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Preface

BAK Basel Economics started the project Regional Growth Factors late in 2003. Aim of this continuing project is an empirically sound contribution to the discussion of location factors and economic growth. The project focuses on the regional perspective. The project is an integral part of the international benchmarking of regions, in which BAK Basel Economics has been involved since the early nineties.

This report is a summery of the results from Regional Growth Factors phase I.

Project phase I was financed by the Swiss national bank (Schweitzer Nationalbank) and the Zurich cantonal bank (Züricher Kantonalbank). Without their support, the project would not have been possible. We thank both institutions!

In the course of the project BAK Basel Economics consulted several institutions and persons, among them economists from the funding institutions, especially Prof. Dr. Peter Stalder and Dr. Hansjörg Schmidt, the members of the BAK Scientific Advisory Board (Prof. Dr. René Frey, Prof. Dr. Bart van Ark, Prof. Dr. Regina Riphahn, Prof. Dr. Paul Cheshire, Prof. Dr. R. Maggi) and Dr. Axel Engelland. Our thanks go to everybody who contributed to the project.

The hypotheses and conclusions drawn in this report do not reflect the opinion of the project sponsors nor that of any other external person involved. BAK Basel Economics is solely responsible for all hypotheses and conclusions. All remaining errors are our own.

With this report the project Regional Growth Factors is not completed. In the contrary: Phase I of the project was only a first step to demonstrate the necessity of further research and to point to the kind of conclusions for economic and regional policy advice to be expected. BAK Basel Economics intends to continue the Regional Growth Factors project.

1 Introduction

Globalisation and decentralisation are challenging the regions' capacity to adapt and improve their economic competitiveness. The pressure to maintain economic growth and social development is felt most at the regional level. The «IBC BAK International Benchmark Club»®, established in 1998, aims to help regions and regional decision makers to cope with this challenge. Its goals are to advise governments, administrations, trade associations, NGO's and companies at the national and regional level on matters of business location quality and economic policy.

The most important tool developed and applied by the «IBC BAK International Benchmark Club»® is its unique database. The IBC database is unmatched in Europe in terms of both regional and sector-specific differentiation and data actuality. Currently it covers up to 279 regions with 64 business sectors per region and annual data from 1980 to 2003. It is regularly extended and updated. Apart from indicators of economic performance the database includes quantitative measures for several location factors as well as framework conditions. The indicators cover for example the areas of innovation (human capital, university quality), taxation (companies, highly qualified labour), regulation (product market, labour market) and accessibility (intercontinental, interregional), among others.

The database enables the Club members to assess in detail strengths and weaknesses of their region and to benefit from the experiences of other regions – i.e. to benchmark themselves against other regions. Benchmarking is a means to compare and assess the multitude of regional location factors and the success of national and regional policy strategies to exploit their potential. Since regions tend to be more specialised than countries, the 'right' set of location factors which satisfies the needs of both firms and people is particularly difficult to find.

But benchmarking is only one approach to support regional decisions makers. The current stage of the IBC database development allows another approach as well: To apply econometric methods in order to identify the impact of quality and quantity of location factors on regional growth. A variety of empirical studies on the subject are available, but they are usually based on country data or focus on regions in a single country. In the study presented here we will analyse the IBC database for an empirical study using a multi-country approach.

To analyse regional growth and the location factors which influence it, we will, as a first step, decompose regional growth statistically. We use a concept known as Shift-Share Analysis and develop a variety of extensions of this basic concept. This allows us to separate and thereby control a variety of different components of regional growth. In the second stage we use panel data methods in order to explain the remaining region-specific growth with region-specific location factors. Although the available data is limited and some regional growth differences can not be explained, a substantial part of the differences can be related to region-specific location factors. Furthermore, indications are found that for the growth performance not only the individual location factors are important, but that certain combinations of different factors have an additional impact on growth. Finally, there is also an indication that different industries react differently to certain location factors.

The analysis of growth factors is an additional tool that extends the philosophy of benchmarking. Both can be used as a tool in the development of policy strategies for sustainable economic growth. An advantage of the combination of growth factor analysis and benchmarking based on the same data is that regional decision makers can use the same measures of location factors – or specific combinations of location factors – identified in the empirical analysis when analysing the position of their region and possible shortcomings using the benchmarking tools.

2 The Shift-Share Analysis

In order to analyse regional growth and the location factors influencing it, we will, as a first step, decompose regional growth in a number of statistical components. We use and extend a concept known as the Shift-Share Analysis.

2.1 Methodology and Data

The Shift-Share Analysis is a concept to disaggregate the regional growth rate in a deterministic way into separate growth contributions. Generally speaking, the concept allows extracting parts from the regional growth which can be explained by general circumstances. What remains are the region-specific effects. The actual growth rate was decomposed into the following effects (or components):

Global Effect

The Global Effect is the part of growth that can be attributed to the general economic development of a higher level geographical unit, e.g. a nation. Apart from country specific settings, continental Europe is used as geographical unit for the global effect. This effect catches general economic trends as well as general business cycles and world trade effects.

Structural Effect

Regions grow differently due to their unequal industry composition. The Structural Effect collects the impact on growth of different industry shares at the beginning of the observation period. It reflects the different growth rates of industries compared with the aggregated economy on the higher geographical unit (continental Europe). This means that regions have different growth rates because of different industry shares which are applied when adding up the individual industry contributions to the regional Structural Effect. Accordingly weighted, the Structural Effects of all regions add up to zero (if all regions together compose the higher geographical unit).

Structural Change Effect

The Structural Effect catches the effect of different industry structures using the weights in the first observation period but does not take into account the effect of changes in the industry mix. It is possible to separate a Structural Change Effect and even to split up the Structural Change Effect in two components: The first one due to global structural changes, the second one to specific regional structural changes. The latter component can be influenced by regional policy while the former component is a function of global developments. The reader is referred to the Technical Report on project Phase I for more information regarding this decomposition, which will not be presented here.

National Effect

Regions may grow differently because of effects related to the country they belong to rather than the region itself. If we analyse sub-national regions and the global level used in the Shift-Share Analysis is above the national level, the influence of the country a region belongs to can be separated. With this effect we can take into account national regulation or country specific monetary policies for example. The National Effect, as it is constructed here, is calculated in a similar way as the Structural Effect. The differences between the industry growth rates in continental Europe and the industry growth rates in the country are added up, using the regional industry shares as weights. Notice that the national effect is not identical for all regions in a country as the industry shares are not identical for all regions.

Regional Effect

The Regional Effect is what is left of regional growth after taking into account growth components which could be explained by other factors. It is what remains to be explained (see below). Notice that

the Regional Effect adds up to zero if weighted appropriately and the regions added up compose the higher geographical unit.

While the basic Shift-Share Analysis consists of the Global, Structural and Regional Effects only, the various extensions developed can be used individually or combined. A further extension is to split the economic growth into the components labour input growth and productivity growth and apply the Shift-Share Analysis to this decomposition. Discussing all results is far beyond the scope of this paper; we will therefore concentrate on the results of two versions of the Shift-Share Analysis:[1]

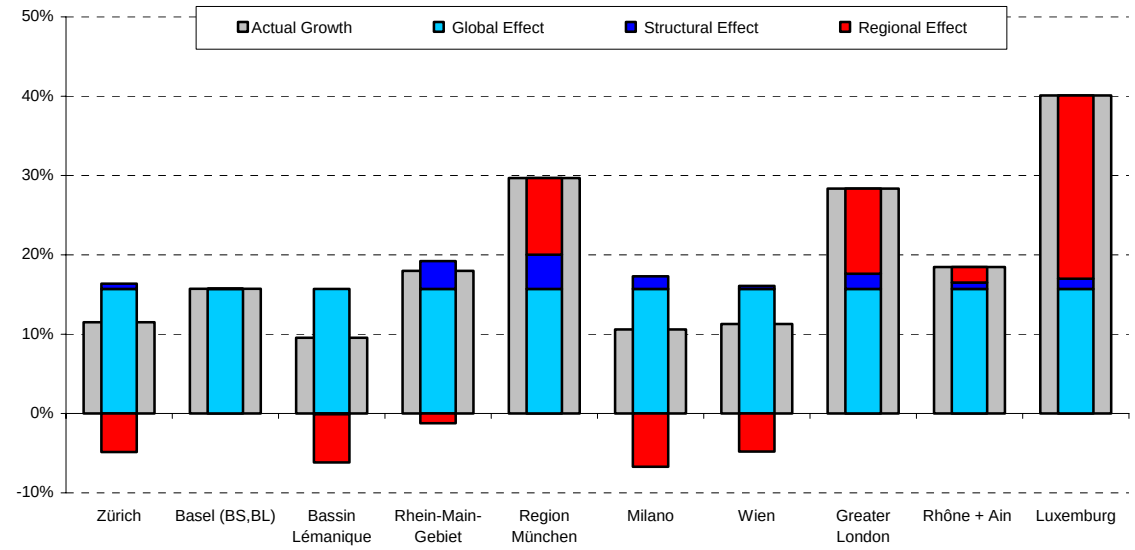
- Basic Shift-Share Analysis (SSA):
  Actual Growth = Global Effect + Structural Effect + Regional Effect
- Shift-Share Analysis Extension I (SSA E-I):
  Actual Growth = Global Effect + Structural Effect + National Effect + Regional Effect

The data used for the Shift-Share Analysis is taken form the IBC database 2003 (annual data 1980 to 2002). Although nearly 300 regions are available in the database, we restrict the research to a sample of 95 regions to get a less heterogeneous set of regions. Most of these 95 regions are aggregates of smaller regions, and it is ensured that the 95 regions geographically cover the entire IBC database. Whenever possible the regions are selected in a way to reflect the idea of a common functional form.

2.2 Results

A wide range of results from the Shift-Share Analysis are available, varying in time, number of regions, and variations of the effects. Even to present only a small part of them is beyond the scope of this paper. We will limit the presentation to a few examples and an overview of the effects.[2] The examples of the Shift-Share Analysis presented are also the starting points used in the econometric analysis discussed in the next chapter.

Figure 2-1 Basic Shift-Share Analysis: Results for Metropolitan Regions (1996-2002)



Source: BAK Basel Economics / IBC database

Figure 2-1 represents the basic Shift-Share Analysis for a sample of metropolitan regions. As can be seen, the Global Effect plays an important role for the size of regional growth, but so do regional differences. Furthermore, we can see that the regional derivation from the average growth can be nega-

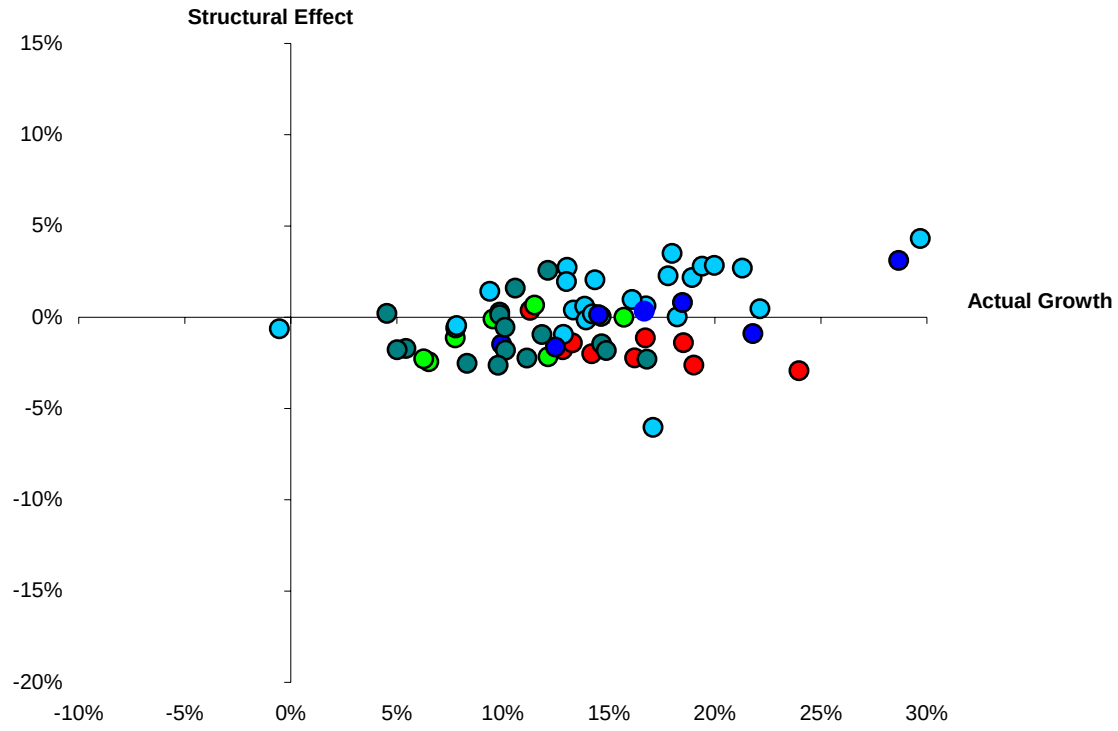
[1] For more information and a comprehensive documentation of all results the reader is referred to the Technical Report on project Phase I.

[2] For a complete overview of the results see the Technical Report, and region-specific analysis of the results will become available as well (e.g. a summary concentrating on Switzerland).

tive or positive for metropolitan regions. This means that metropolitan regions do not regularly have a growth advantage, at least not in the period analysed here (1996 to 2002). This is not true for the Structural Effect. The sample period includes 2001-2002 with problems in typical metropolitan industries like consulting or financial services. Still, nearly all regions have a non-negative Structural Effect, meaning that the industry structure of all metropolitan regions included is advantageous compared to the average of all regions. But the Structural Effects are small compared to the other two effects. This is partly due to the time period as well as the regions selected, but in general it can be observed that the Regional Effect is more important for regional growth than the Structural Effect. Finally, the Regional Effects vary widely. Many regions appear to have a significant influence on their growth[3], even given the common continental European development and focus on a specific industrial sector.

Figure 2-2 shows the relevance of the Structural Effect in the complete sample of 95 regions for growth from 1996 to 2002. Although the Structural Effects are larger for some regions than for the average of the metropolitan regions presented above, the location of the regions close to the actual growth axis shows that the structural effect is less important for regional growth. Furthermore, whether the Structural Effect is positive or negative plays hardly any role for the location of the region in the actual growth ranking. Finally, the position of a region is hardly influenced by its home country. On the other hand, for the Structural Effect, a country's influence can be identified. For example the Structural Effect for Austrian regions is negative in general, while it is positive for most German regions.

Figure 2-2 Actual Growth versus Structural Effect (1996-2002)



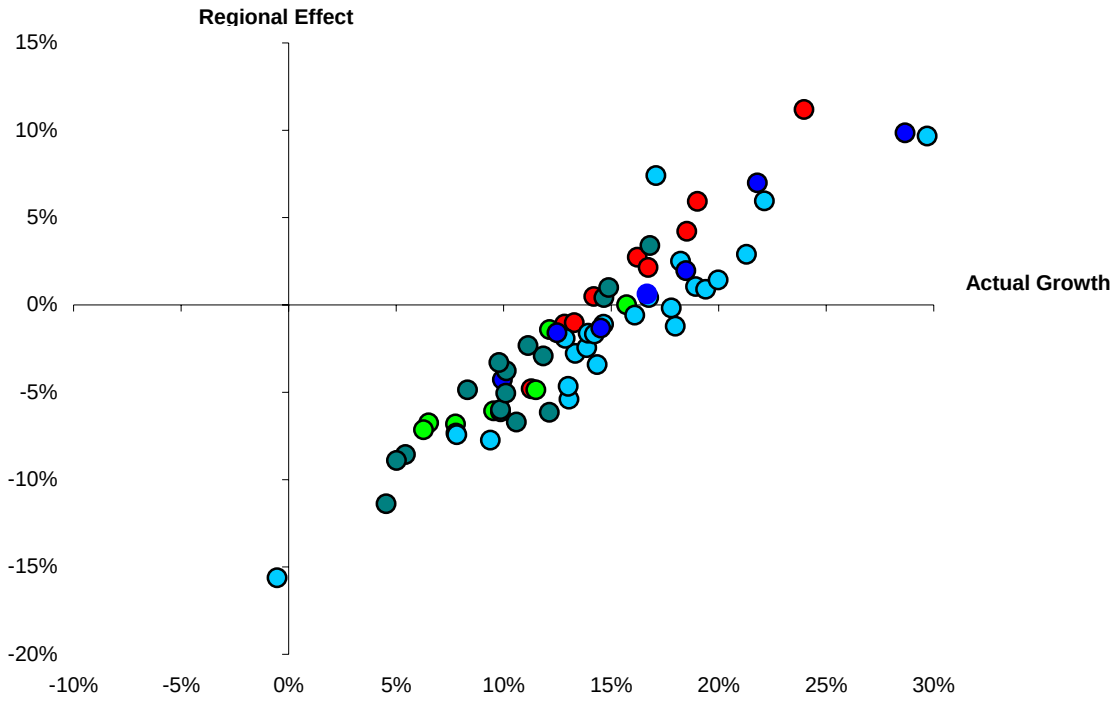
Note: *The colour of the bullets denotes the country the region belongs to:*
Red: Austria; light green: Switzerland; dark green: Italy; light blue: Germany; dark blue: France
Source: *BAK Basel Economics / IBC database*

Other than for the Structural Effect, we can observe much more variation and larger effects for the Regional Effect. As obvious from the above analysis, the position of the region in the actual growth ranking is to a large extent determined by the Regional Effect. Furthermore we notice that the Regional Effect does not only determine the order of the ranking but also the size of the actual growth

[3] Here „'influence"' means not necessarily open to political control but that region-specific characteristics influence the growth pattern.

rate. That means that regions differ substantially in their actual growth due to substantial differences in their Regional Effects. In some cases the Regional Effect offsets respectively doubles the Global Effect but is important for the growth performance of the other regions as well. This result suggests undertaking further research examining the reasons for differences in the Regional Effect.

Figure 2-3 Actual Growth versus Regional Effect (1996-2002)



Note: *The colour of the bullets denotes the country the region belongs to: red: Austria; light green: Switzerland; dark green: Italy; light blue: Germany; dark blue: France*

Source: *BAK Basel Economics / IBC database*

To summarize, the Shift-Share Analysis is helpful in various respects:

- Firstly, it demonstrates that the growth of a region has an important regional growth component which is potentially open to regional policies. The argument that regional growth differences result in large part from differences in the industry mix, is not supported by the data. Although there is a Structural Effect, the systematic and comprehensive analysis shows that it is comparatively small and hardly explains growth differences between regions. Vice versa, region-specific effects are larger and more important for the total growth position of a region.
- Secondly, we believe the Shift-Share Analysis to be a very useful tool when benchmarking regions, especially when applying the different extensions developed. It is beyond the scope of this paper to demonstrate this for individual regions, let alone for all 95 regions. But the interested reader is referred to the documentation for examples of such analyses.[4] Furthermore, we believe that the tools provided by the Shift-Share Analysis will be used in future benchmark analyses within the framework of the IBC.
- The Regional Effect remaining "unexplained" in the Shift-Share Analysis is the perfect starting point for an empirical analysis of the influence of regionally different location factors on regional growth. A variety of influences which are not in the centre of interest in a regional growth analysis, but could compromise the empirical results, are already taken into account.

[4] See e.g. the Technical Report or the summery of results from a Swiss perspective forthcoming in summer 2004. For more information www.bakbasel.com or contact the authors.

3 Regional Location Factors and Regional Growth

After disaggregating the growth of a region into the components relating to different, identifiable impacts on growth, it is of interest to get into some more detail. The Global Effect is not of central interest here; an analysis of this effect is better performed in a different setting e.g. a cross-country setting with other and more policy variables (e.g. monetary policy, fiscal policy, world trade). Nor will the Structural Effect be the focus of attention. It reflects industry growth differentials on a global level which is again not our focus here. The regional component in the Structural Effect, the industry shares, reflects part of the starting conditions of a region. Although they can be influenced by (regional) policy decisions, these relate to developments preceding the first observation period.

Our focus will now be on the Regional Effect, the growth differentials between regions which can be explained by regionally different location factors. We have data on a variety of location factors, some reflecting policy decisions. A short description is given in the following section. We then use econometric methods (also briefly described in the section below) to evaluate the influence of the location factors on regional growth.[5]

3.1 Data and Methodology

The data available for the research are taken from the «IBC BAK International Benchmark Club»® database. In addition to the data on the economic performance of regions already used above, the database includes a variety of location factors on the regional level in topics such as innovation, taxation, accessibility, regulation and population. Additional variables to explain regional growth differentials have been constructed using the available data including variables for regional and industry spillover effects and the path dependency of economic growth. The following sections contain a brief description of the most important variables used. A difficulty with most of this data is that only one observation in time is often available, which tends to be at the end of the observation period.[6]

3.1.1 Variable to be Explained: Regional Growth Effect

We use the Regional Effect from the Shift-Share Analysis as endogenous variable. A variety of different definitions of this effect and time periods have been used, but the two Regional Effects presented here are based on annual data 1996 to 2002 in derivation from the continental European average and the national average respectively. The other specifications tested did not lead to substantially different conclusions.

3.1.2 Politically Influenced Location Factors

Innovation

The IBC database includes a wide range of data on innovation. Unfortunately, until today most indicators are available for only a relatively small number of regions. The next phase of the innovation module planned for 2004/2005 should improve the coverage, but the results presented here are based on two indicators. The share of the regional work-force with a tertiary education is used to catch the effect of the human capital base. It is expressed in decimal notation. The quality of the regional universities is reflected by their score in the Shanghai Index (an index focusing on the top scientific achievements and natural science and listing the 500 best universities in the world). The total scores of all universities in the region are weighted with population, yielding a per capita figure.

[5] Of course it would be possible to include the Shift-Share Analysis in an econometric model. Due to limited resources we did not yet apply this more complex approach. This is an issue for phase II of the Regional Growth Factors project.

Taxation

Two different kinds of taxation measurement sets are available in the IBC database. The first one is on company taxation. The tax burden on a typical investment is calculated taking all taxes into account. The second set of tax indicators follows a similar concept, but for highly qualified labour. For a given (high) available income the tax burden is calculated including social security contributions if they do not yield a market equivalent return. Different 'model' investments and 'model' persons can be used for sensitivity checks. The variables are expressed as tax rates in decimal notation.

Accessibility

The accessibility of a region is measured by the GDP that can be accessed from the region weighted by travel time. The different travel modes rail, road and air are used. The analysis is very detailed, for example including the airport access and check-in times. Two variables are used, reflecting intercontinental accessibility to destinations outside Europe and interregional accessibility to other regions in Europe respectively. The variables are indexed, with 100 for the average.

Regulation

For regulation we only have data on a country level. We draw on information from the OECD Regulation Index and use data from the Frasier Institute (the so called CATO-Indices) to add variation in the time dimension. Two variables are constructed, reflecting the tightness of regulation of the labour market and the product market respectively. The variables are indexed between 0 and 6, i.e. the higher the number the more regulated is a market.

3.1.3 Other Location Factors

Population

The population in the region is available according to gender and age groups (0-14, 15-64, 65+), measured in 1000 persons. Data is available for the complete observation period and growth rates of population could be used as well. Furthermore the population density in 1000 persons per square kilometre was calculated.

Spill-Over Effect

To measure the spill-over effects between regions we constructed a variable reflecting the average GDP per capita in thousand USD in all neighbouring regions. In addition we used different weights to take into account of the different average distances to the neighbouring region. Apart from the level we also used the growth of GDP per capita.

Path Dependency

Although it is not a location factor in the narrow sense, former development might be an important explanation factor for growth of the region. We constructed a variety of variables to catch possible path dependency effects. These include GDP per capita at different points in time, growth rates of GDP and GDP per capita, the Regional Effect in periods before the periods used for the estimation, and the lagged left hand variable.

3.1.4 Econometric Method

We made use of the panel structure of the data. But the data limitations did not allow us to use complex methods. We pooled the data across time and regions and assumed a linear relationship. To take

[6] In these cases we assume that the relation between the regions given by the one observation is constant for complete estimation period. This has to be kept in mind when interpreting the results. For a discussion of these issues and more information on the availability of the data see Technical Report.

unobserved heterogeneity between the regions into account we used the generalised least square method to get valid estimations of the variance. A wide rage of sensitivity checks were used, including variations in the econometric methods applied, different specifications for the left hand variable, alternative selections of explanatory variables and functional forms, and last but not least variations in time and region coverage. The results presented below are taken from the central specification only, but the sensitivity checks did not yield any results which would lead to substantially different conclusions. Vice versa, only conclusions supported by the other specifications are reported.

It's important to note that some restrictions on the interpretation of the results apply. Although the underlying questions have a causal notion, the answers provided here have not. The available data did not allow using any test on causality, and economic theory often supplies arguments for a causal relation in both directions. As more time variation will become available in project phase II, testing for causality of the relations found will be one of the most important steps forward. Until these results are available, some caution in the interpretation of the results is necessary.

3.2 Empirical Results

3.2.1 Regional Effect including National Effect

As explained above, we use the available data on location factors to explain the Regional Effect resulting from the Shift-Share analysis. In the first estimation we are able to explain nearly half of the annual variation 1996 to 2002 of the Regional Effect including the national differences (basic Shift-Share Analysis). This is achieved by a mix of location factors determined by policy decisions and factors which are not, like regional growth in the time preceding the estimation period. Table 3-1 presents the estimation results.

Table 3-1 Estimation Results (incl. National Effect)

Dependent Variable:	**Regional Effect from Shift-Share Analysis** Including National Effect (Basic Shift-Share Analysis)			
Variable	**Coefficient**	**Standard Error**	**t-statistics**	**t-statistics probability**
Constant	-0.0521	0.0092	-5.6922	0.0000
Innovation (Share of population with tertiary education)	0.0633	0.0117	5.4260	0.0000
Taxation (Manpower)	-0.0747	0.0203	-3.6903	0.0003
Taxation (Companies)	0.1007	0.0215	4.6920	0.0000
Accessibility (Interregional)	-0.0001	$3.75 \cdot 10^{-5}$	-1.9976	0.0464
Population Density	$-7.47 \cdot 10^{-6}$	$0.80 \cdot 10^{-6}$	-9.3158	0.0000
Spill-Over Effect, Growth Rate	0.1253	0.0274	4.5760	0.0000
Sectoral Share, New Economy Sector, 1996	0.0935	0.0272	3.4382	0.0006
Sectoral Share, High Value Added Old Economy Sector, 1996	0.0500	0.0176	2.8372	0.0048
Sectoral Share, Investment Goods Sector, 1996	0.0005	0.0001	4.6993	0.0000
Sectoral Share, Personal Services Sector Sector, 1996	0.0014	0.0002	6.2555	0.0000
GDP per capita, 1996	0.0004	0.0002	2.9728	0.0031
Regional Effect 1990-1996	0.0654	0.0123	5.2964	0.0000
Regional Effect (-1)	-0.0914	0.0404	-2.2616	0.0242
Adjusted R-squared	46.11%			
S.E. of regression	0.0135			
F-statistic	30.42	probability	0.0000	
Durbin-Watson Statistics	2.2838			
Total Panel Observations	448			
Estimation Period	1996-2002			

Note: *Estimated with E-Views.*
Source: *BAK Basel Economics*

The coefficients for all variables are significantly different from zero.[7] All other available explanatory variables did not improve the estimation and/or yielded insignificant results. We will discuss the results and the conclusions for individual location factors in more detail below, including the results from different estimations. Therefore, we summarize the results only briefly.

From the variables on regional innovation capacity only the share of the labour force with tertiary education shows a significant impact on growth. As expected it is a strong positive relationship. Taxation plays an important role in explaining the growth differentials. For taxation on highly qualified labour we find the expected negative coefficient, reflecting the fact that lower taxes go along with higher regional growth rates. For the tax burden on companies, we surprisingly find a positive coefficient. As discussed below, we believe this to be the effect of limited data variation and the true effect to be insignificant, as other specifications show. Interregional accessibility, too, does not show the expected coefficient. It is just significant, and in other specifications becomes insignificant. Again, we believe that data problems exist and that the coefficient actually catches the effects of unobserved characteristics related to geography. From the list of variables reflecting politically controlled location factors, we miss the regulation indicators. Neither labour market regulation nor product market regulation showed significant results in the basic specification. Again, the data available was limited. Still, we do find very interesting results for regulation, as will be shown below.

The remaining explanatory variables are related to political influences less directly. The spill-over effect shows that regions benefit from strong growth in neighbouring regions. There are also industry spill-over effects, as the coefficients on the shares of certain industries at the beginning of the estimation period show. As the direct growth effects of different industry concentration are taken into account by the Structural Effect, a positive coefficient means that either these industries when very concentrated in a region grow faster than the European average or that these industries have a positive spill-over effect on other industries in the region and thereby promote growth. For the population density we find a negative coefficient. Population density is an indicator for the structure of the region, and the result does not support the notion of the renewed attractiveness of cities, often heard in the discussion in recent years. However the variable is far from perfect to test this hypothesis, as the regional borders are defined for administrative reasons and not according to economic function. Furthermore, the result is driven by a few outliers. The final three variables reflect the path dependence of region-specific growth. The positive coefficient on the level of GDP per capita at the beginning of the estimation period contradicts the convergence theory. The other two variables catch the influence of earlier growth development on current growth, probably reflecting influences of unobserved variables as well.

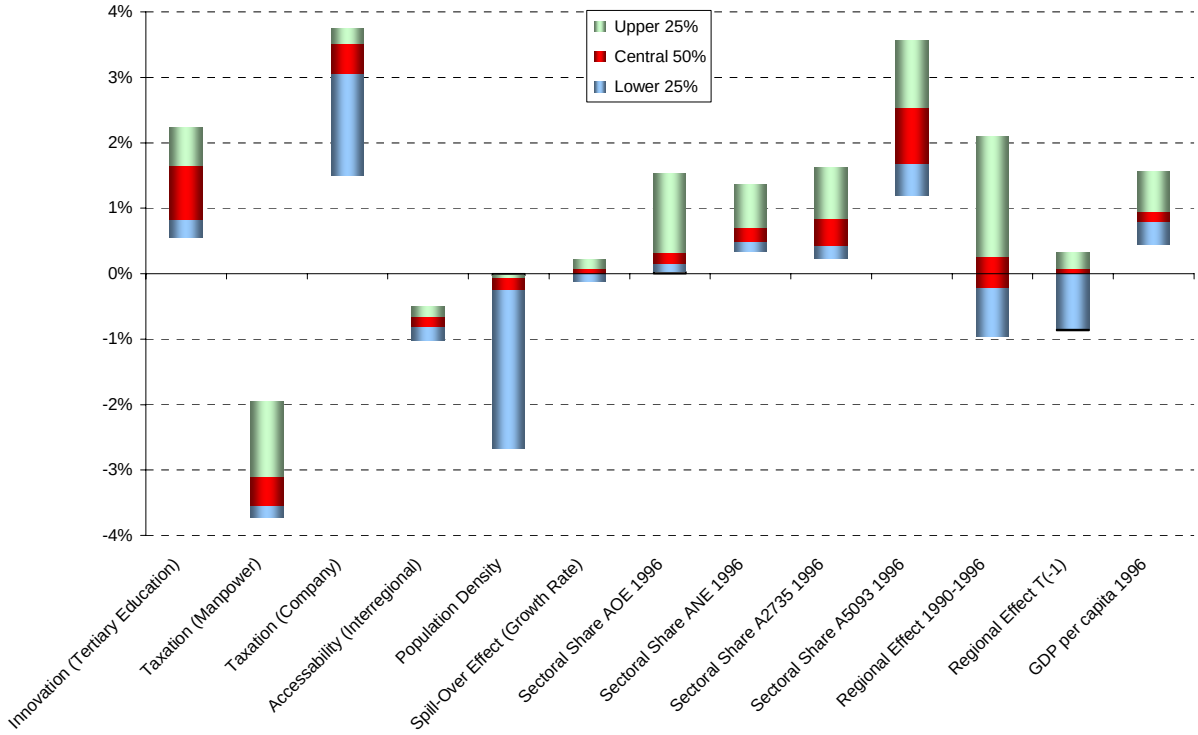
The variables used in the specification are necessary to achieve such a good explanatory power and satisfactory test statistics, and all coefficients have a significant influence on the Regional Effect. But the coefficients presented in Table 3-1 alone do not allow a judgement regarding the impact of a location factor on regional growth. Neither their size alone nor their significance defines the growth contribution of the corresponding location factor. In order to assess the growth contribution of a single location factor we need additional information on the size and variation of the location factors in the sample. Figure 3-1 provides the respective growth contributions. The figure presents the “annual growth contribution” of the location factors using the distribution of the location factors in the sample and the point estimations.[8] The interpretation is as follows: The growth contribution to regional growth of the share of the labour force with tertiary education in the region with the lowest share is annually 1.7 percentage points lower than the growth contribution in the region with the highest share of tertiary educated labour in the sample. For the regions which lie in the 25%-75% quartile with respect to the share of the labour force with tertiary education the growth contribution of this variable is between 0.8 and 1.7 percentage points.

[7] If not mentioned otherwise all statistical test use the 5% significance level.

[8] Notice that this is not a confidence interval.

It is interesting to observe that, although the variables which cannot be politically determined are important for the specification quality, they add comparatively small amounts to the explanation of regional growth. The largest contributions to the explanation are from the share of the labour force with tertiary education, the taxation variables and some of the industry shares. Hardly anything is added to the explanation by earlier growth, the spill-over effect and the population density (with exception of the outliers). Summarising, although on the first glance the estimation results seem to support the assumption that influence of policy decisions on regional growth are very limited, the more detailed analysis shows that this influence can be significant. Furthermore, the influence of policy on regional growth is still underestimated. On the one hand only a limited number of different variables were available. On the other hand, in the long run policy decisions also influence variables not directly determined by politics (such as industrial structure).

Figure 3-1 Location Factors in Regions and Regional Effect (incl. National Effect)



Note: *The Figure presents the effects the estimated coefficients together with the explanatory variables would have on annual growth observed in the regions in the sample. The lower 25% denote the quarter of regions with the lowest growth resulting from this explanatory variable, the upper 25% the regions with highest growth. The remaining regions are in the central 50%.*
Example: The 25% of the regions with the highest share of tertiary educated labour gain an annual growth of 1.7 to 2.2% out of this fact. But even the worst off regions gains 0.6% annual growth out of the share of tertiary educated labour. Half of the regions gain between 0.8 and 1.7%.
Annual growth rates 1996-2002.

Source: *BAK Basel Economics / IBC database*

3.2.2 Regional Effect excluding National Effect

The second estimation presented here uses another version of the Regional Effect. National differences are caught in a separate effect, and the remaining Regional Effect to be explained reflects the derivations from national developments only. Accordingly, most explanatory variables have to be adapted as well. Most of them will also be defined as the derivation from the national average.

In general, the results lead to the same conclusions as those from the estimations based on the Regional Effect of the basic Shift-Share analysis. The differences found are due to two effects. The first issue is more technical. Some of the data problems mentioned above are solved by taking the deriva-

tions from the national average, e.g. the influence of unobserved national characteristics correlated with the observed regional variables as for example expected for accessibility. The second issue relates to the explained effects. Some of the regional location factors also influence national developments, especially as the national level often defines a baseline and the regional differences within a country are much smaller than the differences of regions between countries. As the total differences to be explained and the variation in the explanatory variables decreases, the explanatory contributions of the right hand variables can also change.

If anything, the results for innovation are not only confirmed but strengthened. For taxation we find again a negative coefficient for tax burden on highly qualified labour. For company taxation we can no longer identify a significant coefficient and drop it from the equation. Below we argue that with the use of derivations from national average we now got rid of the data problems related to differences in the national tax systems, and the true influence of company taxation on growth in the setting given here is expected to be zero. For accessibility we can solve some of the data problems as well. Although insignificant, we at least get the expected positive coefficient now. Regulation could not be included as we only have data on country level.

Table 3-2 Estimation Results (excl. National Effect)

Dependent Variable:	**Reginal Effect from Shift-Share Analysis** Excluding National Effect (Shift-Share Analysis SSA E-I)			
Variable	**Coefficient**	**Standard Error**	**t-statistics**	**t-statistics probability**
Constant	-0.0554	0.0105	-5.2886	0.0000
Innovation (Share of population with tertiary education), Difference from national average	0.0905	0.0152	5.9668	0.0000
Taxation (Manpower), Difference from national average	-0.0403	0.0152	-2.6506	0.0083
Accessibility (Interregional), Difference from national average	$2.67 \cdot 10^{-5}$	$2.39 \cdot 10^{-5}$	1.1149	0.2655
Population Density, Difference from national average	$-1.05 \cdot 10^{-5}$	$0.31 \cdot 10^{-5}$	-3.3773	0.0008
Population Density, quadratic, Difference from national average	$1.81 \cdot 10^{-9}$	$79.8 \cdot 10^{-9}$	2.2618	0.0242
Spill-Over Effect, Growth Rate, Difference from national average	0.0665	0.0325	2.0480	0.0412
Sectoral Share, New Economy Sector, 1996	0.1181	0.0287	4.1206	0.0000
Sectoral Share, Sectors with highest growth 1996-2002, 1996	0.0003	0.0001	2.3506	0.0192
Sectoral Share, Sectors with lowest growth 1996-2002, 1996	0.0007	0.0001	5.2116	0.0000
Sectoral Share, Personal Services Sector, 1996	0.0004	0.0002	2.2926	0.0224
GDP per capita	0.0008	0.0002	3.3865	0.0008
GDP per capita, Difference from national average	-0.0170	0.0044	-3.8401	0.0001
GDP per capita, Difference between 1990 and 1980 Difference from national average	0.0316	0.0052	6.0742	0.0000
Regional Effect (-2)	-0.0929	0.0390	-2.3837	0.0176
Regional Effect 1990-1996	0.0507	0.0129	3.9176	0.0001
Adjusted R-squared	29.75%			
S.E. of regression	0.0129			
F-statistic	13.62	probability	0.0000	
Durbin-Watson Statistics	2.3616			
Total Panel Observations	448			
Estimation Period	1996-2002			

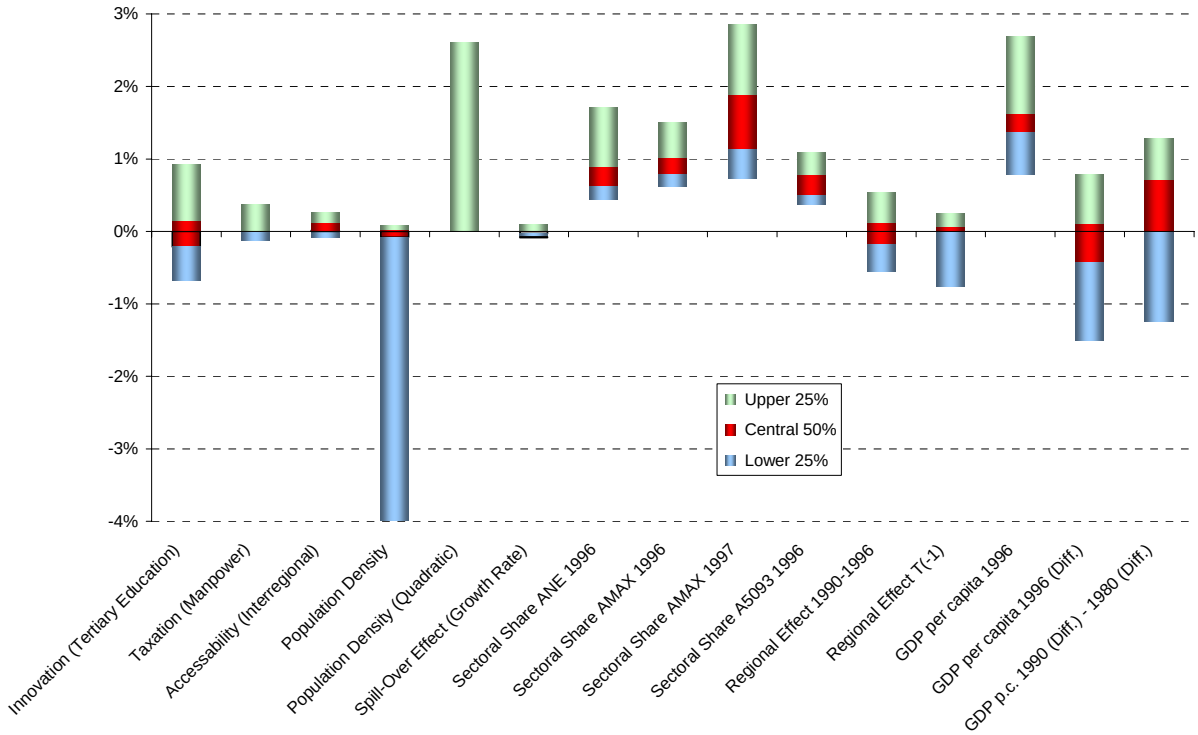
Note: Estimated with E-Views.
Source: BAK Basel Economics

The spill-over effects are confirmed as well. We again find a positive effect of growth in neighbouring regions, and a positive effect of a high share of some industries (even so the pattern is slightly changed when looking for the best specification). The population density again has the negative coef-

ficient, but the significant coefficient for the quadratic term shows that a more complex relationship exists which could not be finally established with the data currently available. The remaining variables again catch the path dependency. They show that history matters.

Figure 3-2 again demonstrates the impact of the estimation results on regional growth given the variation of the explanatory variables in the sample. If we ignore the outliers in the population density variable, we see that the share of manpower with tertiary education is still quite influential on regional growth. This result is all the more important as differences in the national education systems cannot have an effect on the results anymore. For taxation we see less influence which is not surprising: Switzerland is the only country with regionally differing manpower taxation and therefore drives the results. From the remaining variables we see a strong influence of certain sector shares, especially AMAX, the share of the industries growing strongest in Western Europe. The industry spill-over effect is very strong, implying that a high share of fast growing industries in a region is good for the other industries in a region as well.[9] Finally, we can see that path dependency is quite influential once the national effects are taken out. This again comes as no surprise as the growth period on which the estimation is based is comparatively short and a variety of unobserved regional characteristics can influence regional growth before, as well as during, the estimation period.

Figure 3-2 Location Factors in Regions and Regional Effect (excl. National Effect)



Note: *See note in Figure 3-1.*
Variables are measured in derivation to national averages where appropriate (see Table 3-2).
Annual growth rates 1996-2002.
Source: *BAK Basel Economics / IBC database*

After presenting and discussing the two estimations which we consider as central, we will now turn to the individual location factors and their relation to regional growth. The results and conclusions are not alone based on the empirical results presented above but are drawn from a wide variety of estimations, sensitivity tests, and specifications.

[9] Put the other way round, supply shortages (e.g. of labour) seem to be no problem even with a high share of fast growing industries. If the presence of fast growing industries with a high demand for labour leads to labour shortages, other industries could not grow as fast as in absence of such an effect, and we would c.p. find a negative coefficient.

4 Specific Location Factors

4.1 Innovation

In the political discussion innovation is currently the key word in the search for ways to achieve more growth. Although it is agreed that innovation is very important for growth, it is much less clear what innovation abilities really are and what indicators could measure them. Here we empirically tested the influence of two indicators, the share of the workforce with a university degree and the quality of the universities in the region. Theory suggests for both a positive influence on growth, as they improve the innovation possibilities of regional companies and therefore, on average, enable them and consequently the regions to grow faster.

The empirical results show a strong and stable relation between the share of the labour force with university degree and regional growth. In summarising the different estimations we conclude that with a high probability a 10 percentage points higher share of university graduates in the regional labour force goes along with a 0.05 to 0.10 percentage points higher annual growth rate in the region for the sample period 1996 to 2002.[10] As expected from theory, a positive and strong relation between education and growth was empirically proven.

Causality of the relation is an issue. Due to data limitations no tests on the direction of the relation were possible. The process is probably self-enforcing, as strong economic growth attracts highly educated people. But increasing the regional share of highly educated people, either by producing them locally or attracting them from outside the region, is good for regional economic growth. This conclusion is also supported by the positive effects of low taxes on highly qualified employees (see below).

The results for the quality of the regional university are less clear. The available measure, the Shanghai Index, focuses on top scientific quality and in natural science. Theory suggests that there is a positive effect on innovation and therefore growth, but it is probably not constrained to the region the university is located in. The empirical results support these hypotheses. No effects of university quality measured by the Shanghai Index on regional growth differentials could be identified. Theory suggests that for regional growth the quality of the university with respect to the quality of students graduating from the university are much more important. Schools and Universities should be given more incentives (financial and other) that increase performance and reward excellence in education; constructing and testing a respective indicator is part of the plans for project phase II.

4.2 Taxation

Taxation is another important topic when economic growth is discussed. In view of international competition for capital and workplaces, particularly company taxation is thought to be one of the key issues to enhance regional attractiveness. At present especially the new EU member countries follow such a strategy aggressively. With increasing international mobility of highly educated manpower and their growing importance in a knowledge based economy, income taxation becomes a more important issue in international competition. Highly educated persons focus on net available income, while firms competing for such employees have also to bear the internationally different tax and social security burdens. This suggests that lower tax burdens on companies and on highly educated manpower will promote growth, either through more competitive firms or by the attractiveness of the region for new firms.

The empirical results partly support these hypotheses. The level of taxation of highly qualified manpower has the expected negative effect on growth. Furthermore, with a difference of 0.05 to 0.1 per-

[10] The growth contributions of differences in location factors presented here and below are based on the 95% confidence interval of the estimation results, using the overlap between the different main specifications.

centage points higher annual growth rates for 15 percent lower tax burden, a variation observed in the sample, it is rather important. Even excluding Switzerland – an outlier in the case of tax data and a somewhat unusual case in this respect – this conclusion is confirmed, although the confidence interval broadens.

For company taxation the results are less straightforward. We conclude that within the sample of the regions available we can identify neither a positive nor a negative effect of company taxation on regional growth. The positive coefficient found in one case is due to the comparatively low variation especially between regions within one country compared with the variation to and between the Swiss regions. Leaving Swiss regions out of the sample or estimating with derivations from national averages yields no significant results, confirming the hypotheses of data problems.

Summarising, for the sample of regions available here, international competition for capital on the one hand seems to have played its role sufficiently. In the recent period company taxation is not the method to gain a regional growth advantage, at least is not any more. On the other hand, the increasing international competition for highly qualified labour and the increasing focus on the knowledge economy is reflected with a significant advantage for regions with a lower tax burden on highly qualified manpower.

4.3 Accessibility

Accessibility for the workforce of a company to suppliers, customers, or other sources like scientific institutions or even competitors is getting more important. Although in principle well established by theory, it is difficult to evaluate the precise kind of accessibility which is important. Furthermore, due to a lack of data only few empirical tests for this hypothesis were possible on the appropriate regional level apart from case studies. Here we have two indicators of the accessibility of regions available to test the relationship between accessibility and regional growth.

The empirical analysis revealed no significant correlation between accessibility, as measured here, and growth. Even worse, in some specifications, we find a negative coefficient. In general, the results for accessibility are sensitive to the specification. We conclude that the accessibility, as measured, here is highly correlated with other variables, especially with variables related to geography, and partly catches their influence on growth. That view is confirmed in the estimation with national derivations, as no significant influences of the accessibility variables could be found.

Possible explanations for the inconclusive results are data limitations. First the data is only available for the end of the observation period but accessibility is thought to have a long term effect on growth. On the other hand the analysis seems not to suffer from the problem that regional growth might determine accessibility. In such a case we would have found a positive coefficient. Second, the data might not measure the accessibility in a way it really influences growth. A wide variety of ways to define and measure accessibility of a region is possible. We could test only for one of them. Third, the variation of accessibility in the sample is rather low compared to corresponding regional differences in accessibility within Europe- or world-wide. As we plan to extend the sample for the empirical analysis by quite a large variety of regions as the data becomes available, we look forward to find more conclusive results on the influence of accessibility on regional growth in the second phase of the project.

4.4 Regulation

Restrictive regulation is often thought to be one of the reasons for the low growth in Europe. Studies based on country data found such an influence. But regulation could as well differ regionally and explain regional growth differentials. Unfortunately the data available for this study is on country level only. As the regions focus on five countries, the variation of regulation in the sample is low. Although

we are aware of the limitations we include regulation in the empirical analysis because we are interested in interaction terms with other variables.

Given the limitations described above, it is not surprising that in the central specifications we can find no significant influence of the regulation variables. That is the reason why we dropped them from the specification presented here. But further inclusion of interaction terms into the central specification yielded some interesting results. We found some indication that regulation of the product market as well as of the labour market has a negative influence on growth, but a balanced regulation of both markets is better than an unbalanced one, given the overall level of regulation. Furthermore, we find a negative effect of the labour market regulation on growth when we control the interaction of regulation with the share of the labour force with a university degree, which has a positive coefficient. Restrictive labour market regulations are bad when the share of highly educated people is low, as it would be expected when labour market regulations focus on minimum conditions and are less relevant for highly educated manpower.

Although the validity of the results regarding regulation is limited due to the data, interesting conclusions can be drawn. Regulation in one market can not be compensated by deregulating the other market. And the costs of regulation differ depending on regional characteristics, as industry specific estimations revealed (see 4.6 below). In the second part of the project we want to verify these conclusions as a larger set of countries can be included adding variation to the regulation data as well as an update of the data will be available.

4.5 Spill-Over Effects

An important driver of economic growth on national level is the development of international trade. For regions we expect that the growth depends even more on the development of other regions. By the research design we control for the world trade development and other factors influencing growth on a global level. But such spill-over effects depend at least partly on geographic distance as well. We expect that the economic performance of neighbouring regions influence one another. Such effects can, for example, work through local demand for intermediate products or income effects of commuters. Another reason for such a relationship is spill-over effects of specific location factors to neighbouring regions, e.g. an airport.

As expected the empirical analysis shows a positive relation between the growth of neighbouring regions. Although this relation is stable and adds substantially to the overall explanatory power of the estimations, the effect on regional growth of the average growth of GDP per capita of neighbouring regions is comparatively small. A two percentage points higher annual growth rate in neighbouring regions (a variation observed in the sample) leads to a 0.01 to 0.03 percentage points higher annual growth rate in the region; a fairly small increase.

Although fairly small and not to be influenced by regional policy makers, the spill-over effect is interesting for further research. Especially discriminating between the two possible explanations for spill-over effects would be interesting, as spill-over effects of regional location factors could have important policy implications like co-financing investments. Such questions can be answered with the more complex measures of spill-over effects. The construction of such data is planned for project phase II.

4.6 Industry-Specific Influences of Location Factors

It is important for regional decision-makers to know the influence of location factors on total regional growth in general. But it is just as much of interest to know whether for certain industries the set of location factors necessary for strong growth deviate from the set for the general economy. If a region is already focussed on a certain industry, such results would help to improve their decision making. Possibly, it allows one to recognise and quantify the trade-off faced by the region regarding the focus

of their policy towards the general economy or the special sector. Furthermore, theory as well as various company surveys reveals such differences.

And we do find such differences between industries, although due to the capacity limitations the approach used in project phase I was very basic. This line of research will be improved and extended in the project phase II. In general, the results of the industry specific estimations do not contradict the conclusions for the whole economy, but the coefficients vary in size and significance.

For ’structurally strong old economy‘ sectors like the Chemical Industry or Investment Goods Producers, high taxation has a stronger negative impact on growth than for the average economy. Furthermore, these industries are especially dependent on highly qualified manpower. Finally, there is also some indication that regulation, especially product market regulation, is more important for these industries than for the economy on average.

For typical ’New Economy‘ sectors such as telecommunication or IT-services we find a somewhat different picture. Neither taxation nor regulation seems to play an important role for growth. Especially for the latter one this is probably due to the ’average‘ measurement of regulation, which by construction has to ignore very special regulations which are of potentially high importance for such industries. In phase II of the project we plan to tackle such issues by including industry specific regulations indices. Returning to the ’New Economy‘ sectors, we find there is a strong and above average positive influence of the regional share of highly qualified manpower on the growth of these industries. As they are especially high-tech industries, this is not surprising.

5 Conclusion

This paper showed the main results of phase I of the Regional Growth Factors project, a project within the framework of the «IBC BAK International Benchmark Club»®. The aim of the ongoing research is to analyse regional growth and the location factors which influence it. More precisely, econometric methods are used to identify the quality and quantity of the impact location factors have on regional growth. National and regional decision makers can use the information provided in combination with other benchmark tools to improve policy strategies.

In the analysis we use a two-step approach. In the first step we apply the Shift-Share Analysis to regional growth, a method to separate regional growth into its components global development, industry structure and region-specific characteristics. The Shift-Share Analysis demonstrates that the economic growth of a region has an important regional growth component which is potentially open to regional policies. The second step concentrates on the econometric analysis of regional growth factors. A variety of location factors are used to explain the region-specific growth performance calculated by the Shift-Share Analysis. The location factors available are from the areas innovation (education of workforce, university quality), taxation (companies, highly qualified manpower), accessibility (intercontinental, interregional), regulation (product market, labour market), spill-over effects from neighbouring regions or other industries, and variables reflecting the economic history of a region (e.g. GDP per capita, growth in earlier periods).

The main conclusions of phase I of the Regional Growth Factors project are:

- Industry structure has an impact on regional growth, but it is comparatively small. The economic growth of a region has an important regional growth component which is potentially open to regional policies. Although the available data is limited, the estimation results are of sufficient quality and show that a substantial part of the region-specific growth differences can be related to region-specific location factors.
- A positive and strong relationship between the education of the labour force and growth exists, as was expected from theory. The empirical results show that a 10 percentage points higher share of university graduates in the regional labour force goes along with a 0.05 to 0.10 percentage points higher annual growth rate in a region.
- We find that the tax burden has a negative influence on regional growth. For the taxation of highly qualified manpower the results suggest a 0.05 to 0.1 percentage points higher annual growth rate for a 15 percentage points lower tax burden. For company taxation, we can not identify a significant influence on regional growth within the sample. Company taxation could have reached very low levels everywhere in the sample due to strong international competition, which could explain its insignificant impact. The results do not necessarily mean that lowering company taxation is not a regional advantage, but at least for the regions in the sample income, taxation of highly qualified manpower is a more important issue.
- For regulation in general, we can not identify a significant impact on regional growth. As the data is limited to the national level and five countries only, this is not surprising. Despite the data limitations, we find some indication that high regulation is bad, and given the overall level of regulation,, an unbalanced degree of regulation on the product and the labour market is worse than balanced regulation. Furthermore, the cost of regulation seems to differ depending on regional characteristics such as industry focus of the region. Further research on the impact of regulation on growth at the regional level will be necessary to confirm these findings.
- Apart from the “political” location factors we find influence of other regional characteristics as well. There is a positive influence from the development of neighbouring regions, and the regional growth also depends on former growth experience in the region – “history matters”. Furthermore,

the results indicate that not only the individual location factors are important for growth, but that certain combinations of these factors have an additional impact on growth. Finally, there is also an indication that different industries react differently to certain location factors. For example the innovation variable has a stronger impact on growth in the “new economy” sector and in other innovation intensive industries like the chemical industry than for the average of all industries.

For phase II of the project Regional Growth Factors (July 2004 to May 2005) a variety of extensions are planned. Most of these relate to the IBC database and should help to overcome the data limitations. Relying on the extended data we will also use further estimation techniques and tackle more issues than in phase I of the project. Phase II will finally enable us to develop data-based growth scenarios for national and regional policy makers.

- The first extension concerns geographical coverage, and is partly already under way. New regions as well as new countries will be included in the IBC database: Norway, Finland, Denmark, Sweden, Poland, the Czech Republic, Slovakia, Hungary and Slovenia and some regions in the UK and US. Moreover, an effort will be made to include location factors for as many regions as possible. The size of and the variation within the sample of regions available for the analysis will increase substantially and lead to more reliable results in the empirical analysis.
- Within phase II we will include additional location factors as they become available, especially for the topics innovation and regulation.
- With regard to the econometric analysis, the most important extension will be in the time dimension. We will extend the data on location factors backwards in time. This allows the use of a much wider variety of econometric methods, especially tests for causality.
- Relying on the extensions of the database described above, we will be able to use more sophisticated estimation techniques. One important step is the inclusion of the deterministic Shift-Share Analysis into the econometric estimations. The most important step relates to the causality issue. Utilizing the extended database, especially a better time coverage for the location factors, and applying more sophisticated estimation techniques will enable causal conclusions.
- Finally, the extended data set will allow us to estimate the impact of more differentiated and other, additional location factors on regional growth. Furthermore, more conclusions for the interaction of different location factors, on industry specific implications of location factors, and on region-specific reactions will be possible.

Project Phase II will enable BAK to provide crucial information on policy-relevant growth factors. The extension of the dataset as well as new estimation techniques make it possible to estimate growth scenarios under different policy settings, making such econometric analysis much more valuable to policy makers. We hope that with the extensions described above we will be able to contribute further to the debate on regional growth factors and help to improve future decision-making on the regional level.