$B_{net} = \sum_{i=1}^{n} (bnX_i - bnI_i)$$

B_{net}	*net banknote migration*
bnX_i	*banknote exports to country i*
bnI_i	*banknote imports from country i*

In order to be able to elaborate regional disparities, it is necessary to define a region j, which is a part of country i. The sum of the banknote exports into all regions j of the destination country i results in the banknote exports to country i (2), and the sum of the banknote imports from all regions j of the source country i results in the banknote imports of country i (3).

(2) $$bnX_i = \sum_{j=1}^{n} bnX_{i,j}$$

(3) $$bnI_i = \sum_{j=1}^{n} bnI_{i,j}$$

On the basis of these two equations it is possible to express the importance of a particular region in the country (4):

(4) $$\frac{bnX_{i,j}}{bnX_i} = \alpha_{i,j} \quad \text{or} \quad \frac{bnI_{i,j}}{bnI_i} = \beta_{i,j}$$

$\alpha_{i,j}$	*weight of region j in country i regarding banknote exports*
$\beta_{i,j}$	*weight of region j in country i regarding banknote imports*

The banknote exports and banknote imports of a region are determined by different influencing factors. This model is based on the assumption, that the banknote exports are a function depending on tourist traffic into country i, euro cash holdings in country i and on commercial holdings of banks, exchange offices and other enterprises in country i (5). The banknote exports increase only, if the holdings increase from one period to the other.

(5) $$bnX_{i,j} = f\,(T^{-}_{i,j}, R_{i,j}, G_{i,j})$$

Assumptions:

(6) $$T^{-}_{i,j} > 0$$

(7) $$(R^{t}_{i,j} - R^{t-1}_{i,j}) > 0$$

(8) $$(G^{t}_{i,j} - G^{t-1}_{i,j}) > 0$$

The banknote imports are a function depending on the tourist traffic from country i, euro cash holdings in country i and on commercial holdings of banks, exchange offices and other enterprises in country i (9). The banknote imports increase only, if the holdings decrease from one period to the other.

(9) $$bnI_{i,j} = f\,(T^{+}_{i,j}, R_{i,j}, G_{i,j})$$

Assumptions:

(10) $$T^{+}_{i,j} > 0$$

(11) $$(R^{t}_{i,j} - R^{t-1}_{i,j}) < 0$$

(12) $$(G^{t}_{i,j} - G^{t-1}_{i,j}) < 0$$

$T^{-}_{i,j}$	*tourist traffic into region j of country i (from Austria)*
$T^{+}_{i,j}$	*tourist traffic from region j of country i (to Austria)*
$R_{i,j}$	*euro cash holdings in region j of country i*
$G_{i,j}$	*commercial euro holdings in region j of country i*
$R^{t}_{i,j}$	*euro cash holdings in region j of country i at time period t*
$R^{t-1}_{i,j}$	*euro cash holdings in region j of country i at time period t-1 (previous period)*

$G_{i,j}^{t}$ *commercial euro holdings in region j of country i at time period t*

$G_{i,j}^{t-1}$ *commercial euro holdings in region j of country i at time period t-1 (previous period)*

All these influencing factors are determined by

- the size of the population
- the level of income
- the economic performance and
- the preferences of the population for the different means of payment of the particular region.

3.3 Cash Circle Flow Model (Forecast)

With the introduction of euro cash as legal tender in country i, changes in the holdings become irrelevant to banknote migration, as the national central bank of country i will be responsible for the issue of banknotes. Therefore the following equation applies (13):

(13) $$R_i , G_i = 0$$

Consequently, the tourist traffic remains as determining factor for banknote migration:

(14) $$bnX_{i,j} = f(T_{i,j}^{-})$$

(15) $$bnI_{i,j} = f(T_{i,j}^{+})$$

3.4 Statistical Evidence

Commercial banks that are allowed to deal with foreign currency are obliged to report their foreign currency transactions to the OeNB.

Based on these reports it is possible to demonstrate the flows of cash between Austria and its neighboring countries, the Czech Republic, Hungary and Slovakia. In all three cases the net flows to Austria are positive. Therefore, more euro cash is returning to Austria than it is leaving the country.

The total inflows from the three neighboring countries in question amount to about 8% of the Austrian cash in circulation in 2000. Whereas, the total outflows amount to less than 3%.

Table 4: Aggregated Flows from and to Austria

In mio. EUR	2002	2003	2004	2005[7]
Total outflows from AT to CZ, HU and SK	376.43	143.27	159.01	127.90
in % of Austrian cash in circulation (2000)	*2.68*	*1.02*	*1.13*	*0.91*
Total inflows from CZ, HU and SK to AT	1,062.12	1,196.79	1,040.00	495.38
in % of Austrian cash in circulation (2000)	*7.57*	*8.53*	*7.41*	*3.53*
Net flow AT-(CZ+HU+SK)	**685.69**	**1,053.52**	**880.99**	**367.48**

Source: OeNB.

According to the net flows of euro cash, it is obvious that Austria has an important inflow of cash from its neighboring countries. This result is supported by an ECB report on the issuance of euro banknotes. The report shows that since 2003 the OeNB has been issuing fewer banknotes than it received. While the Deutsche Bundesbank (DBB) provides the vast majority of the banknotes to non-euro area countries, the OeNB has been the most prominent receiver of returning banknotes. Consequently, the OeNB is facing a substantial increase in its banknote sorting and re-distribution activities.

The transaction in Czech crown, Hungarian forint and Slovak crowns are substantially lower than the euro cash flows between Austria and those countries. Most of these transactions are a result of payments into and from an account in Austria. Smaller parts but still essential are interbank dealings and the exchange of money by tourists.

Based on the available statistical data, it is possible to calculate the total amount of cash transactions. In 2004, about 1.7 billion euro in cash were transferred between Austria and its neighboring countries, the Czech Republic, Hungary and Slovakia.

By applying the Quantity Theory of Money and assuming that the size of the Gross Regional Product (GRP) corresponds to the number of cash transaction between the countries involved, the CENTROPE region transferred about 533 million euro in cash in between the borders of the region. Thus, almost one third of the total migrating cash is circulating in CENTROPE.

[7] Until 30 June 2005.

Table 5: Total Cash Flows between Austria and Its Neighbouring Countries

Transaction with	Currency	2004		
		Inflows	**Outflows**	**Total**
		In mio. EUR		
Czech Republic	Crown	96.97	97.38	194.35
	Euro	469.96	53.08	523.04
Hungary	Forint	97.42	97.03	194.45
	Euro	424.39	88.74	513.13
Slovakia	Crown	41.74	42.92	84.66
	Euro	145.65	17.19	162.84
Total		**1,276.13**	**396.34**	**1,672.47**
CENTROPE (estimated)		407.00	126.00	533.00

Source: OeNB, author's calculations.

4. Euro Area Enlargement – Consequences for the OeNB

4.1 Frontloading in the New Euro Area Countries

The enlargement of the European Union was accomplished in May 2004. All new Member States have expressed their wish to join the euro area. Estonia, Lithuania and Slovenia will most probably be the first new Member States that will introduce the euro. Their preparations have reached an advanced level. Provided they fulfill the Maastricht criteria, the euro will become the legal tender of these countries on 1 January 2007.

The other new member states will follow in the subsequent years. The Czech Republic and Slovakia have already approved their national changeover plans. According to these plans Slovakia is preparing for the introduction of the euro in 2009 and the Czech Republic in 2010. Both dates are preliminary. They depend on the economic situation and the public opinion. In Hungary preparatory work is ongoing. Although, the national changeover plan has not been approved by the government yet, the Hungarian coordinating institutions in charge of the preparations for the euro changeover have set the 1 January 2010 as the national target date for euro adoption.

The frontloading process (the distribution of banknotes and coins in a specific country before the euro introduction) was one of the major challenges for the current euro area countries. Each of them managed it in a different way depending on economic and cultural factors. The economic structure, the public opinion and the payment habits (the use of credit and debit cards) influenced the decision on how many banknotes and coins should be frontloaded. The ratio of frontloaded cash to cash in circulation reveals the differences. While in Austria the frontloaded cash reached about 75% of total cash in circulation, the frontloaded amount in Spain remained at about 18% (Gruber and Ritzberger, 2005).

The situation for the new Member States is significantly different. The euro is already legal tender in the euro area. Thus, it is a foreign currency to the new Member States prior to the cash changeover. According to a study on euro cash holdings in Austria's neighbouring new Member States and in Croatia there are already substantial holdings of euro cash (Stix, 2005). Therefore, the amount of cash to be frontloaded will probably be lower than in the case of no additional cash holdings. The total amount of euro cash needed for circulation will reach the value of about 9 billion euro in the Czech Republic, about 6 billion euro in Hungary and about 3 billion euro in Slovakia, based on the current amount of their local currency in circulation.

Assuming that there will not be a significant change in the behavior of cash use, people in the three countries will most probably prefer low denominated euro banknotes. Therefore, the amount of money per capita in terms of pieces of banknotes will be higher than it is in Belgium or Finland, where higher denominated banknotes are preferred.

4.2 Consequences for the OeNB

Cash (banknotes and coins) must be distributed in order to supply the users of cash (consumers, enterprises, banks). The demand for cash is analyzed, regulated and met by the NCBs. In the Eurosystem the NCBs are cooperating in order to ensure the distribution of euro cash and the efficient management of surpluses or shortages among the NCBs. The ECB is continuously monitoring and coordinating the storage and the transport of euro banknotes and coins. At the moment, alternative storage and transport options are being discussed.

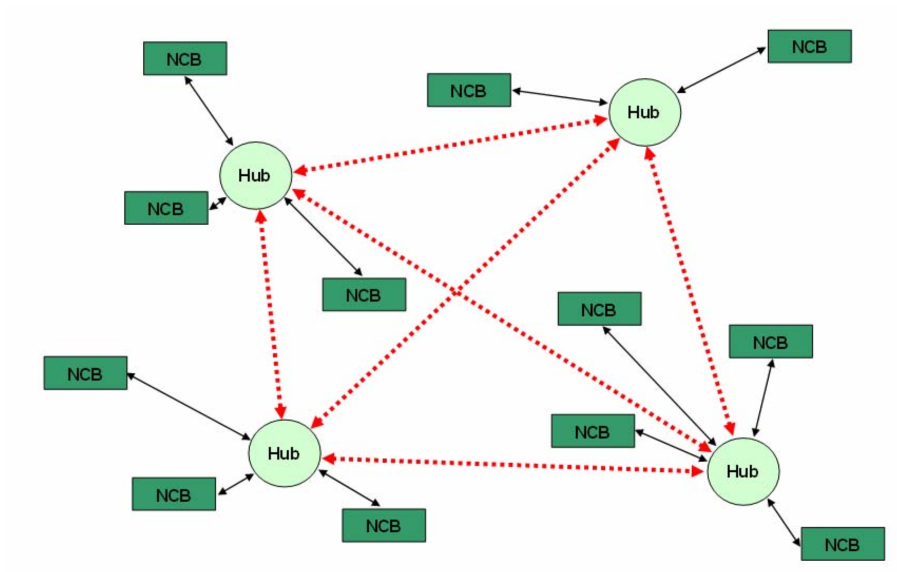
The current situation is characterized by a complete interconnection of each NCB. Newly printed banknotes and surplus stocks are (re-)distributed between NCBs according to the monthly delivery schedule. All twelve NCBs are interlinked among themselves. The development and maintenance of the delivery schedule is however an administratively complex process and does not always result in the most efficient organization of the transports. As new Member States will most likely join the euro area soon, the administration will become even more complex. In addition, the so-called Single Euro Tender Procedure (SETP), regulating the procedures for the production (printing) of new banknotes, will have an impact on the planning process in the long run.

With the increase of receiving and supplying NCBs, more scheduled transports and ad-hoc bulk transfers will be needed, leading to an increasingly difficult efficient management of those transports. Given the fact that seven out of the ten new Member States have less than six million inhabitants, there will also be an increasing need for transports with smaller banknote volumes.

The impact of SETP will also be considerable. Currently, the distribution plan takes into account the requirements of the NCBs, so that an NCB in need of a large quantity of a certain denomination produces this denomination itself in order to avoid cross border transports. In the SETP framework printing works will be awarded with production orders independently of where the banknotes are needed.

Against this background the ECB evaluated an alternative to the current concept. The proposed concept is based on a hub-and spoke system, where excess stocks would be delivered to an assigned hub and then transported to the NCBs that require banknotes. The current common procedure of delivering newly printed banknotes directly from the printing works to the requesting NCB would be maintained.

Chart 4: Hub-and-Spoke System



Source: Author's calculations.

The assigned hub would supply its NCBs with the banknotes needed. The transport coordination could be performed by the hubs without any involvement of the ECB. The advantage of low transport times of the current system by using direct links among the NCBs would be replaced by a decrease of costs due to the bundling of flows, concentration of equipment and sorting at specific location. In addition, it would allow transports by truck for shorter distances.

On one hand a hub-and-spoke solution would enhance a more efficient transportation by maximizing the number of combined shipments. It would lower the overall logistical costs through efficiency gains. It would balance unequal flows more easily and it would reduce the complexity in the planning of the transports considerably. On the other hand the implementation of hubs would need additional investments of interested parties in order to meet the necessary requirements. Compared to the current situation, the number of transports would definitely increase in any case. By sticking to the current system the number of transports will increase with the accession of new Member States and with the launch of the SETP. The question is, if the system still stays manageable given the current complexity.

In order to reach a high degree of efficiency, it is important to elaborate the decision on the location of the hubs thoroughly. Following the discussion in the ECB, it seems most reasonable to place the respective hubs strategically. Four hubs (or perhaps five after the accession of new Member States) would probably be sufficient. Special attention should be paid to the existing infrastructure (especially airports). High security standards and good connections to the other airports in Europe are a precondition for a successful implementation of a hub.

The OeNB is well integrated in the ESCB. Cross-border transports have already been made to all participating euro area member states. In addition, the OeNB is already cooperating with the central banks of the new Member States. Especially the euro cash changeover is of great interest for them. The experiences in euro cash matters, the already existing cooperation network with Central and Eastern European countries and the strategic favorable geographical location contribute to the fact that Vienna could be a perfect location for a hub. Administered by the OeNB a hub in Vienna would meet several conditions stated above and it would offer some important advantages:

- Favorable geographical location: Vienna is close to four new Member States that will introduce the euro. Slovenia will be first. It will most probably join the euro area already in 2007. Slovakia will possibly follow in 2008 or 2009. The timetables in the Czech Republic and in Hungary are still in abeyance, but they might become members of the euro area in 2010 depending on the political willingness and the economic preparedness (Maastricht criteria).
- Well prepared airport: The airport of Vienna meets the security conditions for cash transfers as the OeNB already uses it for current cross-border transports. The airport is well interconnected with a lot of other European airports especially with those of the new Member States in Central and Eastern Europe. Furthermore, there already exists a close cooperation with the Bratislava airport.
- OeNB experience: The introduction of the euro, the reorganization of the cash services, the cooperation in the ESCB and the experiences with the current cross-border transport procedures have made the OeNB an attractive and experienced partner for many central banks in Central, Eastern and Southeastern Europe.

- The OeNB is well prepared to run a hub in Vienna. It disposes of state-of-the-art vaults and it has adequate transport capacities in order to be able to meet future requirements.
- CENTROPE: Vienna constitutes the core of CENTROPE together with Bratislava. CENTROPE is definitely an important European market with about 7 million inhabitants (almost 34 million people including the respective home country), a GDP of about 122 billion euro and a hypothetical need for cash of about 8 billion euro. The total cash in circulation in euro terms in the Czech Republic, Hungary, Austria and Slovakia and including Slovenia would amount to about 30 billion euro. The region consists of metropolitan areas (Vienna, Bratislava), major towns (Brno and České Budějovice in the Czech Republic; Győr, Sopron and Szombathely in Hungary; St. Pölten in Austria and Trnava in Slovakia) and emerging areas with high growth rates. In addition, the unique situation of the proximity of two capital cities offers the opportunity of a close co-operation especially between the central banks of Austria and Slovakia.
- Returned and sorted banknotes: The OeNB had a negative net-issuance development since 2003, meaning that it issued fewer banknotes than it received. It has even been the most prominent receiver of banknotes returning from customers in non-euro area countries. Compared to its capital key, the OeNB has, thus, a much higher share in returned and sorted banknotes than its capital key might indicate.
- Euroization: The high degree of euroization in South-eastern Europe underlines the need for logistical and strategic stocks in geographical proximity.
- Furthermore, Kosovo and Montenegro having introduced the euro unilaterally can benefit from it due to their relative geographical proximity.
- Commercial banks: Austrian commercial banks play an essential role as investors in Central, Eastern and South-eastern Europe. They manage the whole region from their headquarters in Vienna. It is advisable to maintain close links to the commercial banks. The installation of a hub in Vienna would emphasize the role of the financial market place.

The disadvantages of installing a hub in Vienna would consist in:

- Infrastructural links: Apart from the airport, which already meets the conditions, the railway and motorway infrastructure lag behind the development of the traffic in the region. The infrastructural links between Austria on one hand and its neighboring countries in the north and west must be improved in due time.
- Investment costs: The creation of a hub would need investments in the storage facilities in order to get the capacities needed. The investment costs for a hub in Vienna depend on the needed capacities. As a matter of fact, the vaults of the OeNB are already capacious. A hub in Vienna could probably be a cheap solution, being, thus, even an advantage.

5. Conclusion

It is a unique situation in Europe that two capital cities are this closely situated, forming the core of the so-called CENTROPE region. CENTROPE is characterized by a well-performing economy and great potentials of growth and cooperation. However, it is still a heterogeneous region with substantial disparities in wage and productivity levels, and a suboptimal infrastructural network.

The CENTROPE project is an initiative of the Federation of Austrian Industry aiming at developing a multilateral, binding and lasting cooperation strategy for the region.

As a matter of fact the central banks of the Czech Republic, Hungary, Austria and Slovakia are directly involved. Therefore, it is important to analyze the potential challenges and chances from a central bank's point of view. One essential question arises from the fact that banknotes are migrating across borders. The so-called banknote migration is determined by the cash in circulation, the currency holdings, tourism and the labor force migration, which are influenced by the size of the population, the economic performance, the level of income, the preferences for specific means of payment, the branch network of the commercial banks and the role of the currency beyond the national borders.

According to the analysis made in this study, about one third of the migration between the Czech Republic, Hungary, Austria and Slovakia takes place within the CENTROPE region. About four fifths of the total cash flows between Austria and its neighboring countries are inflows to Austria.

The significance of the region, the strategic position of the Bratislava-Vienna axis in the European framework and the characteristics of the banknote migration lead to a specific challenge for the Oesterreichische Nationalbank related to euro cash logistics.

In the euro area it is necessary to supply cash efficiently and to meet the requirements of the stakeholders (especially national central banks, cash transport organisations and commercial banks). The OeNB has identified the changing environment. Preparations have already been made in order to meet the conditions of an efficient cash distribution and to cope with the future challenges of the euro area enlargement. A hub for banknotes and coins in Vienna would be a beneficial approach for an efficient management of euro cash. The costs of cash have most recently attracted more and more attention. The supply and the demand for banknotes and coins should be managed smoothly and should be cheap. The enlargement of the euro area is inexorably approaching. It is a chance for the OeNB to contribute a profitable solution for the wider European context.

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Traffic Sensitivity of Long-Term Regional Growth Forecasts

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Abstract

We estimate the sensitivity of the regional growth forecast in the year 2002 resulting from changes in the travel time (TT) matrix. We use a dynamic panel model with spatial effects where the spatial dimension enters the explanatory variables in different ways. The spatial dimension is based on geographical distance between 227 regions in central Europe and the travel time matrix based on average train travel times. The regressor variables are constructed by a) the average past growth rates, where the travel times are used as weights, b) the average travel times across all regions (made comparable by index construction), c) the gravity potential variables based on GDP per capita, employment, productivity and population and d) dummy variables and other socio-demographic variables.

We find that for the majority of the regions the relative differences in growth for the year 2020 is rather small if the accessibility is improved. But there are differences as how many regions will benefit from improved train networks: gross domestic product (GDP), employment, and population forecasts respond differently.

Keywords: Dynamic panel models, long-term growth forecasts, BMA, traffic sensitivity analysis, road and train travel times

JEL Classification: R1, R41, L92, C21

1. Introduction

Long-term forecasting is a big challenge for the regional modelling, since only a few years of panel data are available on a regional basis. Furthermore, traffic dependent models must be developed to explore the sensitivity of travelling times

[1] The computations have been made by H. Berrer as part of the SIC project.

on the socio-demographic variables of a region. Using the sophisticated model choice procedure BMA (Bayesian model averaging, see Raftery et al. 1997) for the entire regional data set we have successfully reduced the pool of variables and we are able concentrate solely on demo-economic variables with traffic related backgrounds.

We consider two types of forecasts (with or without country-wise adjustments) and 2 railway TT scenarios: scenario 1 assumes that all presently planed projects (i.e. for the decade 2000–2010) will be realized according to the national traffic plans. Scenario 2 assumes railway investments that will remove all in the year 2000 known bottlenecks in the decade from 2010 to 2020.

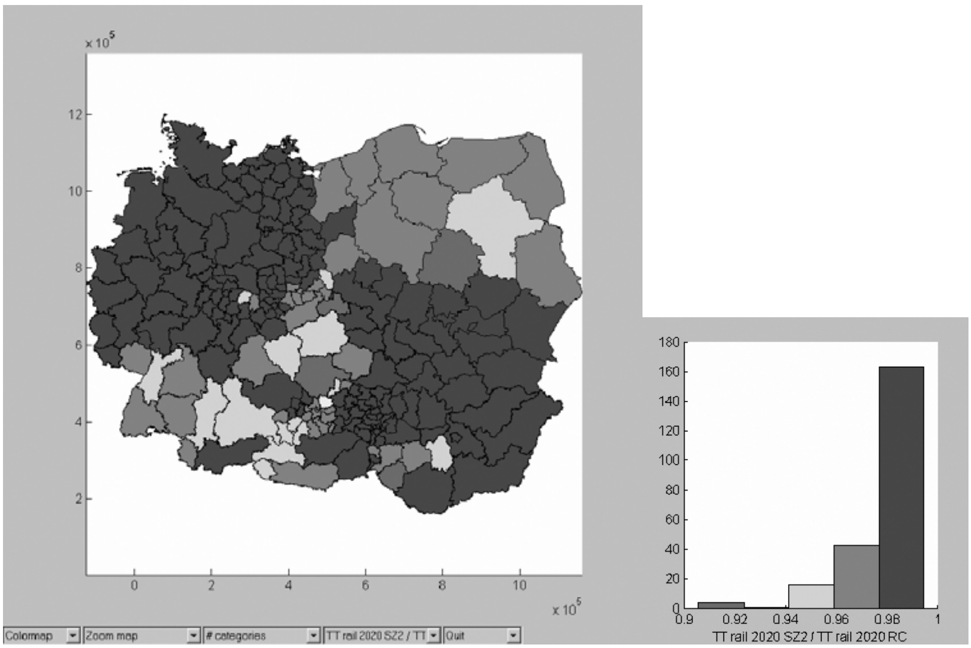
We will forecast the main economic characteristics of a region, namely the GDP growth rates, the employment rate and the population growth rate. The population growth rates forecast are compared with middle scenario ÖROK forecasts in the appendix, and surprisingly we find only small differences (the maximum is 0.5%) between this long-term demographic projection method (based on 100 age classes and constant fertility assumptions) and our panel base forecast. The comparison is shown for the SIC regions in the appendix B.

In the remaining section 1 we introduce the regional modelling approach and in Section 2 describe the traffic dependent GDP growth model. We define all the "spatial" related regressor variables that pick up the space and traffic interactions between all regions. Then we present the sensitivity analysis based on the long range forecast and the traffic improvement scenario 2. Section 3 and 4 extends this approach to the modelling and forecasting of the employment growth rate (EMPL%) and the population growth rate (POP%). A final section concludes.

Chart 1 shows the travel time reductions based on railway investment programs in 6 countries (Austria, Germany, Poland, Czech Republic, Slovakia and Hungary). They are based on the research work of an Interreg 3b project (SIC![2]) and are made available by the company BVU (www.bvu.de). From chart 1 we see that the largest travel time reduction can be expected for the Czech regions (Liberec and Jihorosky), the Hungarian regions and for the Polish region Lodzkie. (Note that the minimal ratios of TT reductions in chart 1 lie between 0.90 and 0.92 and indicate up to 8% to 10% faster travel times). The main problem of the TT reduction lies in the spatial distribution of the improvements. It is not the focus corridor between Berlin and Budapest that gets the highest improvements, but the orthogonal axis from Warsaw across Prague to Munich. This will be the reason for some of the counterintuitive results in the estimation results of the paper.

[2] SIC! SUSTRAIN Implement Corridor, an Intereg 3b project. http://www.sustrain-ic.net/

Chart 1: The Percentage of Travel Time Reduction between the Two Train TT Scenarios, i.e. TT1/TT2



Note: Scenario 1 (TT1 or current planning state: "reference case") and Scenario 2 (TT2 or improved railway connections: "free train"). Legend of the histogram: 5 classes of reduction from 0.9 (10% reduction) to 0.98–1.0 (small reduction).

Two types of forecasting methods were used: a) adjusted forecasts: growth in all regions of a country was restricted so that an average predicted growth was maintained in each country and b) unadjusted forecasts: growth prediction without country-specific restrictions.

1.1 The Regional Growth Model

The econometric model uses a dynamic panel model and data set for period 1995–2001 in 227 regions of 6 countries, where the main focus regions are located between Berlin and Budapest and consists of Nomenclature of Units for Territorial Statistics (NUTS)-3 regions, while most of the regions outside this proposed new traffic corridor are measured at NUTS-2-level. We use a Barro and Sala-i-Martin (1995) type growth regression model allowing for convergence, where the convergence terms are measured by the levels of the dependent variables, GDP, employment (EMPL) and population (POP) in the year 1995 (i.e. the first year of the data base of the present study). The dependent variable is the growth rates for the 3 focus variables: (real) regional GDP growth (GDP%, discounted by the national inflation rate), the employment rate (EMPL%) and the population growth rate (POP%).

We started with a traditional spatial model with up to 6 nearest neighbours, but we soon found out that – for traffic purposes – the transformation to special (= spatial) regression variables has more explanatory power. These linear and non-linear transformations are possible in our case since we obtained travel time (TT) matrices for train and road networks between all 227 regions. In the BMA analysis all the newly created TT and traffic variables were selected more often than traditional spatial variables, based on neighbourhood (continuity) or distance (nearest neighbours).

The following groups of explanatory variables were used in the forecasting model and in the preceding model choice procedure (BMA, see Raftery et al. 1997):

Travel times (TT) between 227 regions for the year 2000 (in the matrix TT1) and the year 2020 (in the matrix TT2).

Average travel times: a) average TT, b) weighted TT: with distance ("Far index") and with inverse distance ("Near index"), c) harmonic means, d) speed averages.

Accessibility indices: Based on the TT on road and on train we calculated an index with minimum 0 and maximum 1. This index is constructed either for the whole area (all) or the normalization in each country.

Potential indices: based on the gravity formula of Newton A*B/ D, where A and B denote the variables for the origin region and destination regions, and D is a distance measure. The following variables were used: GDP, GDP per capita (pc), employment, population, productivity: GDP per worker (pw)[3].

Infrastructure variables: a) the number of highway entrances per highway (Autobahn) km, b) the number of railway stations per rail km, c) the length of highway net per square-km and the length of railway net per square-km.

TT adjusted growth rates: Only past average weighted growth rates were calculated where we used the train TT or the road TT as weights.

1.2 The Sensitivity Analysis

The sensitivity analysis is needed to show the dependence of the regional growth rates on the TT of the variables on the right hand side that enter in linear and non-linear form. For the sensitivity analysis we use the models estimated by the BMA method since we selected trough this method the best regressor variables using the Scenario 1 rail travel times. With this model we calculate iteratively the future

[3] The exact formula is $x_i = \Sigma_j\ a_i b_j / d_{ij.}$

growth rates and the level of the dependent variable in the model until the year 2020. (Note that the model is specified in a causal way, i.e. no contemporaneous regressor variables are allowed.) The alternative forecasts for Scenario 2 are calculated in the same way. Finally, we compare both forecasts for the year 2020 and calculate the difference as percent of the Scenario 1 forecasts. These differences are plotted by geographical maps to see where the strongest positive and negative effects can be expected. This approach is called the unadjusted sensitivity analysis.

We derived also an "adjusted" sensitivity analysis, by looking at the country averages of forecasts and then we demand that the pattern of changes of the forecast model is zero over all regions within a country. This approach shows a sensitivity pattern without international boundary spill-over that means all push and pull effects of growth rates are equalized in each country.

1.3 Caveats

To make the results of the sensitivity analysis visible we have employed statistical maps as a graphical visualisation technique for the 227 regions. The advantage is that a large amount of data information can be understood faster than studying tables, but the disadvantage is that graphics stir up many more questions of the type "Why do we see these differences?" Thus, we have to warn the reader that not all of these questions can be answered satisfactory. Some differences will be due to occasional bad regional observations or data quality, some due to misfits of the model and some will be just unexplainable. We have followed the rule that the total graph has to reflect and present a sensible picture to justify our modelling approach.

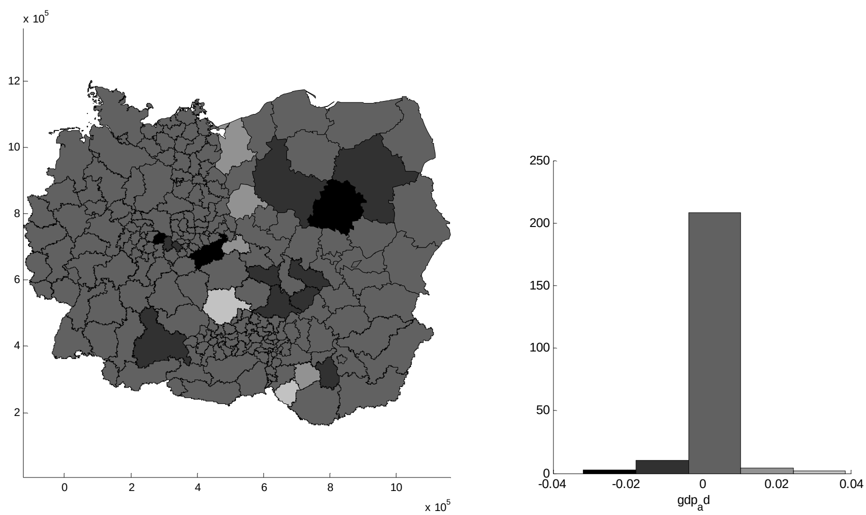
Furthermore we want to emphasize that we focus on a regional model where the regressor selection was done in such a way as to maximize the possible influence of train TT. This approach was chosen, since it was clear that traffic impacts, especially for train travel times on growth will be generally small. Thus, an "optimal regional growth model" will probably give slightly different results; also a model that will be based solely in road travel times or both. (Note that the interaction between the road TT and train travel times needs also some special studies).

Therefore we recommend regarding our study as a magnifying glass of train TT on regional growth patterns, while the other (observed and non-observed) factors are more or less kept constant.

2. The GDP Growth (GDP%) Model with Spatial Traffic Interactions

The sensitivity analysis of the travel time induced GDP forecasts for the year 2020 is shown in chart 2a for the adjusted model and for the un-adjusted model in chart 2b.

Chart 2a: The Adjusted Model: The Differences between GDP Levels for 2020 is Computed in Percent. The Majority of Regions Will only See a Slight Positive Train Travel Time Effect.



Legend: grey: no growth, dark grey: negative growth, light grey: positive growth.

Summary of the sensitivity analysis for the adjusted model: Out of 227 regions there were 86 regions with negative growth, 23 with zero growth and 118 with positive growth effects.

A regional map of the sensitivity analysis is shown in chart 2a for the scenario "free trains" (i.e. all major railway bottle necks will be removed) given by the matrix TT2 in comparison with the present (planned and realized 2000–2010) rail travel times, given by the matrix TT1. Let us denote by GDP2020(TT1) the GDP forecasts for the year 2020 by the TT1-matrix and GDP2020(TT2) for the TT2-matrix. We have plotted the Diff_GDP variable, i.e. the relative change of the GDP levels for 2020 based on 2 train travel time matrices, according to the formula:

Diff_GDP = (GDP2020(TT2) – GDP2020(TT1))/ GDP2020(TT1).

Most positive changes in the regional GDP can be seen for the region Jena (in Eastern Germany) and those regions of the Czech Republic (e.g. Karlovarsky), which borders Germany, but also for Moravian regions (Moravskoslezsky and Olomoucky) bordering Poland. The largest negative growth impulse can be seen for the southwestern Hungarian region Zala, which is peripheral within Hungary and can move the growth towards regions closer to Budapest. Also some peripheral regions in Poland (Szczecinski, Nowosadecki) might slightly suffer due to lack of train TT improvements. Most German regions are not affected, and in Austria only those regions (that border Germany) are above zero growth.
From table 1b we see the top and low ten regions with traffic related growth differences from the unadjusted model. Surprisingly we see well-known larger cities, like Prague, Dresden, Frankfurt (Oder), Pest and Györ. Note that we see from the top 10 list that only 7 regions have a positive traffic impact: 3 from Poland and 4 from Slovakia.

Table 1: Scenario Sensitivities: The Top and Low Region of GDP Growth Rate Differences 2020

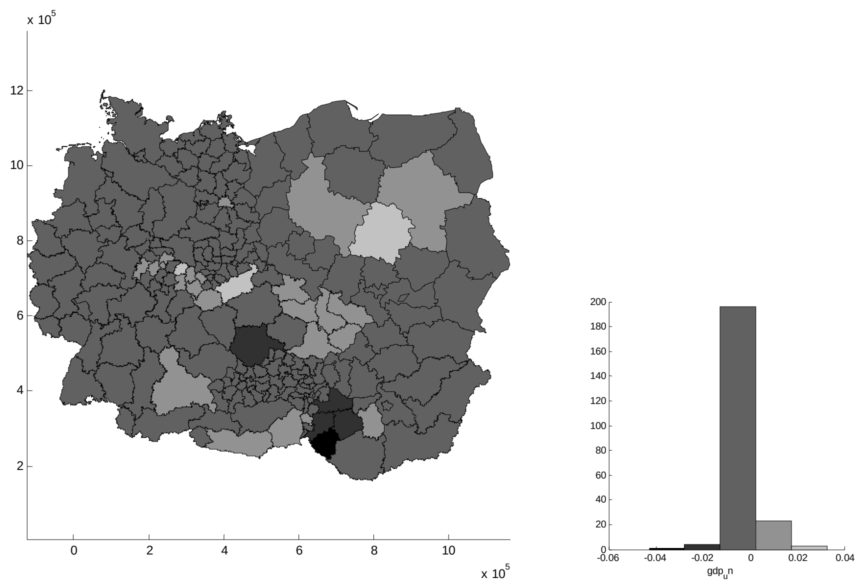
a) From the adjusted model

Zala	–0.036	Jena	0.022
Praha	–0.016	Lodzkie	0.022
Szczecinski	–0.014	Zlinsky	0.026
Nowosadecki	–0.014	Karlovarsky	0.027
Podkarpackie	–0.013	Moravskoslezsky	0.028
Kujawsko-Pomorskie	–0.013	Liberecky	0.046

b) From the unadjusted model

Low 10		***Top 10***	
Zala	–0.059	Oberwart	–0.003
Praha	–0.037	Vysocina	0.000
Stredocesky	–0.032	Jena	0.000
Pest	–0.027	Zlinsky	0.004
Dresden	–0.027	Wielkopolskie	0.005
Vas	–0.027	Karlovarsky	0.005
Cottbus	–0.027	Moravskoslezsky	0.006
Gyor-Moson-Sopron	–0.027	Mazowieckie	0.013
Del-Dunantul	–0.027	Lodzkie	0.024
Frankfurt (Oder)	–0.027	Liberecky	0.024

Chart 2b: Scenario Sensitivities of the Unadjusted Model: GDP Growth Sensitivities: Only a Few Regions Will Benefit from Improved Train Travel Times.



Colour legend: dark grey: negative growth, light grey: positive growth.

Summary of the sensitivity analysis for the unadjusted model: Out of 227 regions there were 218 regions with negative growth, 2 with zero growth and 7 positive growth effects.

Note that the results of chart 2b are rather pessimistic with respect to train TT changes. This might be a consequence of the declining GDP growth rates during the observation period, which leads to depressed long-term forecasts. The next table 2 summarizes the BMA estimates for the GDP% model.

From table 2 we see that the BMA estimate for the constant is not significant, and the Slovakia dummy variable is the only fixed effect that is negative (–2.1%). That means that Slovakia has a –2.1% base line handicap for regional growth, on average in our model. Slovakia needs strong positive impulses from other variables to overcome this GDP growth handicap compared with the other 5 countries. The convergence effect for the log GDP level is negative (Lgdp.1995: –.011), but the level effect of (log) population is positive (Lpop.95: .01).

Table 2: The GDP Growth Model and Spatial Traffic Variables (BMA Estimates)

Bayesian Model Averaging Estimates	Nobs= 227,	Nvars = 20	
Dependent Variable GDP%:	Average GDP	growth rates	(1995–2001)
R-squared = 0.886			
nu,lam,phi = (4, .25,3))	ndraws = 25000		
# models visited	= 2249		
******************************	Posterior Estimates		
Variable	Coefficient	t-statistic	t-probability
const	–0.017	–0.9	0.35
Lgdp.1995	–0.011	–8.4	0.00
Lgdp.giTT.rail.96	–2.289	–5.5	0.00
Lgdp.giTT.rail.97	–0.024	0.0	0.98
Lgdp.giTT.rail.98	0.059	0.3	0.74
Lgdp.giTT.rail.99	–0.003	0.0	1.00
Lgdp.giTT.rail.00	0.086	0.3	0.76
Lpop.95	0.009	7.6	0.00
Lempl.00.95	0.388	7.7	0.00
Lpop.00.95	0.289	4.2	0.00
nodes.per.highway.km	0.015	2.9	0.00
TT.train.far	0.176/1000	11.7	0.00
acc.all.bahn.dist.avg	0.048	12.2	0.00
potential.gdp.empl.00.95.rail	0.123	9.0	0.00
potential.all.empl.95.rail	0.015	5.4	0.00
potential.all.gdp.cap.00.95.rail	0.153	11.3	0.00
d.aut	0.000	0.0	0.96
d.sk	–0.021	–7.2	0.00
d.hu	0.000	0.0	0.97
d.ger	0.000	–0.2	0.81
d.pl	–0.001	–0.4	0.71

The coefficients of the past POP and EMPL growth rates are both positive and between 0.29 and 0.39: this implies that a 3 % growth rate in either employment or population will result in a 1 % larger GDP growth rate.

Three out of the 5 inverse-TT weighted past EMPL growth rates are negative, and all of them are rail TT effects. The sum of these effects is – 2.2 that show a strong negative time dynamic component that was observed for GDP growth in the late 1990s. The long distance weighted TT variable for railways and the accessibility index based on train TT (acc.all.bahn.dist.avg: 0.048) have a positive influence and might be interpreted as a good transportation proxy variable (TT.far.train: 0.176). All potential variables have a positive effect, and all are based on rail TT. A significant potential effect is found for the change of the GDP per capita (potential.all.gdp.cap.00.95.rail), for productivity changes (GDP/ employment: potential.gdp.empl.00.95.rail), and for the employment potential (potential.all.empl.95.rail).

3. The Employment Growth (EMPL%) Model with Spatial Traffic Interactions

The Bayesian model averaging estimates for the EMPL% model are given in table 3:

From table 3 we see that the R^2 is 0.85 and quite high. The intercept is 2% and not different from zero: this shows that the regressors of the model are able to explain much of the GDP growth variation (and a little insignificant constant is present). Concerning the country fixed effects, only Slovakia is significant and has on average a 2.4% higher growth in employment. The convergence coefficient of the log employment level (Lempl.95) is significant and negative as expected, while the level effect of log GDP (Lgdp.95) is positive and about the same size as the initial employment (Lempl.95) coefficient. The coefficients on the GDP and population growth rates (Lpop.00.95, Lgdp.01.95) are both positive and almost 0.5: This implies that a 2% growth rate in GDP or population will result in a 1% larger EMPL growth rate.

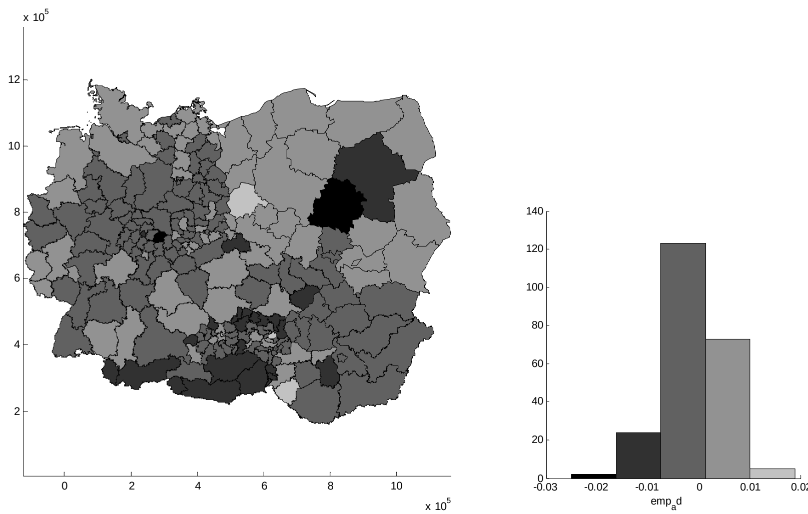
Surprisingly, the inverse rail TT weighted past EMPL growth rates are negative, also the coefficient of the road TT effects, although the sum of the effects of the growth rates on roads (short and long distance weighted) for the years 2000 and 1999 is Small negative (Lempl.gTT.road.99 + Lempl.giTT.road.00).

Table 3: EMPL Growth Model and Spatial Traffic Variables (BMA Estimates)

Bayesian Model Averaging	Estimates		
Dependent Variable: EMPL%,	Average GDP	growth rate	(1995–2001)
R-squared	= 0.849		
Nobs= 227	Nvars = 23		
ndraws	= 25000		
nu,lam,phi	= (4., 0.25, 3)		
# models visited	589		
********************************	Posterior Estimates		
Variable	Coefficient	t-statistic	t-probability
const	0.020	1.6	0.11
Lempl.95	–0.010	–9.8	0.00
Lempl.gTT.road.99	–1.019	–2.8	0.00
Lempl.giTT.rail.00	–2.206	–4.4	0.00
Lempl.giTT.road.00	0.798	2.4	0.02
Lgdp.95	0.011	9.9	0.00
Lgdp.01.95	0.486	10.6	0.00
Lpop.00.95	0.481	8.1	0.00
TT.train.far	–0.000075/1000	–5.2	0.00
acc.all.bahn.dist.avg	–0.023	–5.5	0.00
potential.gdp.cap.95.rail	0.012	4.9	0.00
potential.empl.95.road	–0.007	–3.3	0.00
potential.gdp.00.95.rail	–0.298	–5.3	0.00
potential.gdp.cap.00.95.rail	0.310	8.7	0.00
potential.gdp.cap.00.95.road	–0.101	–3.6	0.00
potential.gdp.empl.00.95.rail	–0.247	–14.8	0.00
potential.gdp.empl.00.95.road	0.140	6.2	0.00
potential.all.gdp.00.95.rail	0.187	3.9	0.00
potential.all.gdp.cap.00.95.rail	–0.143	–5.2	0.00
d.aut	–0.001	–0.2	0.85
d.sk	0.024	9.6	0.00
d.hu	0.000	0.1	0.91
d.ger	–0.001	–0.4	0.70
d.pL	0.001	0.3	0.76

The, long distance weighted travel time for railways (TT.far.train) has a positive influence and might be interpreted as a good transportation proxy variable, while the effects of the 9 potential variables is quite mixed. The potential variables of GDP per capita (potential.gdp.cap.95.rail) have a positive effect, surprisingly many negative potential effects are found for rail TT potentials. But the highest positive potential effect is found for the change of the GDP per capita potentials for trains (potential.gdp.cap.00.95.rail: 0.31). This reflects some kind of complex interactions in the potential variables but also, that the rail and road TTs have different effects on the regional growth rates when combined with macro economic indicators.

Chart 3a: Scenarios Sensitivities of the Adjusted Model: The Differences between EMPL for 2020.



Legend: dark grey: negative growth, light grey: positive growth.

Summary of the sensitivity analysis for the adjusted model: 95 regions are negative, 25 have zero growth and 107 have positive employment effects in 2020.

The results of the employment growth sensitivity analysis are shown in chart 3 and table 4a for the scenario "free trains" (without major railway bottle necks) for EMPL% forecasts. We see negative employment growth effects only for the Hungarian and Polish regions, which were also in lowest ranks of GDP growth (Zala, Szczecinski, Nowosadecki, Podkarpackie) while the majority of regions exhibit a +/– zero effect. Positive effects can be seen again for Jena and for regions in Poland (Lodzkie) and Czech Republic (Zlinsky, Karlovarsky, Liberecky).[4]

[4] The best Austrian regions are Oberwart, Gmunden and Vöcklabruck.

From table 4b we see that the unadjusted EMPL growth differences are the lowest in Polish regions (Lodzkie, Mazowieckie, Centralny Slaski) and next to Jena (East Germany) there are, surprisingly, 5 regions from Austria. But also on the positive growth effect for Employment we find 6 regions of Austria, with Wels (Land), Vas and Jihocesky benefiting the most from better travelling times.

Table 4: Scenarios Sensitivities: The Top and Low EMPL Growth Differences for 2020

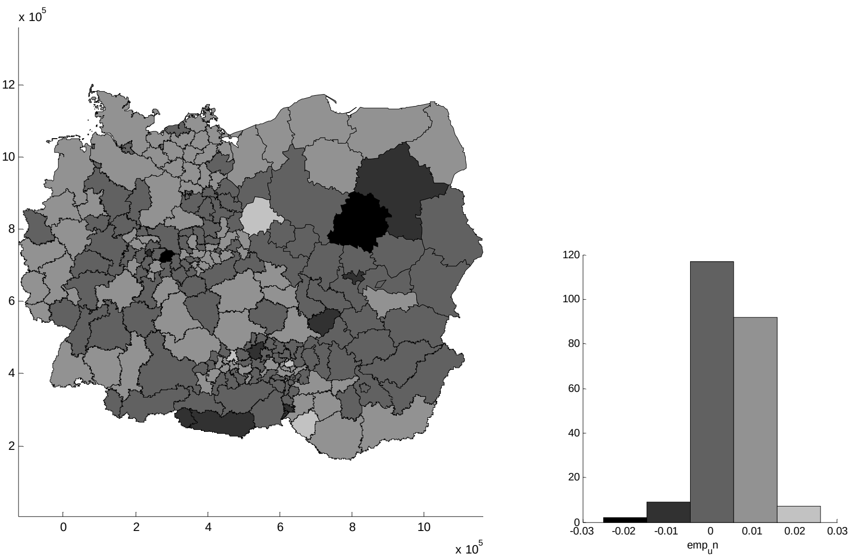
a) The adjusted model

Low 10		***Top 10***	
Jena	–0.025	Vas	0.008
Lodzkie	–0.025	Jihocesky	0.009
Jennersdorf	–0.014	Urfahr Umgeb.	0.009
Güssing	–0.014	St.Pölten Stadt	0.009
Osttirol	–0.013	Szczecinski	0.009
Zwettl	–0.013	Wien	0.013
Kärnten	–0.012	Zala	0.017
Oberwart	–0.012	Wels Stadt	0.018
Waidhofen a.d. Thaya	–0.011	Linz Stadt	0.018
Zlinsky	–0.011	Zielonogorski	0.019

b) The unadjusted model

Lodzkie	–0.025	Wels Land	0.015
Jena	–0.020	Vas	0.015
Mazowieckie	–0.008	Jihocesky	0.015
Jennersdorf	–0.006	Urfahr Umgeb.	0.017
Güssing	–0.006	St.Pölten Stadt	0.017
Osttirol	–0.006	Zielonogorski	0.019
Erfurt,	–0.006	Wien	0.021
Centralny Slaski	–0.005	Zala	0.024
Zwettl	–0.005	Wels Stadt	0.025
Kärnten	–0.005	Linz Stadt	0.026

Chart 3b: Scenario Sensitivities of the Unadjusted Model: The Differences between EMPL for 2020: Only 13% of the Regions Will Not Benefit from Improved Train Travel Times.



Summary of the sensitivity analysis for the unadjusted model: 29 regions are negative, 8 have zero growth and 190 have positive employment effects in the year 2020.

4. The Population Growth (POP%) Model with Spatial Traffic Interactions

The following table 5 summarizes the BMA estimation results.

From table 5 we see that the R2 is again quite high (0.77) but less than the previous 2 models. The intercept is –1% and not different from zero. No country fixed effects is significant. We conclude that population growth seems to follow a rather similar pattern in these 6 countries. The convergence coefficient of the log population level could not be significantly estimated and there are no level effects except the changes of potential variables. Interestingly, the GDP per capita and the GDP per worker potential variable enter the regression in pairs.

Table 5: POP Growth Model and Spatial Traffic Variables (BMA Estimates)

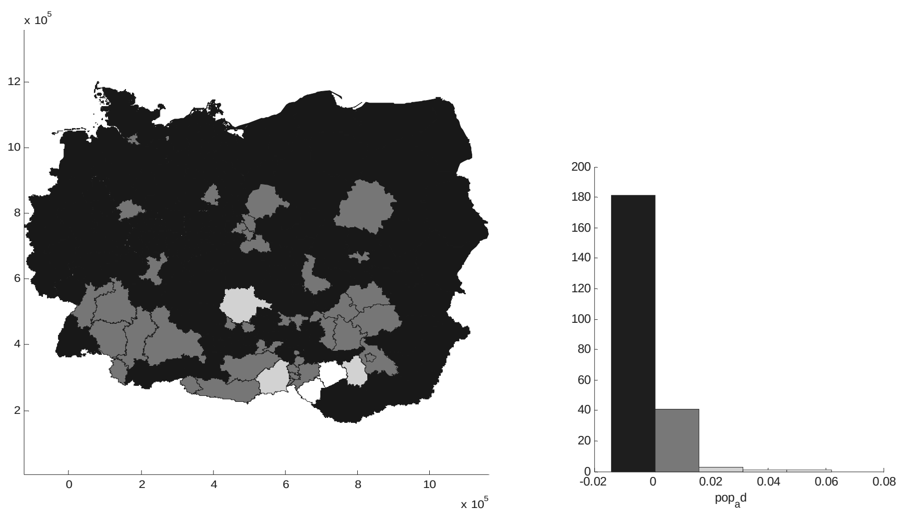
Bayesian Dependent Variable: POP%,	Model Average	Averaging Population	Estimates growth
R-squared = 0.7675			
Nobs = 227,	Nvars = 23,	Ndraws	= 25000
(nu,lam,phi) = (4., 0.25, 3)	# models	= 927	
**		Posterior Estimates	
Variable	Coefficient	t-statistic	t-probability
const	–0.01	–1.1	0.28
Lpop.gTT.rail.96	–74.65	–7.5	0.00
Lpop.gTT.rail.97	87.98	6.4	0.00
Lpop.gTT.rail.98	–110.03	–11.4	0.00
Lpop.gTT.road.97	–62.44	–6.1	0.00
Lpop.gTT.road.99	29.27	9.1	0.00
Lpop.giTT.rail.97	–8.79	–3.3	0.00
Lpop.giTT.rail.98	–13.86	–7.8	0.00
Lpop.giTT.road.96	–4.52	–4.9	0.00
Lpop.giTT.road.97	4.56	3.4	0.00
Lgdp.01.95	0.14	3.9	0.00
Lempl.01.95	0.20	4.7	0.00
TT.road.far	0.00	–4.4	0.00
TT.road.harm	0.00	2.8	0.01
potential.gdp.cap.00.95.rail	–0.15	–8.5	0.00
potential.gdp.cap.00.95.road	0.09	4.2	0.00
potential.gdp.empl.00.95.rail	0.11	6.8	0.00
potential.gdp.empl.00.95.road	–0.10	–5.3	0.00
potential.all.pop.00.95.rail	0.21	3.9	0.00
d.aut	0.00	1.1	0.26
d.sk	0.00	0.0	1.00
d.hu	0.00	–0.1	0.91
d.ger	0.00	–0.6	0.53
d.pl	0.00	–0.4	0.72

The productivity pair for road TT and train TT almost cancel (the sum of the coefficients of potential.gdp.empl.00.95.rail and potential.gdp.empl.00.95.road is

-.01), while for the GDP per capita pair, we find a negative combined effect for the changes (–0.06 for potential.gdp.cap.00.95.road and ~rail). That means that differences in potential growth in high growing regions are less favourable for population growth. Note that there is a fifth variable with a positive growth effect based on population potential differences, and it has the largest positive coefficient (potential.all.pop.00.95.rail: 0.21). This is an indication that regions benefit from a positive population growth feed back loop, based on population potentials and discounted by train travel times.

Note that dynamic time pattern for the TT weighted population growth rates is characterized by diversity and rather strong: 5 past TT weighted growth rate variables are far distance weighted (gTT), and 4 variables are short distance weighted (giTT). The effects of road based growth rates for the year 1996 and 1997 almost cancel (the sum is –4.52 + 4.56 = 0.04) while the combined effects of the short term effects from the year 1997 and 1998 are negative. Surprisingly, in the long run the combined effects of TT weighted past population growth rates are also negative (Lpop.gTT.road.97 + ~.99:–33) for road and –100 (sum of Lpop.gTT.rail.96, ~.97, ~.8) for train. This implies that regional train related growth is about 3 times as important than road related population growth. These estimates imply that the auto-projected population growth dynamics works negatively for all regions and will lead to depressed forecasts in the long run.

Chart 4a: Scenarios Sensitivities of the Adjusted Model: The Differences between POP Forecasts 2020: The Majority of Cells Will Have an Improvement up to 1%



Summary of the sensitivity analysis for the adjusted model: 140 regions have negative growth 23 zero growth, 64 positive growth rates.
The results of the population growth sensitivity analysis are shown in chart 4a and table 6a for the scenario 1: "free trains" (i.e. no major railway bottle necks) for POP% forecasts. We see negative population effects for a Hungarian region (Komarom-Esztergom) and Austrian city regions (Wels, Wien, Linz) and for Germany it is Jena (–1.1%). Some Austrian cities seem to develop a demographic trap: young people move out and leave old people behind.

The best population growth can be seen for Austrian regions (Jennersdorf, West-/Oststeiermark) and Hungarian regions (Fejer, Veszprem, Zala).

From table 6b we see the differences from the unadjusted model. Now Bratislava is on the loosing side for demographic influences, but also the cities Wels and Jena. Furthermore, we see further eastern regions with a negative demographic trend: 2 regions of Bohemia (Ustecky, Pardubicky) and 2 from Slovakia (Vychodne Slovensko, Zilinsky kraj), respectively. Under the top 10 best performing population growth regions we notice 5 regions from Austria (2 smaller ones from Burgenland, next to the "Lander" Kärnten and Vorarlberg) and some from Hungary (Veszprem, Zala) and Slovakia.

Table 6: Scenarios Sensitivities: The Top and Low POP Growth Differences

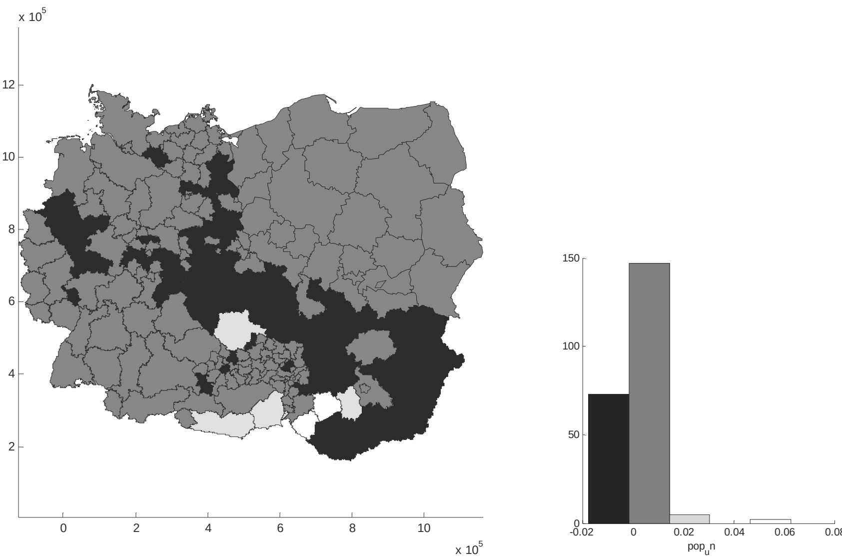
a) The adjusted model:

Komarom-Esztergom	–0.013	Jennersdorf	0.015
Wels Stadt	–0.012	West-/Oststeiermark	0.018
Wien	–0.011	Fejer	0.020
Linz Stadt	–0.011	Jihocesky	0.025
Jena	–0.011	Veszprem	0.047
Plauen (Stadt & Vogtland)	–0.010	Zala	0.063

b) The unadjusted model:

Low 10		***Top 10***	
Vychodne Slovensko	–0.017	Vas	0.012
Bratislavsky kraj	–0.015	Güssing	0.012
Komarom-Esztergom	–0.013	Vorarlberg	0.013
Ustecky	–0.012	Kärnten	0.015
Jena	–0.010	Jennersdorf	0.019
Plauen (Stadt & Vogtland)	–0.009	Fejer	0.020
Zilinsky kraj	–0.008	Jihocesky	0.021
Wels Stadt	–0.008	West-/Oststeiermark	0.022
Del-Dunantul	–0.007	Veszprem	0.047
Pardubicky	–0.007	Zala	0.063

Chart 4b: Scenario Sensitivities of the Unadjusted Model: The Differences between POP Forecasts 2020. The Number of Regions with Positive and Negative Changes is Almost Equal.



Summary of the sensitivity analysis for the unadjusted model: 97 regions have negative growth, 27 zero growth, and 103 positive growth differences.

Chart 4b shows that 97 regions (43%) have negative population growth rate differences due to improved TTs. This seems to be odd, since we would expect a larger proportion of regions. But it has to be taken into account (and as a sad fact?), that the demographic population trends in all regions of the 6 countries are completely negative (including cities but without migration) if the past trend of the 1990s is extrapolated. Thus, we have to view the results as a success, since now we predict 57% of the regions will have positive population growth if the improvements in TT will be implemented. Clearly, region growth will become more competitive in the next decades since the population is shrinking in central Europe and migration trends are difficult to predict in the long run, as we have seen from the migration wave around 1990, i.e. the fall of the Iron Curtain.

Table 7: Summary of TT Scenario 2

a) adjusted model

	negative	zero	positive
GDP	0.38	0.10	0.52
EMPL	0.42	0.11	0.47
POP	0.62	0.10	0.28

b) unadjusted model

	negative	zero	positive
GDP	0.96	0.01	0.03
EMPL	0.13	0.04	0.84
POP	0.43	0.12	0.45

From table 7 we see that in the adjusted model we can expect positive GDP effects for more than 50 % of the regions to profit from train TT. Positive employment effects can be expected a little bit less (i.e. 47 %), and the lowest train TT effects can be expected for population growth: just every 4th region or 28 % of the regions will benefit.

Clearly, our population growth forecasting does not follow standard demographic projection methods which are based on yearly age groups and different fertility and mortality assumptions. Surprisingly, our long-term forecast are very similar, as we can see from appendix B, where we have compared the forecasts from the ÖROK (which actually was made by Statistics Austria, the central statistical office of Austria) and our level forecast, based on iterative application of the panel growth rate forecasts. As we see differences are very small, the largest being for a small region in northern Austria (Gmünd) with 0.5%. Other minor differences can be found for the suburbs of Vienna, where the largest absolute increase in population is expected. Since no reliable migration data could have been obtained for the 6 countries and the period 1995–2001, we hope to find a smaller model in future that can incorporate (reliable) migration variables as well[5].

4. Conclusions

We have shown in this paper that the regional growth rates of GDP, Employment and population can be explained to a large degree by traffic dependent spatial or time series variables. The dynamic panel model was estimated by BMA and allows sensible long-term predictions of these regional target variables. Also, a TT and

[5] Currently, reliable and comparable migration (balance) data were only available for the year 2001, but the effects were not significant.

traffic related sensitivity analysis was discussed: We see that the traffic scenario “free train”, i.e. a removal of all bottle-necks of the current year 2000 in rail network of central Europe, will bring on average more regions positive growth. Some regions could see slower growth if the new accessibilities will change the focus of economic growth.

The growth scenario will change slightly if we impose the restriction that the future growth rates will take place on the expense of regional reallocations in each of the 6 countries. These growth rates differences will be in the range of +/–2% of the GDP level in the year 2020. These results were obtained by a sensitivity analysis and is valid for both, the adjusted (i.e. country restricted regional growth) and unadjusted (i.e. unrestricted regional growth) model. It seems that accessibilities by TT improvements will best benefit employment growth in a few regions across the 6 countries. Also, about 50% of the regions will be positively influenced by TT improvements for GDP. An important sensitivity result concerns the population growth: According to our traffic related model, 43% region can not reverse the negative demographic trend in the future and will shrink (ceteris paribus, i.e. holding other influence factors fixed). But it should be kept in mind that the GDP and other growth rates can be highly volatile: Our (sensitivity) results are dominated short run time dynamics and eventually TT improvements will have different effects in the long run if other influencing factors are considered.

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Appendix A: List of Variable Abbreviations

Lgdp.1995	Logarithm real GDP
Lgdp.gTT.rail.96	average GDP growth rates 1996, weighted by rail TT
Lgdp.gTT.rail.97	average GDP growth rates 1997, weighted by rail TT
Lgdp.gTT.rail.98	average GDP growth rates 1998, weighted by rail TT
Lgdp.gTT.rail.99	average GDP growth rates 1999, weighted by rail TT
Lgdp.gTT.rail.00	average GDP growth rates 2000, weighted by rail TT
Lgdp.gTT.road.96	average GDP growth rates 1996, weighted by road TT
Lgdp.gTT.road.97	-”- 1997
Lgdp.gTT.road.98	-”- 1998
Lgdp.gTT.road.99	-”- 1999
Lgdp.gTT.road.00	-”- 2000
Lgdp.giTT.rail.96	average GDP growth rates 1996, weighted by inverse rail TT
Lgdp.giTT.rail.97	average GDP growth rates 1997, weighted by inverse rail TT
Lgdp.giTT.rail.98	average GDP growth rates 1998, weighted by inverse rail TT
Lgdp.giTT.rail.99	average GDP growth rates 1999, weighted by inverse rail TT
Lgdp.giTT.rail.00	average GDP growth rates 2000, weighted by inverse rail TT
Lgdp.giTT.road.96	average GDP growth rates 2000, weighted by inverse road TT
Lgdp.giTT.road.97	-”- 1997
Lgdp.giTT.road.98	-”- 1998
Lgdp.giTT.road.99	-”- 1999
Lgdp.giTT.road.00	-”- 2000
Lempl.95	Logarithm of employment 1995
Lpop.95	Logarithm of population 1995
Lpop.dichte.95	Logarithm of population density 1995
Lempl.00.95	% changes of employment 1995-2000
Lpop.00.95	% changes of population 1995-2000
youth.dep.ratio	percentage of 0-20 years old in the population
old.dep.ratio	percentage of 60+ years old in the population
nodes.per.highway.km	highway access points per highway km
highway.per.km2	highway density in a region
Roads.per.km2	road density in a region
Railstation.per.km	Rail station density per rail net km
Railnet.per.km2	railway density in a region
TT.train.ave	average train TT
TT.train.far	average train TT, weighted by distance
TT.train.near	average train TT, weighted by inverse distance
TT.train.harm	harmonic average train TT
TT.train.speed	average speed for rail ways
TT.road.ave	average road TT
TT.road.far	average road TT, weighted by distance
TT.road.near	average road TT, weighted by inverse distance
TT.road.harm	harmonic average road TT
TT.road.speed	average speed on road
potential.gdp.95.rail	within country potential index based on GDP and rail TT 1995
potential.gdp.95.road	within country potential index based on GDP and road TT 1995
potential.gdp.cap.95.rail	within country potential based on GDP per capita and rail TT 1995
potential.gdp.cap.95.road	within country potential based on GDP per capita. and road TT 1995
potential.pop.95.rail	within country potential based on population and rail TT 1995

potential.pop.95.road	within country potential based on population and road TT 1995
potential.empl.95.rail	within country potential based on employment and rail TT 1995
potential.empl.95.road	within country potential based on employment and road TT 1995
potential.gdp.empl.95.rail	within country potential based on productivity and rail TT 1995
potential.gdp.empl.95.road	within country potential based on productivity and road TT 1995
potential.gdp.00.95.rail	% change of potential index based on GDP and rail TT 1995-2000
potential.gdp.00.95.road	% change of potential index based on GDP and road TT 1995-2000
potential.gdp.cap.00.95.rail	% change of potential index based on GDP_pc and rail TT 1995-2000
potential.gdp.cap.00.95.road	% change of potential index based on GDP_pc and road TT 1995-2000
potential.pop.00.95.rail	% change of potent. index based on population and rail TT 1995-2000
potential.pop.00.95.road	% change of potent. index based on population and road TT 1995-2000
potential.empl.00.95.rail	% change of pot. index based on employment and rail TT 1995-2000
potential.empl.00.95.road	% change of pot. index based on employment and road TT 1995-2000
potential.gdp.empl.00.95.rail	% change of pot. index based on productivity and rail TT 1995-2000
potential.gdp.empl.00.95.road	% change of pot. index based on productivity and road TT 1995-2000
potential.all.gdp.95.rail	-“- as above but for all 6 countries (227 regions)
potential.all.gdp.95.road	-“- as above
potential.all.gdp.cap.95.rail	-“- as above
potential.all.gdp.cap.95.road	-“- as above
potential.all.pop.95.rail	-“- as above
potential.all.pop.95.road	-“- as above
potential.all.empl.95.rail	-“- as above
potential.all.empl.95.road	-“- as above
potential.all.gdp.empl.95.rail	-“- as above
potential.all.gdp.empl.95.road	-“- as above
potential.all.gdp.00.95.rail	-“- as above
potential.all.gdp.00.95.road	-“- as above
potential.all.gdp.cap.00.95.rail	-“- as above
potential.all.gdp.cap.00.95.road	-“- as above
potential.all.pop.00.95.rail	-“- as above
potential.all.pop.00.95.road	-“- as above
potential.all.empl.00.95.rail	-“- as above
potential.all.empl.00.95.road	-“- as above
potential.all.gdp.empl.00.95.rail	-“- as above
potential.all.gdp.empl.00.95.road	-“- as above
d.aut, d.sk, d.hu, d.ge, d.cr, d.pl.	Dummy variables for countries

Appendix B: Comparison of the ÖROK Population Forecast and the Panel Forecast

ÖROK forecast	2001	2021		total population 2001–2031	panel-forecast	relative difference
Amstetten, Waidhofen a. d. Ybbs	121,156	120,376	108.9	Amstetten	120.5	0.1%
Baden	126,807	140,973		Baden	140.4	–0.4%
Braunau am Inn	94,859	96,844		Braunau	96.8	0.0%
Bruck a. d. Leitha	39,942	42,465		Bruck a.d. Leitha	42.4	–0.3%
Eferding	30,559	31,018		Eferding	31.0	–0.1%
Eisenstadt (St+U), Rust	51,886	54,644	11.9	Eisenstadt (Stadt)	54.5	–0.3%

Freistadt	63,948	65,160	Freistadt	65.2	0.0%
Gänserndorf	88,338	100,580	Gänserndorf	100.1	–0.5%
Gmünd	39,989	36,413	Gmünd	36.6	0.5% *)max
Gmunden	99,298	100,384	Gmunden	100.4	0.0%
Grieskirchen	61,901	63,149	Grieskirchen	63.1	0.0%
Güssing	26,902	25,699	Güssing	25.8	0.3%
Hollabrunn	49,906	52,695	Hollabrunn	52.6	–0.3%
Horn	32,252	31,270	Horn	31.3	0.2%
Jennersdorf	17,863	17,633	Jennersdorf	17.7	0.1%
Kirchdorf a. d. Krems	55,097	56,069	Kirchdorf	56.1	0.0%
Korneuburg	67,917	78,495	Korneuburg	78.0	–0.6%
Krems (Land)	54,267	55,081	Krems (Land)	55.1	0.0%
Krems a.D. (Stadt)	23,669	25,053	Krems an der Donau	25.0	–0.2%
Lilienfeld	26,989	27,221	Lilienfeld	27.2	0.0%
Linz(Stadt)	184,100	183,834	Linz Stadt	183.9	0.0%
Linz–Land	129,220	144,024	Linz Land	143.6	–0.3%
Mattersburg	37,400	40,163	Mattersburg	40.1	–0.2%
Melk	75,358	76,345	Melk	76.4	0.0%
Mistelbach	72,511	75,742	Mistelbach	75.6	–0.2%
Mödling	106,411	117,230	Mödling	116.8	–0.4%
Neunkirchen	85,675	85,323	Neunkirchen	85.4	0.1%
Neusiedl am See	51,659	52,785	Neusiedl	52.7	–0.1%
Oberpullendorf	37,840	37,356	Oberpullendorf	37.4	0.1%
Oberwart	53,276	51,168	Oberwart	51.3	0.2%
Perg	63,980	69,596	Perg	69.4	–0.3%
Ried im Innkreis	58,132	60,720	Ried	60.7	–0.1%
Rohrbach	57,699	57,694	Rohrbach	57.7	0.1%
Sankt Pölten (Land)	93,166	98,794	St.Pölten (Land)	98.6	–0.2%
Sankt Pölten (Stadt)	49,111	51,080	St.Pölten Stadt	51.0	–0.1%
Schärding	56,851	59,028	Schärding	59.0	–0.1%
Scheibbs	41,343	40,089	Scheibbs	40.2	0.2%
Steyr(Stadt)	39,443	39,988	Steyr Stadt	40.0	0.0%
Steyr-Land	57,526	59,292	Steyr Land	59.3	–0.1%
Tulln	64,422	73,858	Tulln	73.5	–0.5%
Urfahr-Umgebung	77,856	88,359	Urfahr Umgeb.	88.0	–0.4%
Vöcklabruck	126,523	130,388	Vöcklabruck	130.3	0.0%

Waidhofen a. d. Thaya	28,144	27,115	Waidhofen a.d. Thaya	27.2	0.2%
Wels(Stadt)	56,628	61,389	Wels Stadt	61.3	–0.2%
Wels-Land	62,986	68,663	Wels Land	68.5	–0.3%
Wien	1,550,679	1,656,554	Wien	1653.3	–0.2%
Wien Umgebung	102,025	118,264	Wien Umgebung	117.6	–0.0054
Wr Neustadt (Stadt)	37,677	40,771	Wiener Neustadt	40.7	–0.0024
Wiener Neustadt(Land)	71,850	79,842	Wiener Neustadt(Land)	79.5	–0.0038
Zwettl	45,587	41,720	Zwettl	41.9	0.0049

Vienna and the CENTROPE Region: An International Business Perspective

Delia Meth-Cohn

Economist Intelligence Unit – The Economist[1]

Methodology

This research study was based primarily on ten in-depth interviews, conducted from June to October 2005, with senior regional executives of large multinationals either currently or formerly based in Vienna. Most of the interviewees have a long-standing relationship with the Economist Intelligence Unit's Corporate Network, which brings together around 180 multinationals operating in the Central and Eastern Europe region. We also spoke with senior officials at the Austrian Business Agency, AmCham and the Boston Consulting Group.

Senior consultant Delia Meth-Cohn, the author of this paper, has been examining trends on the topic of corporate structures and locations in the region over the past three years. She has had dozens of discussions with regional managers from a wide range of industries and locations. She has written white papers on corporate structures and shared service locations in Central and Eastern Europe.

[1] The Economist Intelligence Unit is a specialist publisher serving companies establishing and managing operations across national borders. For over 50 years it has been a source of information on business developments, economic and political trends, government regulations and corporate practice worldwide. The Economist Intelligence Unit (EIU) delivers its information in four ways: through its digital portfolio, where its latest analysis is updated daily; through printed subscription products ranging from newsletters to annual reference works; through research reports; and by organising seminars and presentations. The firm is a member of The Economist Group.

Executive Summary

- Vienna's role as a hub for Central and Eastern Europe has changed dramatically over the past 15 years. The size and scope of regional headquarters has shrunk over the years as local subsidiaries took on more management and support responsibilities. Now most Vienna-based hubs are small, high-level, strategic management units.
- Vienna's attractiveness as a location for these hubs has also changed. Although initially the obvious choice for international companies starting operations in Eastern Europe, a combination of poor Austrian policies and the emergence of new locations, weakened Vienna's position. These weaknesses remain, but selecting the right location is no longer a key issue. More important are which functions the strategic hubs should carry out, which markets they should cover and whether they need to exist independently of European headquarters (HQ) at all.
- From the perspective of multinational companies, Central Europe's importance as a growth market is diminishing. Not only is the market maturing rapidly, but other markets in the Eastern Europe Middle East and Africa (EEMEA) region are taking the limelight and at least two of them – Russia and Turkey – are coming to be seen as global growth markets. At the same time, multinational interest in Central Europe as a high-value, low-cost manufacturing and services location is growing.
- These changing business realities threaten to make the traditional Vienna hub irrelevant, with operations easily assumed by more autonomous local subsidiaries and/or European headquarters. But pressure to constrain costs in emerging markets is pushing companies to keep local subsidiaries lean and to share services wherever possible. That has created a niche for small hubs, staffed by experienced managers who can provide strategic services to a broader range of markets.
- As a result, from an international business perspective, the real opportunity for Vienna is not in servicing a narrowly defined CENTROPE region, but in providing high-level support for a much wider region. CENTROPE is just too small to be an internationally relevant region.
- Several large international companies already use their Vienna hubs to cover Russia, Turkey, the Middle East and Africa. More recently, companies have started using Vienna to take responsibility for western Central Europe, including Austria, Switzerland and even Germany.
- But if this is to be more than a temporary solution as corporate structures respond to changing markets, Vienna needs to support the continued geographical and functional development of regional hubs by focusing on finding solutions to three key problems: weak transport infrastructure, work permits for senior management from the U.S., Japan and Central Europe, and expat tax treatment.

1. Central Europe and the Vienna Hub: An Overview

Business realities have changed rapidly in Central Europe over the past decade and each new facet brings different challenges to Vienna's role as a business hub for the region.

Only 15 years ago, Central and Eastern Europe (CEE) was a haven for business pioneers, who usually explored the new markets of the Czech Republic, Slovakia, Hungary and Poland from a comfortable base outside the region. From the late 1980s to the mid-1990s and even beyond, the choice of Vienna as a location for CEE headquarters was what one regional manager described as a "no-brainer". Proximity, infrastructure and quality of life were the main criteria:

- Vienna was not drab Eastern Europe, but it was close both physically and in mentality to its neighbours.
- It was traditionally seen as neutral and had simpler visa regulations.
- It had a network of service industries (lawyers, consultants) and managers who had experience in the region.
- It had Vienna International Airport and Austrian Airlines.

Time and again, regional managers reiterate that the rapid build-up of unrivalled air connections did more to build Vienna's reputation over the years as a business hub than any other factor. Sadly, government policy failed to go beyond rhetorical support for Vienna as the "gateway to the East". Instead of embracing that role, successive governments were defensive about the implications. They decided against the rapid development of modern road and rail connections to cities like Prague, Brno, Bratislava and (for rail) Budapest. They also failed to ensure that international companies could easily hire expatriate managers for their regional operations. Not only was it time-consuming to organise work permits, since they fell under restricted immigration quotas, but procedures were untransparent, leaving companies to the mercy of inaccessible bureaucrats.

Non-European companies were particularly frustrated at the months of battling through lawyers to bring in senior managers from the U.S.A. or Japan, or from the region itself. A few large companies – AIG, Marsh, Oracle among others – gave up and shifted their regional operations to Brussels or Geneva. Numerous others, no doubt, decided against locating in Vienna to avoid the problems.

> "We needed 25–30 top people to set up a hub, but we couldn't get the permits. Now we are in Geneva and it took us just six weeks to get 25 work permits."
> *U.S. IT company which gradually shifted its entire CEE hub out of Vienna*

But that dissatisfaction was disguised by new companies pouring into Vienna. In 1995, Austria joined the EU, making life considerably easier for European companies and expats to operate out of the city. Austrian companies had also started to do serious business in Central Europe, which they came to define as their extended home market, becoming major players in sectors like finance, retail, industry and logistics.

A new flurry of business excitement was sparked in 1998 by the start of negotiations with the first wave of ex-communist countries to join the EU. When newcomers looked for a location to base their CEE regional HQ, Vienna was always on their list, accompanied by places like Budapest, Prague, Munich, Amsterdam and London. Companies with developed regional operations saw sales growing phenomenally and started to invest in growth, shifting resources into building up stronger local operations.

In some ways, it was the heyday of Vienna's career as a business hub for the region. Between 1999 and 2001, the Austrian Business Agency helped around 20 large companies to set up CEE operations in Vienna, compared to only one in 2004, according to managing director, Rene Siegl. In addition, dozens of companies acquired Austrian firms, largely to get their hands on a well-developed business in Central Europe (CE). Or they gave their Austrian subsidiaries more resources to develop business in the region.

But the Vienna regional HQ concept was already on its way out, for two reasons:

- First, Vienna's competitive advantage was eroding as Central European cities became more pleasant and accessible. In addition, locations like Brussels, Geneva or London were increasingly seen as alternative options, as they built up connections and Vienna failed to address its shortcomings.
- Secondly, the CEE pioneers were localising their operations, building up the capacity of subsidiaries in Warsaw, Prague and Budapest. While sales growth was good, the rising overhead costs of full local operations were easily justified. As a result, regional headquarter operations were scaled down not only in size, but also frequently in scope, shifting away from a legal holding company structure towards a much smaller support office.

1.1 The Vienna Hub after EU Enlargement

The arrival of EU enlargement sparked the latest phase of development for Vienna's hub operations. Instead of viewing the CEE region as a homogenous whole, companies began to see a group of very different markets, maturing at different paces and in different ways. Using experience of grouping small markets in western Europe, multinationals started to think of the CEE region as a number of clusters – New EU Member States , Central Europe, Baltics, Southeastern Europe (SEE), Commonwealth of Independent States (CIS).

As a result of this splintering of the CEE region, the question exercising most regional managers and corporate boards these days is not where to put the CEE hub or whether Vienna is better than Prague. The hot issues are:

- What kind of functions makes sense for existing Vienna hubs?
- Is a separate HQ necessary at all now that Central Europe is part of the EU? Isn't a CE cluster reporting to European HQ sufficient?

- Can the Vienna HQ expand its strategic oversight beyond Central Europe and Southeastern Europe (SEE) to a wider range of clusters?

> "The basic question is what exactly an HQ should be. Does it play a management function or a support function? If it's support, it will have to move out of Vienna – that's a pure cost question. For us, HQ means management capacity and its location will be wherever the most important leader wants to be."
> *U.S. high-tech company with CEEMEA HQ in Vienna*

Companies are still responding to this new set of questions and there is constant flux while they try to find appropriate structures for the new business challenges they face. But the initial indications suggest a wide variety of possible and overlapping outcomes for Vienna's role as a hub:

- Some companies have shifted or are planning in the next few years to shift all responsibility for the CEE region to European HQ, frequently in Geneva or London.
- Several companies have expanded the geographical scope of their Vienna HQ to justify the high overheads. Many now cover SEE; a few still have reporting responsibility for Russia and CIS and others are taking over that responsibility; some of the largest companies have concentrated reporting and strategic responsibility for Middle East and Africa in Vienna (the Central and Eastern Europe, Middle East and Africa (CEEMEA) region); a new trend is to include Switzerland and even Germany as part of the Central Europe region.
- Most companies have turned large regional HQ operations into a small, flexible management unit – focusing on overall strategy, finance, marketing, human resources. Functions like back-office, IT support and so on are handled in the market or in competence centres within the region.
- Many companies expect their Vienna HQ to become increasingly virtual. The location is little more than a centre of gravity and depends on the wishes of the regional manager. Other top managers need not be in the same location.

> "Maintaining expats in Vienna is very expensive, so we are working on a virtual model. It's already happening to an extent – our EEMEA marketing director recently moved back to London. If you bring an expat over from the U.S.A., then perhaps you need to make a decision about where to locate them. Otherwise in Europe, they can pretty much choose."
> *U.S. pharmaceutical firm with CEEMEA HQ in Vienna*

2. Business Outlook in Central Europe: the Multinational Perspective

2.1 Central Europe as a Sales Market

EU enlargement in 2004 has clearly been positive overall for multinationals operating in the region, bringing predictability and boosting the chances for sustainable growth now and in the long term. But accession has also brought increased competition and, consequently, an extra push to consolidation, reshaping the way many companies view their business in the region.

Although most trade and investment reforms took place before 2004, accession itself brought three significant changes:

- it gave legal and macroeconomic security and predictability;
- it removed customs barriers (and long delays for lorries at the border); and
- it brought an influx of EU funds (around EUR 10 billion a year) directed at infrastructure, farmers and small business.

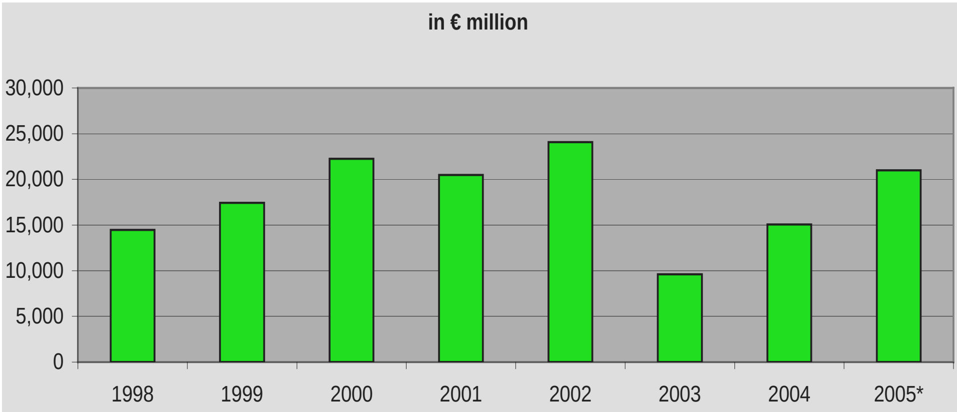
That brought a new spurt of international interest in the region. Companies that had avoided the risky east now feel safer moving into the new EU Member States. Some are coming in to take market share as the window of opportunity for entering the region closes, mostly by buying up existing players. Others are relocating manufacturing, R&D, call centres or back-office services to take advantage of strong skills and low labour costs (see page 12). Foreign direct investment flows, which had started shrinking as privatisation came to an end, are now picking up again (see chart next page).

EU enlargement has also kick-started the growth of small and medium-sized enterprises (SMEs), with an increasing number investing in modernisation and expansion. The renaissance of the SME sector, particularly visible in the more advanced markets like the Czech Republic, is a result of increased competitive pressure at home and growing opportunities abroad, as well as greater access to financing through bank credits and EU funds.

Small and medium-sized enterprises' development is vital to the economic future of Central Europe – it is the missing piece of the transition puzzle. It is also key to sustaining international corporate interest in the region over the long term as SMEs finally start to play a significant role as customers, suppliers and partners. But the best local businesses are also becoming formidable competitors to international companies, with good products and strong marketing savvy but much lower overheads.

The increased competitive pressure is accelerating the process of consolidation in Central Europe, where markets are still far more fragmented than in the EU-15. How strongly the impact is felt differs by sector. For most industrial sectors, consolidation is just beginning as pan-European distributors start to penetrate the market and regional players emerge out of national heroes. Central Europe is finally booming for companies selling capital goods, which are now focusing on building up the capacity of local subsidiaries. The IT industry and services sector is growing strongly too, helped by SME growth and the push to modernisation.

Chart 1: FDI Flows in the New Member States



*Source: EIU *projection.*

Consolidation in these sectors is clearly happening, but it is boosting the business of international companies by improving distribution channels and allowing them to swallow up smaller competitors. The consumer goods sector enjoyed a similar boost in the late 1990s as retailers simplified trade structures and international companies wiped out local competition. But consolidation is now squeezing multinational companies hard. Not only are they fighting against each other, but also against the surviving local companies and new entrants to the market. The latest consolidation push represents what many companies see as the final battle for market share in a maturing Central Europe – the winners expand; the rest sell up, go bankrupt or retreat into niches, just as in the rest of the EU.

Look at the retail sector to see the pace and scale of the consolidation that is raging throughout the consumer goods sector. In 2001, the top 10 retailers accounted for about 40% of sales. That increased to around 60% in 2004, but 2005 has already seen massive concentration as retailers juggle to ensure they have sufficient scale to be in the top three or four – or get out of the market. Tesco, for example, is swallowing up Carrefour's Czech and Slovak hypermarkets. Meinl recently sold its Czech stores to Ahold and its Polish ones to Tesco. Meanwhile, discounters have moved in, with Lidl making a very successful debut last year. Walmart, the U.S. giant, started moving in this year, buying up parts of the Belgian Delhaize chain in its first, but certainly not last, acquisition. And to cap it all, local retailers have formally clubbed together in purchasing groups to streamline their supply chains and compete with the international giants.

The increase in competition and consolidation has changed the way consumer goods companies view the region, and the situation is most extreme in the Czech Republic, Hungary and Slovakia. While for now industrial and services companies are enjoying strong sales growth and often good profit margins too, international companies in the consumer goods sector see Central Europe as a tricky hybrid market. As in mature markets, prices are under pressure, competition is high, costs are rising – and sales growth is sluggish as markets saturate. And yet, there is still emerging markets potential since per capita sales levels are low and market shares are still shifting.

That dilemma makes corporate strategy in the region a balancing act between maintaining a sufficiently strong local focus to exploit the growth potential, while keeping costs in line with the small size, sluggish growth and low prices of the markets. For now it is consumer goods companies that are most affected, but it is only a matter of time – five, ten years at most – before the pressures of competition squeeze other sectors too. In other words, the CENTROPE region is losing its emerging markets status and becoming just a collection of small EU markets – much like Austria, but poorer.

2.2 Central Europe as an Investment Market

EU enlargement may mark the final spurt of interest in the more mature Central European countries as growth markets. But that maturity has opened up a new medium and long-term perspective perspective for Central Europe as an investment market, by prompting international companies to rethink their footprint across Europe, as they are doing globally.

The shift towards lower-cost production locations is not new, but the terms of the debate have shifted with EU enlargement. Much of the first wave of cheap assembly production has already moved on to places like China, Romania or Ukraine. And many companies have also consolidated production facilities that were scattered around the region into one location, now that border delays have disappeared. But far from representing the end of investment interest in Central Europe, this is the start of a new focus on bringing higher value-added parts of the supply chain to a region with relatively low costs, high skills levels, strong workforce motivation and favourable tax regimes.

Central Europe has already managed to carve out a significant niche as an automotive manufacturing hub. Almost USD 25 billion has been invested in the Czech Republic, Slovakia, southern Poland and Hungary over the past ten years. A further USD 5 billion or more has been committed since EU enlargement, as Asian companies – Hyundai, Kia, Toyota and their suppliers – see the region as the perfect EU manufacturing location.

This is Europe's answer to the coming influx of Chinese-made cars. Auto production will rise from 2.3m cars a year now to 3.8m by 2008, including Romania and Turkey, which are both growing fast as auto investment pours in. That still only represents about 20% of European car production, but with all new plants opening in the region and some closing in the west, that could ultimately rise to as much as 60% over the next 15-20 years.

Central Europe has also developed a fledgling electronics production cluster, largely in the Czech Republic and Hungary, led by outsourced manufacturers like Flextronics, Foxconn and Solectron. But in this sector, the region is still battling to compete with China. That is partly because of lower transport costs but also partly because Central Europe lacks an efficient network of basic suppliers for parts like metal casings which are still imported from China.

This points to a key element in maintaining Central Europe's competitiveness with China: expanding such networks beyond the core Central European countries to take advantage of lower costs, natural resources and sufficient skills. Already, auto suppliers have started shifting labour-intensive parts of production to cheaper locations like Romania, Turkey and Ukraine as wages in Central Europe rise and the availability of skilled labour shrinks.

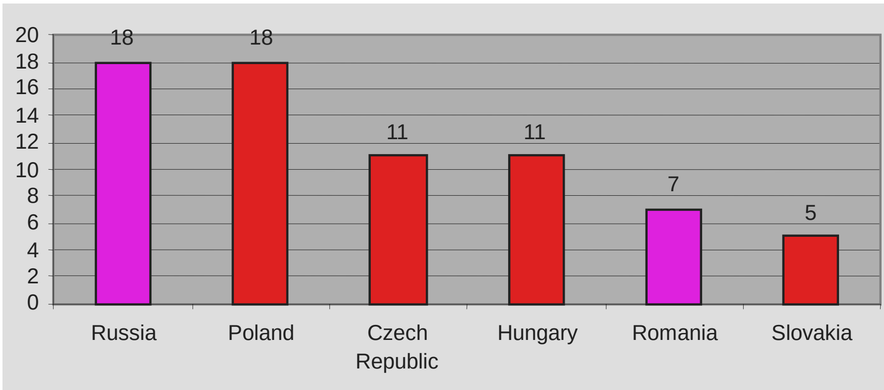
It is not only in production that international companies are rethinking their portfolios in Europe. Budapest, Bratislava and Prague have become hot locations for companies looking to locate or outsource competence centres for back-office functions, call centres, R&D and IT services. More pioneering companies are now moving into provincial cities and cheaper locations like Riga and Bucharest. In these sectors, Central Europe is competing with the other emerging giant, India. Its success at promoting "nearshoring" as an alternative to "offshoring" has eve prompted the big Indian outsourcers, like Tata, Wipro and Progeon, to open offices in the region to set up their own nearshore operations.

2.3 Central Europe's Place in the Broader EEMEA Context

Until recently, Poland, the Czech Republic and Hungary were the biggest markets in the CEE region and the main focus of management attention. That is now changing fast as new growth markets – Russia, Turkey, Southeastern Europe and even the Middle East – compete for resources. The shift in strategic weight away from the Central European core has already brought big changes for the Vienna hub, but the process is only beginning.

According to a survey of Economist Intelligence Unit (EIU) Corporate Network clients in June 2005, average sales in Russia were around the same size as in Poland, which has about five times fewer people. Next year's survey will already show a different picture. The Russian market is growing in leaps and bounds – on average around 25-30% a year. Within less than ten years, it will be the largest market in Europe (by volume at least) for many companies. For a select few, Heineken for example, it already is. And for virtually all multinational companies, Russia is a key global growth market, a place to focus senior management attention and resources.

Chart 2: Country as a % of CEE Sales, 2004



Source: Corporate Network survey 2005.

Turkey is the other large market to have pushed its way on to the agenda of senior management. For decades, Turkey was an opportunistic, roller-coaster market, with excellent sales one year followed by a crash the next, due to a political or financial crisis. That pattern has changed with responsible government policies and the straitjacket of EU negotiations and IMF agreements. In a world where many companies see salvation in emerging markets, Turkey offers size (70 million people), youth, relative wealth and relative predictability. Although Austrians tend to view Turkey as part of the Middle East, international companies increasingly view it as part of their European operations. Indeed, a few companies have recently located their CEE hub in Istanbul and Turkey is a natural expansion market for companies and managers with experience in Central Europe.

A third growth pole in the CEE region is Southeastern Europe. And although the long-term potential here is small (the official GDP of the entire region is only half that of Austria), current growth, especially in booming Romania, requires a special focus and the medium term outlook for the smaller markets is buttressed by the shift words EU accession. Finally, the Middle East Africa region, long tacked on to EEMEA as an afterthought for most companies, has taken on a new dynamic, driven by massive oil revenues that show little sign of dwindling, plus a push to reform and open up to foreign companies.

3. Outlook for Vienna's Role in the CENTROPE Region

From the perspective of multinational companies, Central Europe's importance as a growth market is diminishing. Not only is the market maturing rapidly, but other markets in the EEMEA region are taking the limelight and at least two of them – Russia and Turkey – are coming to be seen as global growth markets. At the same time, multinational interest in Central Europe as a high-value, low-cost manufacturing and services location is growing.

These business developments hold significant threats for the continued relevance of Vienna as a strategic location for international companies. If Central Europe is merely the poorer end of EU markets, then there is no need for significant hub operations. And since investment planning is part of a broader reshuffling of global corporate assets, it is decided at global or at least European headquarters – not in the regional hub itself.

But the new business realities also hold an opportunity for Vienna. The pressure to constrain costs in emerging markets is pushing companies to keep local subsidiaries lean and to share services wherever possible, much as in western Europe. Equally, recent attempts to dissolve regional structures in favour of functional or vertical divisions have proven inadequate in developing emerging markets. That has created a niche for small regional hubs, staffed by experienced managers who can provide strategic services to a broader range of markets, simplifying reporting lines and management in the European or global HQ.

As a result, from an international business perspective, the real opportunity for Vienna is not in servicing a narrowly defined CENTROPE region, but in providing high-level support for a much wider region. CENTROPE is just too small to be an internationally relevant region.

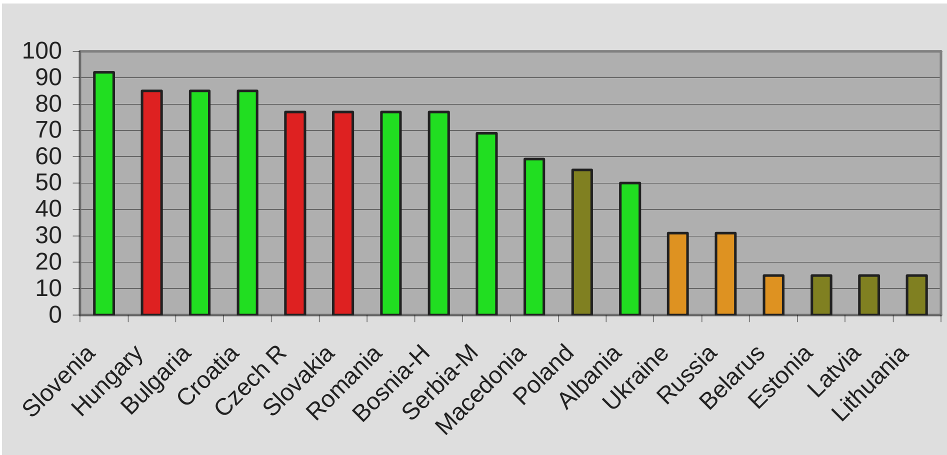
3.1 What Regions Can a Vienna-Based Hub Realistically Service?

Could Vienna become a broader hub for international companies? The potential is clearly there. Most companies with a hub in Vienna have taken on the running of the South-East European region or cluster, where the markets are too small to warrant large local operations. A 2005 survey by Boston consulting Group shows that around 80% of CEE hubs in Vienna manage the larger SEE markets.

The location was helped by excellent air connections to all Balkan capitals, otherwise lacking both within the region and from other west European locations. It was also helped by latent animosities which made a neutral headquarters ideal and by Austria's high-profile political role as a champion of the region in the EU. And, as in Central Europe, the emergence of international companies' hubs for SEE has been encouraged by the success of Austrian companies, which moved rapidly and strongly into these markets. Indeed, Austrian business has taken a pioneering role in virtually all of the Balkan countries.

Chart 3: Countries Serviced by Vienna-Based Regional HQ

(% of responses)



Note: Differently shaded bars refer to regions.

Source: Boston Consulting Group, 2005.

The current need for a SEE hub acts as an anchor for keeping Central European operations in Vienna. But the window of opportunity for SEE could be relatively short. Once Romania and Bulgaria join the EU in 2007 (or latest 2008), most companies will absorb them into a "new Member States" or "Central Europe" cluster – and will probably take that opportunity to include the remaining SEE markets in that structure too. This will be a turning point for Vienna. Will it be in a position to expand its strategic focus to other growth markets? Or will it become obsolescent?

Vienna's experience with servicing Russia is mixed. As the Russian market has grown, most international companies have shifted increasing responsibility for Russia and other CIS markets to the Moscow office. The reason is simple: Russia's potential overshadows all other CEE markets: either its development is restrained by the need to share resources or the other markets are suffocated.

As a result, many companies have split their CEE operations into two halves: Central Europe and CIS. With EU enlargement, these two parts sometimes even report to different organisations – the Central European cluster to an EU HQ and the CIS cluster to an EE or *Eastern Europe Middle East and Africa* (EEMEA) rump. But despite Moscow's growing autonomy, the Russia manager still reports back to around a third of CEE hubs in Vienna, according to the Boston Consulting Group survey. And it is not just a leftover of the early CEE HQ days. Several European companies have brought their Russia operations into the Vienna hub recently–Henkel shifted responsibility for Russia from Germany to Vienna; Heineken brought its enormous Russian operations into a newly established CEE hub in Vienna, relieving HQ in Amsterdam.

> “The CEMEA hub is a temporary way to add flexibility until markets are more mature. Russia will report directly in a few years.”
> *U.S. IT company, based in Vienna*

In future, as the Russian market grows bigger, it could start reporting directly to European or global HQ, taking on the status of large markets like China and India, which sit uncomfortably in standard regional structures. But since these uncomfortable markets will become key global growth markets, companies are trying hard to find structures to embrace them, allowing for dynamic sales growth while keeping costs under control.

For several large companies in Vienna – IBM, Kraft, Eli Lilly, Hewlett Packard – that structure is *Central Europe Middle East Africa* (CEMEA), embracing the whole of CEE, plus Turkey, the Middle East and Africa. Financial services provider, Western Union, even covers the whole of Europe and Asia from Vienna. The usual set-up is to have a handful of CEMEA directors, plus CE managers physically based in Vienna. Russia is more autonomous with responsibility for other CIS markets, and Middle East Africa managers also report in from sub-regional hubs in places like Dubai and Johannesburg.

But Vienna has no monopoly on this structure. Geneva and London boast the most CEMEA hubs and are far better placed to take on an even broader role in supervising emerging markets, a structure some companies are now developing. Brussels and Amsterdam also compete with Vienna.

Vienna’s advantages are limited: in addition to the usual complaints, Vienna’s air links to the Middle East and Africa are relatively weak. That it has still managed to play this role is largely down to the ability of CEE managers to leverage their experience into other emerging markets. If Vienna is to expand its broader CEEMEA role rather than gradually lose it, it will need significant developments in creating an expat-friendly environment and a more supportive political stance towards key markets like Turkey.

Over the past year, the Vienna hub has seen a new development. Instead of just looking east, regional managers have taken on new responsibility for the western part of Central Europe – Austria, Switzerland and, in some cases, even Germany. IBM, for example, has brought Austria and Switzerland into its CEMEA structure. A U.S. food company, has split its Vienna-based CEMEA HQ into two groups. Central Europe, includes the new EU Member States (in a cluster), Austria, Switzerland and Germany. EEMEA covers Russia, the Balkans and Middle East Africa. That corresponds more to the organisation of its main customers and allows the new EU Member States to learn about how to work in maturer markets from German management. Heineken has also brought overall responsibility Germany into its new Vienna HQ, arguing a similar case of synergies.

In the long term, this geographical understanding of the Central European cluster will increase in importance. And Vienna's advantages are several: it is centrally located, it is an EU member, it has a significant business role in all markets, it's business environment and performance is improving and it is not big enough to squash the interests of other markets.

3.2 How Can Vienna Improve its Attractiveness as a Hub Location?

For companies, the location of CEE regional hubs is no longer a key issue. They are small – they frequently employ less than 10 people and rarely more than 30, mostly key strategic managers. They are also increasingly organised on a virtual basis, with a leading manager in one location and others elsewhere, supervising functions like finance, human resources and IT for the region.

> "It doesn't matter where the HQ is these days because it's so small."
>
> *U.S. pharmaceutical company, with two EEMEA clusters located in Paris*

But if Vienna wants to retain its position in the CEE market, these hubs are crucial. They help shape business in the region, bolster management expertise and act as champions for Austrian business. Although they employ few people, they are important players.

So what can Vienna do to encourage their development? The new characteristic of these small high-level hubs is that they are dependent on the wishes of a few key players. If the top managers do not want to stay in Vienna, then chances are the location will shift. In this respect, Vienna's strengths are threefold:

- The availability of senior management with experience in the region and personal ties to Austria
- An attractive location for expats to live in
- Proximity by air and road
- But as management changes take place and virtual hub models become more standard, these factors alone will not be enough to sustain Vienna's position. Expatriate managers are put off by three big factors in Vienna:
- Income tax and the tax treatment of expat perks like housing, schools and cars in comparison to location like Geneva or Brussels.
- Bureaucratic delays in getting work permits for non-EU expat managers (and from new EU Member States)
- The lack of rapid road and rail connections (and absence of urgency in developing them)

> "The lacking infrastructure is a catastrophe. And trying to hire highly qualified employees at short notice is a fiasco."
>
> *German consumer goods producer, with large CEE operations in Vienna*

As one Austrian regional director puts it: “Regional headquarters came to Vienna, but what are we doing to keep them? There’s nothing happening in this respect.” If Vienna is to grasp the full potential of its current position, it must do two things:

First, do something about the irritants that push companies to look at leaving Vienna or limiting their operations. True, there have been attempts to address these issues – but these fail to get to the core of the problem. Moves to reduce corporate tax and introduce Gruppenbesteuerung came far too late for most multinational companies, which long ago opted to tax their European operations in locations like Geneva and Amsterdam. And attempts to improve the process for granting expat work permits are still stymied by bureaucratic delays.

Secondly, Vienna needs to look at how it can encourage and support the further development of international companies running CEE operations in the city. That means looking at the anchors hubs can develop to maintain their relevance. One anchor, as discussed above, is to service a wider geographical territory from Vienna. Another is to expand the functions Vienna provides for the mother company.

For pharmaceutical companies, for example, this might be shared R&D facilities or medical trial capabilities linked to Central Europe. U.S. pharmaceutical company Eli Lilly has had its CEE HQ in Vienna for around 20 years and took on HQ functions for Middle East Africa in 2002, with the idea of sharing EEMEA directors for key functions. The true costs of that decision turned out to be much higher than expected: now the hub is becoming more virtual and considering moving everything to European HQ in London. But what keeps the company in Vienna is a medical trials unit and research centre, with strong links to the Vienna university and doctors around Central Europe. This is an anchor that makes Vienna valuable as the costs of maintaining an HQ operation rise. Unless the expat issue is solved, Lilly’s hub will probably continue to shrink. But it will maintain a presence in Vienna.

For manufacturing companies, the anchor could be logistical, taking advantage of Austria’s central location. German detergent producer Henkel, for example, which covers the entire CEE region, opened a central warehouse in Vienna in 2005, serving Austria and all the neighbouring countries. But this kind of strategy will not become more widespread without a rapid improvement in infrastructure. The slow pace of build-out reflects government failure to grasp the role that Austrian-based business are capable of playing in an enlarged Europe. If the CENTROPE region is to have any real meaning for Austria-based business at a local or international level, it requires concrete backing with roads, improved rail connections, labour market flexibility and language training.

> “The infrastructure needs to get much better before the CENTROPE economic space can develop dynamically.”
> *U.S. consumer goods producer, with CE hub in Vienna*

Appendix

Statistical Information

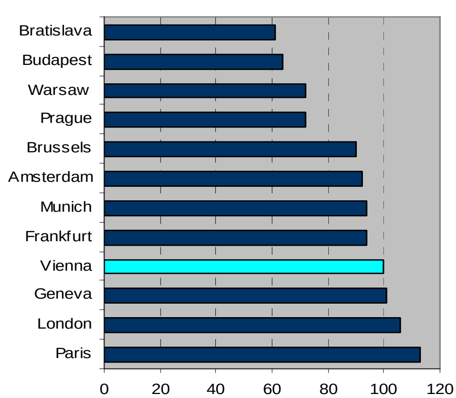
Table A1: Road Connection from Vienna to Other European Destinations: (Distances and Travel Time)

City	km	hours
Bratislava	68	1.00
Brno	127	2.10
Budapest	247	2.30
Prague	296	4.00
Munich	435	4.15
Krakow	467	5.45
Berlin	627	8.15
Warsaw	705	10.45
Frankfurt	719	6.30
Zurich	757	7.20
Brussels	1,108	10.00
Amsterdam	1,159	10.30
Paris	1,241	11.00
London	1,421	14.00

Source: Michelin route planer.

The capitals of Slovakia, Hungary, Czech Republic and Poland are closer to Vienna than most other European capitals. Three capitals – Bratislava, Budapest and Prague – are within a 300km radius from Vienna. However, the travel time by road or rail is comparatively long to these cities due to the lacking infrastructure.

Chart A1: Overall Cost of Living Index

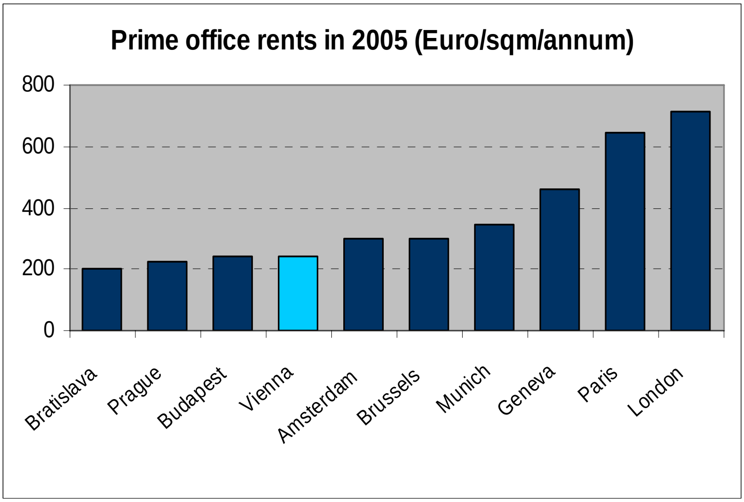


Note: Vienna=100.

Source: EIU 2005.

The EIU's most recent study on cost of living shows that Vienna is slightly more expensive than many Western European centres such as Brussels, Amsterdam, Munich and Frankfurt. Vienna is on average 25% more expensive than capitals in Central Europe.

Chart A2: Prime Office Rents in 2005



Source: CB Ellis 2005.

Office rents in Vienna do not differ considerably from the ones in Central European capitals. With an annual rent of Eur240 per sqm, Vienna is far more competitive than other Western European cities. Cities like Geneva, Paris and London cost at least twice as much.

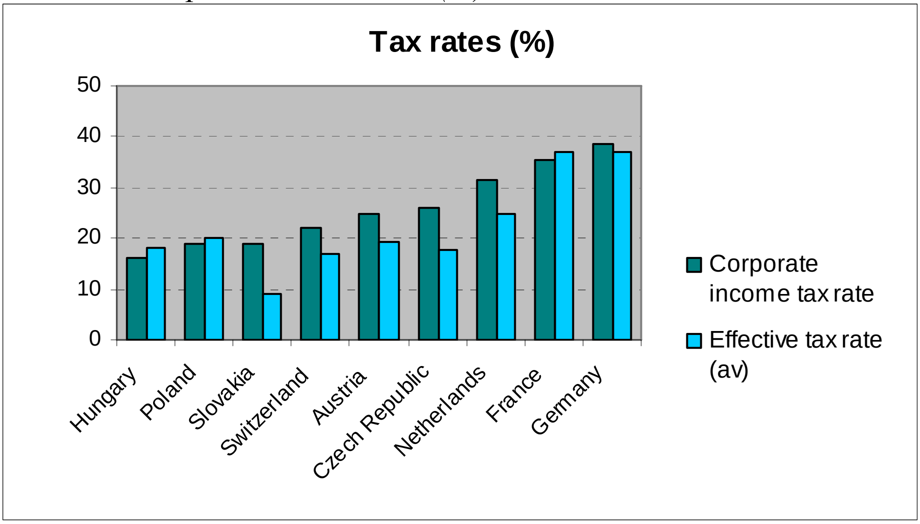
Table A2: Top Statutory Personal Income Tax Rate 2005

Country	%
Austria	50
Belgium	50
Germany	42
Poland	40
United Kingdom	40
Hungary	38
Czech Republic	32
Slovakia	19

Source: Eurostat 2005.

Although Austria has made an attempt to bring tax levels down and increase the country's competitiveness by amending taxation legislation, both personal and corporate income tax levels remain relatively high. For foreign companies, high personal income tax and the difficulty to bring in staff from non-EU-countries remain obstacles that reduce the attractiveness of Vienna as a HQ.

Chart A3: Corporate Income Tax (%)



Source: CD Howe Institute.

Note: The marginal effective tax rate is the tax paid as a % of the pre-tax rate of return to capitalbased on the assumption that the after-tax rate of return is sufficient to cover the cost of equity and debt finance provided by international lenders.

Abbreviations and Acronyms

CE	Central Europe
CEE	Central Eastern Europe
CEMEA	Central Europe Middle East Africa
CEEMEA	Central and Eastern Europe, Middle East and Africa
CIS	Commonwealth of Independent States
EEMEA	Eastern Europe Middle East and Africa
EU	European Union
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
HQ	Headquarters
SEE	Southeastern Europe
SME	Small and Medium Sized Enterprises
R&D	Research and Development

Questionnaire

Why does Your Company have Its Regional HQ in Vienna?

- Since when has you company been based in Vienna?
- Why did your company choose Vienna and who was responsible for this decision? Was it an objective (objective advantages) or subjective choice (personal preferences)?
- How many people work in the Vienna office? Is it a legal entity? Who does it report to?
- How much autonomy do local operations in each country in the CEE region have? How is this changing – more power, less power?
- What is the region the Vienna hub is responsible for? Have there been changes in the past few years – more countries, less countries?
- What functions/activities are run from your Vienna office?
- Has this changed in the past few years (clustering, shared service centres, IT competence centres etc)? If so, why? Are there such changes planned? Are these changes linked to EU enlargement?
- How have changing strategies towards the CEE markets affected the Vienna HQ?
- How has EU enlargement affected Vienna's role in the enlarged EU or in the CE region?

What Are Vienna's Strengths and Weaknesses as a Regional Centre from a Business/Strategic/Financial Perspective?

- What makes Vienna a good place for a CEE base?
  (possible pros)
  – Airport/flight connections
  – Geographical proximity to the region
  – Cultural proximity to the region
  – HR/skills
  – Taxes
  – Quality of life
  – Government support
  – R&D
  – Banks
  – Critical mass of companies
- What are the arguments against Vienna?
  (possible cons)
  – Taxes

– Bureaucratic hurdles
– Infrastructure (roads, rail)

- What is the government doing to keep companies here? What is missing?
- Are there any discussions in your company about moving to a different location? If so, which locations are mentioned?
- What would be arguments for your company to move your headquarters to another city?
- What would make Vienna the natural location for CEE? What would stop your company from moving?
- Which other locations in Europe do you consider to be good bases for CE business?

What's the Outlook for Vienna and CENTROPE?

- How important is the region Vienna-Bratislava-Brno-Györ for international companies? Do you consider this to be a business region?
- How do you think this region will develop over the next years?
- What is the likelihood of Vienna becoming a financial centre of greater importance and how does its closeness to Bratislava affect further development?
- What does Vienna have to do to strengthen its position as a regional hub?
- Where do you see growth areas and potential in the region?

Panel Discussion

Philip Schuster

Institute for Advanced Studies

Following the second session the workshop ended with a panel discussion that was chaired by *Bernhard Felderer* (Institute for Advanced Studies – IHS). After introducing the discussants he asked them to give their opinions on what measures were and which will be important for the CENTROPE region. Furthermore, the economic and political implications of one of the main findings, namely CENTROPE being an inhomogeneous region, were discussed. How should this be confronted and what opportunities could arise from this conclusion?

Elena Kohútiková (Vice Governor of Národna banka Slovenska) found that the most important thing that has changed, speaking for Slovakia, was the way of thinking. Giving the example of a young Slovakian boy that did not know Lenin, she showed how especially the young generation has oriented towards the West and how barriers in minds have been lifted. Such a large mental shift probably has not occurred for the Austrians. The entry to the European Union (EU) in 2004 is the event that has most affected the lives of the people in these regions. And still political decisions like transition periods for free movement of labor and the delay of the liberalization process for services make the accession countries feel that they have not fully arrived in Europe yet. The fears of parts of the Austrian population in this matter are difficult to comprehend for the people in the other CENTROPE regions. One thing that should strengthen the integration process, not only in an economic but especially in a psychological way, is the introduction of the euro in Slovakia.

Furthermore three reforms were proposed to boost integration in the CENTROPE region. First of all, regional integration should be supported by improving the infrastructure and correcting deficiencies of the past in this regard. Second, investment in education and research and development has to increase as the advantage of low wages will diminish in the future. And last but not least, reforms in the national social and health care systems are inevitable. These measures should confront the most serious problems in order to prevent a deceleration in the integration process in this region within the next ten years.

Madeleine Mahovsky (European Commission) emphasized the need to distinguish analytically between Austria and the other CENTROPE regions. For Austria, the crucial issue is to finally eliminate the Iron Curtain persisting in people's minds. While Austrian firms were pretty successful in doing so, as the high foreign direct investments (FDI) into the EU-10 suggest, Austrian employees remain rather anxious, although their fears often seem unjustified. For the other CENTROPE regions the main challenge in the years to come is to aim at macroeconomic stability with a view to adopting the euro. A key priority for these regions is to strengthen further their ability to attract FDI, notwithstanding the fact that the peak in terms of inbound investment is likely to be over and privatizations have largely been realized. Another challenge is the completion of the automotive cluster in Slovakia with a view to fully exploit its economic potential. Such growth poles play a key role regarding the diffusion of technology, which in combination with the related increase in productivity represents an important driving force for income growth. It is crucial to rapidly eliminate the severe shortcomings concerning physical infrastructure, notably transport infrastructure. The matter is truly urgent, in particular for Austria, to prevent firms from settling in or moving to other regions. Yet, it is important to be aware of a potential trade-off between spatial efficiency and equity. More specifically, improvements in the inter-regional transport infrastructure may cause regional inequalities to widen, at least during a transition period.

The European Commission recognizes the special difficulties of border regions, in particular at the former external EU borders. For that reason, it not only welcomes efforts such as the CENTROPE project, which aims at overcoming the cultural, social and economic divide, but also supports them financially via the Structural Funds. To this end, a specific "European Territorial Cooperation" objective has been created for the next Structural Fund programming period 2007–2013 and its financial envelope increased compared to the current "Interreg" community initiative.

Eugen Antalovsky (Europaforum Wien) stated that talking about CENTROPE means to look at different levels and fields of activities and decision processes. The Central European Region which is a core part of whole Central Europe needs alertness not only because of the economic framework and dynamic. One must therefore distinguish three levels of action: 1) the level of economy, e.g. the world of business, finance, enterprises, regional and global markets; 2) the level of politics, e.g. the world of European as well as national and regional decision making and steering, of strategies and measures of public authorities and institutions; 3) the level of civil society, e.g. the world of people, public opinion, multiple life styles, diversity, culture, identity and participation.

Unless economy has its own "rules" these three levels are interdependent. The speed and the quality of integration in Central Europe, and from our point of view especially in CENTROPE, can be accelerated or slowed by strategies and measures in the sphere of politics and society. We know a lot of barriers in CENTROPE which hinder a more dynamic integration process. For example the fear of some parts of the population and politicians of a fully liberalized labor market, or the very heterogeneous systems of spatial and infrastructure planning and financing, or the various approval procedures for international enterprises etc.

On one hand CENTROPE is a symbol for geographical location and an attempt to give a region consisting of parts of four Member States a brand which you can use easily in the public debate. On the other hand CENTROPE is a process to build an integrated Central European Region, this means to win people for an open minded, innovative and prosperous development of their living and working space.

Thus CENTROPE is mainly an instrument and facilitator for

- mobilization of people, experts, politicians and institutions for an effective and efficient way of European Integration in this cross-border region;
- multilateral coordination and cooperation for designing and planning common perspectives and programs in all those projects where cooperation boosts the benefit and diminishes transaction costs;
- strengthening the competitiveness and quality of the region as an Europe-wide and international attractive business location and sustainable living space.

So CENTROPE may help to change some of the persistent mental maps which hinder a modern and fruitful integration in the region.

Peter Huber (Austrian Institute of Economic Research – WIFO) pointed out that the understanding of processes in CENTROPE is still very limited due to the lack of data and appropriate models. So there is a lot of work to do in terms of data collection and model development. Next he discussed one of the main findings of this workshop, namely that CENTROPE is not a homogenous region, at least not in an economic sense. This result is disappointing as more progress was expected after fifteen years of integration. On the other hand this should not be surprising as migration and labor mobility are still very restricted and the liberalization of services has been deferred. In response to the allusion that the WIFO had supported transition periods for labor mobility, *Peter Huber* justified his point of view as the concept of transition periods as suggested by the WIFO differs from the one that was actually established.

Although one can be confident that companies will exploit potential cooperation opportunities, as the example of the airports of Vienna and Bratislava shows, there are still unsolved problems. As CENTROPE seems to be for the time being only a political concept it needs to be put on a higher level. That means that the main task for the near future is to operationalize this concept in order to address problems in transport planning, urban development, etc. more efficiently. This includes the demand for better institutional solutions. In addition, communication should be improved as many delicate issues are not fully discussed. Networking ought to be carried out at every single level. Only if the concept is brought on a more operational basis so that the benefits are visible it will gain wider acceptance.

Christian Helmenstein (Federation of Austrian Industries) stressed that integration in the CENTROPE region has been disillusioning so far. The fact that the share of Austrian component suppliers in the Slovakian automotive cluster's value added amounts for only 2% was cited as an example. What could be the reasons for this integration deficit? Among other things, border effects were mentioned. These include language barriers and uncertainty concerning customs clearance that hampers just-in-time supply. Especially small and medium-sized businesses, representing Austria's growth engine, are affected by bureaucracy involved in cross-border trade. As bureaucracy can be considered as fixed costs that are spread over output, primarily small and medium-sized enterprises are handicapped.

Furthermore, one can notice that research and development spillovers have not occurred to the desirable extent. The chances of reciprocal learning that could lead to increased output have not been exploited adequately. Generally speaking, the mobilization of network capital is insufficient. So there is much room left for improvement but what are the strengths of CENTROPE compared to other regions like Basel, Luxembourg or Maastricht-Aachen-Liège. Unlike the mentioned regions, CENTROPE features a high degree of heterogeneity. But this is not necessarily a drawback; in fact this can be considered to be an opportunity. Dynamics arise from differences in factor prices and diversity in human capital that can be observed in the CENTROPE region. This is especially advantageous in times of fast structural changes as we are experiencing them now when a lot of creativity is needed. On the basis of variety and heterogeneity CENTROPE seems to be one of the best suited regions in Europe to face the challenges of globalization.

In conclusion, the panel discussion showed that the high degree of heterogeneity of CENTROPE could be an opportunity for the future development. The main tasks of the CENTROPE project, being coordinating and strengthening integration and competitiveness in this region can be supported by various measures. The improvement of the physical infrastructure, the ease of labor mobility and the introduction of the euro in the remaining CENTROPE regions were mentioned. In this regard major progress could be made within the next five to ten years. In this context CENTROPE can be considered to be a "future region".

Contributors

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List of “Workshops – Proceedings of OeNB Workshops”

For further details on the following publications see *www.oenb.at*

Periodical Publications
of the Oesterreichische Nationalbank

For further details see www.oenb.at

Monetary Policy & the Economy *quarterly*
This quarterly publication, issued both in German and English, offers analyses of current cyclical developments, medium-term macroeconomic forecasts and studies on central banking and economic policy topics. It also summarizes the findings of macroeconomic workshops and conferences organized by the OeNB.

Statistiken – Daten & Analysen *quarterly*
This publication contains brief reports and analyses focusing on Austrian financial institutions, cross-border transactions and positions as well as financial flows. The contributions are in German, with executive summaries of the analyses in English. The statistical part covers tables and explanatory notes on a wide range of macroeconomic and financial indicators. The tables and additional information and data are also available on the OeNB's website in both German and English. This series also includes special issues on selected statistics topics published at irregular intervals.

econ.newsletter *quarterly*
The quarterly English-language newsletter is published only on the Internet and informs an international readership about selected findings, research topics and activities of the OeNB's Economic Analysis and Research Section. This publication addresses colleagues from other central banks or international institutions, economic policy researchers, decision makers and anyone with an interest in macroeconomics. Furthermore, the newsletter offers information on current publications, studies or working papers as well as events (conferences, lectures and workshops).

For further details see *www.oenb.at/econ.newsletter*

Financial Stability Report *semiannual*
Issued both in German and English, the *Financial Stability Report* contains first, a regular analysis of Austrian and international developments with an impact on financial stability and second, studies designed to provide in-depth insights into specific topics related to financial market stability.

Focus on European Economic Integration *semiannual*

The English-language publication Focus on European Economic Integration is the successor publication to Focus on Transition (published up to issue 2/2003). Reflecting a strategic regional research priority of the OeNB, this publication is a channel for communicating our ongoing research on Central and Eastern European countries (CEECs) as well as Southeastern European (SEE) countries ranging from economic country studies to studies on central banking issues and related topics. One of the purposes of publishing theoretical and empirical studies in the Focus on European Economic Integration, which are subject to an external refereeing process, is to stimulate comments and suggestions prior to possible publication in academic journals.

Workshops – Proceedings of OeNB Workshops *three to four issues a year*

The *Proceedings of OeNB Workshops* were introduced in 2004 and typically comprise papers presented at OeNB workshops at which national and international experts, including economists, researchers, politicians and journalists, discuss monetary and economic policy issues. Workshop proceedings are available in English only.

Working Papers *about ten papers a year*

The OeNB's *Working Paper* series is designed to disseminate, and provide a platform for discussing, findings of OeNB economists or outside contributors on topics which are of special interest to the OeNB. To ensure the high quality of their content, the contributions are subjected to an international refereeing process.

Economics Conference (Conference Proceedings) *annual*

The *Economics Conference* hosted by the OeNB represents an important international platform for exchanging views and information on monetary and economic policy as well as financial market issues. It convenes central bank representatives, economic policymakers, financial market players, academics and researchers. The conference proceedings comprise all papers presented at the conference, most of them in English.

Conference on European Economic Integration
(Conference Proceedings) *annual*

This series, published in English by a renowned international publishing house, reflects presentations made at the OeNB's annual conference on Central, Eastern and Southeastern European issues and the ongoing EU enlargement process (formerly East-West Conference).

For further details see *ceec.oenb.at*

Annual Report *annua***l**

The *Annual Report* of the OeNB provides a broad review of Austrian monetary policy, economic conditions, new developments in the financial markets in general and in financial market supervision in particular as well as of the OeNB's changing responsibilities and its role as an international partner in cooperation and dialogue. It also contains the OeNB's financial statements.

Intellectual Capital Report *annual*

This report has been published in German and English since 2003 as a review of the OeNB's intellectual capital, business processes and services. To perform its tasks, the OeNB requires extensive specialized knowledge about core central banking activities and about the related infrastructure. The OeNB has been accumulating and managing this expert knowledge for many years to ensure that it remains in a position to fulfill its commitment to stability in a dynamically changing environment. An intellectual capital report is particularly well suited to recording information about the strategically important management of intellectual capital, in particular human and structural capital.