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MEASURING CHANGES IN REGIONAL COMPETITIVENESS OVER TIME

A SHIFT-SHARE REGRESSION EXERCISE

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Abstract:

Regional development in Austria has long been characterized by an east-south-west divide with eastern and southern states trailing western states in terms of value added and employment growth. In the 1990's, however, growth in value added was higher in the south and east and in terms of employment western states were outperformed by southern states. Applying an extended version of a regression shift-share approach proposed by Toulemonde (2001) these regional growth differentials are explained by decomposing annual value added and employment growth into regional, sectoral and temporal components; subsequently region-idiosyncratic and structural growth determinants can be distinguished. The results show that regional growth differences are accompanied by similar differences in the level of regional competitiveness. They also point to the fact that regions suffering from structural disadvantages often perform better than regions characterized by structural advantages which may be interpreted as a catching up process.

Keywords: Shift-Share, regional development, employment, value added

JEL Classification: R11, O18, C33

Measuring Changes in Regional Competitiveness over Time
A Shift-Share Regression Exercise

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Any mistakes remain our sole responsibility.

1 Introduction

Regional development in Austria has long been characterized by an east-south-west divide: Eastern and also southern states border the former communist countries of Eastern and Southeastern Europe and thus, until the end of the 1980's, suffered from the political, social and economic barrier established by the iron curtain. Their location at the periphery of Western Europe gave these regions a comparative disadvantage particularly in terms of foreign market access. Consequently, the manufacturing sector in the east mainly served private or public domestic demand. In addition to structural factors (e.g. a large share of nationalized heavy industries in the south) this explains why eastern and southern states experienced slower economic growth than the westerly regions of Austria, which had better access to the large markets of the European economic core areas (Germany, France, etc.).

Between 1976 and 1990 average employment growth in the east and the south[4] of Austria was on average 0.7 percentage points lower than in the west (see Diagram 1).[5] In terms of real value added the growth gap was somewhat smaller, the east trailing the west by 0.4 percentage points, while employment growth in the south was 0.6 percentage points lower than in the west (see Diagram 2).

In the 1990's external economic conditions in Austria changed considerably: the countries in Eastern Europe opened their borders for trade and began their transition from centrally planned to market oriented economies. Thus new market opportunities emerged and the eastern and southern states moved from the periphery to the center of Europe. At the same time Austria's integration into the European Union began with the country formally entering the EU in 1995. Hence domestic markets in Austria were more accessible to foreign companies without requiring them to locate in the country, thus weakening the domestic demand-oriented manufacturing base in Austria's east.

The empirical evidence shows (see Diagrams 1 and 2) that after 1990, eastern and southern states were catching up in terms of value added growth and performing even slightly better than western states. Employment growth, however, was still lower in the east while the southern states took the lead, leaving western states behind by about 0.2 percentage points on average.

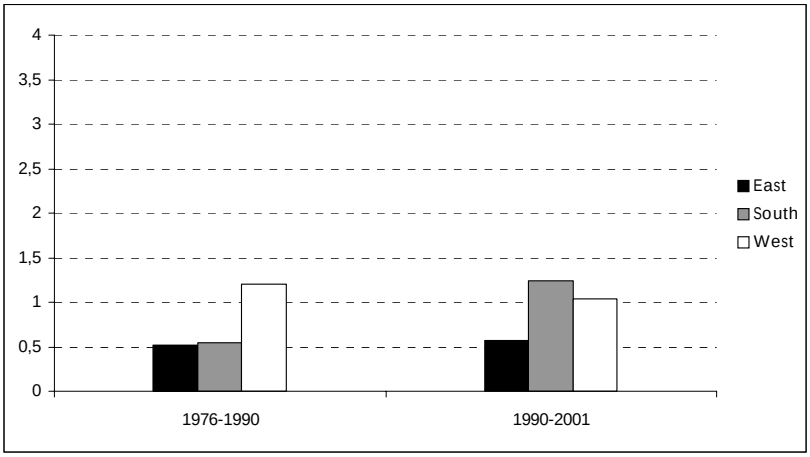
Analyzing the growth performance by regions conceals considerable intraregional differences in growth. This applies foremost to the eastern region, where employment and value added growth rates for Lower Austria and Burgenland have been above or close to the national rates, while Vienna has grown much slower than almost all other Austrian states both in the period before and after 1990 and both with respect to employment and value added.[6] The growth gap for the Vienna region not only concerns the manufacturing sector, where companies as they grow tend to locate outside metropolitan regions, but also the service sector. However, some companies leaving Vienna probably moved to the surrounding areas of Lower Austria which justifies focusing the analysis on regions rather than states. Interstate differences have been less pronounced in the south and west (Diagrams 3 and 4; see also Tables A2-A5 in the Appendix).

[4] The Austrian states are aggregated as follows: Vienna, Lower Austria and Burgenland make up the east, Styria and Carinthia the South, Upper Austria, Salzburg, Tyrol and Vorarlberg the west of Austria.

[5] We are much indebted to Raimund Kurzmann for his enormous efforts devoted to generating the regional time series used here.

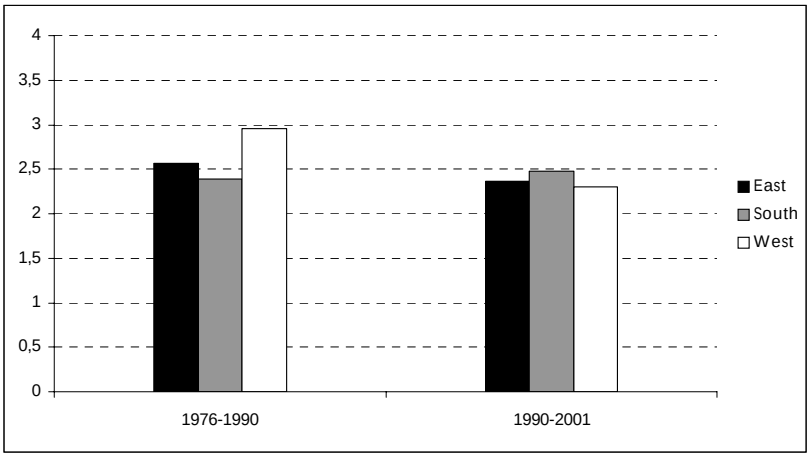
[6] In fact, growth rates for Vienna were the lowest of all states except for real value added in the period between 1976 and 1990 when Styria grew slightly below the Viennese rate.

Diagram 1: Annual average growth rates of dependent employment by regions in %



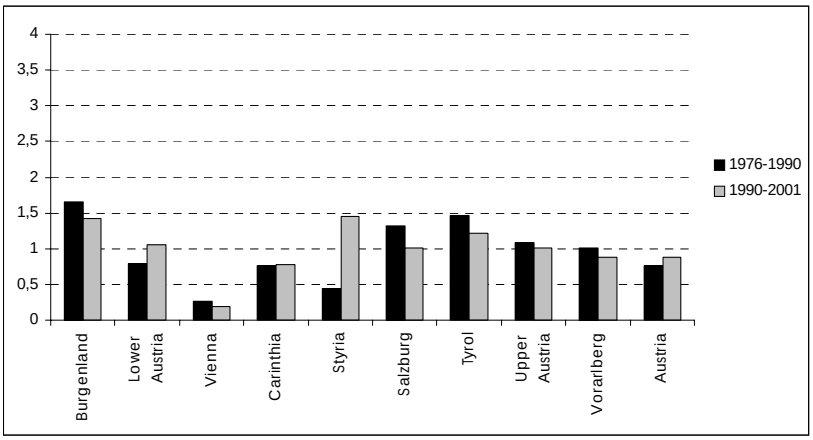
Source: Statistics Austria, own calculations.

Diagram 2: Annual average growth rates of real value added by regions in %



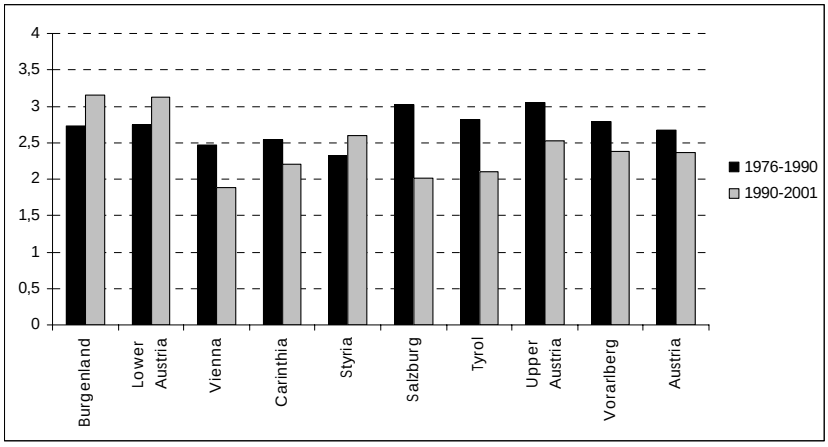
Source: Statistics Austria, own calculations.

Diagram 3: Annual average growth rates of dependent employment added by states in %



Source: Statistics Austria, own calculations.

Diagram 4: Annual average growth rates of real value added by states in % [7]



Source: Statistics Austria, own calculations.

When comparing the aggregate economic development of countries or regions over time one question that often arises is to what extent observed differences in growth can be explained by nation- or region-idiosyncratic effects and to what extent by differences in sectoral composition. With respect to regional development in Austria, we want to explore if the observed growth advantages of western states are mainly due to favorable structural preconditions, i.e. above average shares of dynamic industries, or rather caused by locational factors that firms in various sectors benefit from, in this case the access to large and dynamic markets.

Likewise, are the lagging states in the east of Austria haunted by a disadvantageous industrial structure or an insufficient endowment of growth drivers, in particular poor market access? If the latter holds, can we observe any improvements in competitiveness in the 1990's after the transformation process of East European economies started as well as the integration of the Austrian economy into the European Union advanced?

To separate the structural growth determinants from those related to the competitiveness of a country or region traditional shift-share analysis has been used extensively. However, despite numerous extensions of the basic shift-share equation it is still widely criticized in particular for failing to arrive at a clear-cut separation of these two factors of growth. In attempting to cope with this problem, research efforts have been devoted to estimating the shift-share equation econometrically.

In an attempt to contribute to the exploration of the unemployment issue in Europe, Marimon and Zilibotti (1998), building on work by Stockman (1988) and Costello (1993), develop and apply a shift-share regression model to study employment and labor cost growth in European countries during the 1970's and 1980's. In this model growth rates are decomposed into country, temporal and sectoral effects. Furthermore, virtual economies are constructed by filtering out the country-specific effects; the comparison between actual and virtual time series provides an indication of how the country performed independent of the initial sectoral structure of its economy. Marimon and Zilibotti's model is applied in a regional context by Toulemond (2001), who analyzes the determinants of employment growth of Belgian provinces between 1974 and 1992.

The focus in this paper lies on analyzing the factors behind regional economic development in Austria; the main spatial unit of analysis are the Austrian states, which are then aggregated to the three regions mentioned

[7] see the Appendix for summary information on the 9 Austrian regions

earlier. We apply Marimon and Zilibotti's shift-share regression model, decomposing annual value added and employment growth as indicators for regional competitiveness into regional, sectoral and temporal components for the period between 1976 and 2001; subsequently, differences between the regions and states with respect to these variables are analyzed by constructing virtual regional economies.

From the analysis different types of regional industries can be identified:

- Dynamic industries where an increase in output and perhaps market share also requires more labor.
- Industries where a high degree of competitiveness is associated with additional output but less employment.
- Industries that lose both in value added and employment due to low competitiveness.

Aggregating over all industries, regions and states can then be categorized accordingly. In addition to the calculation of a competitive component of regional growth, the influence of changes in the sectoral composition of the regional economies on their growth performance is also analyzed.

The following section of the paper describes the shift-share regression model and the calculation of virtual time series needed to measure competitive and structural growth components. After providing information on the data base applied – which is always a crucial issue at the regional level – the results of the empirical analysis are presented. Finally we draw some conclusions and point at further research needs.

2 A shift-share regression model

Shift-share analysis is a traditional, well known and often applied method to decompose growth rates into a structural and a competitive component. The method was applied to empirical analysis as early as in the 1960s and underwent numerous extensions and improvements in the 1970s (see Richardson, 1978, for an overview of various shift-share approaches and extensions).

The original shift-share equation is an identity which decomposes a sectoral growth rate, e.g. of employment, into three components: a growth effect with respect to a reference area, which in regional applications is commonly the national economy ("national share"); a structural effect ("proportional shift") and a factor of competitiveness ("differential shift"). The national share shows how the sector would have evolved if it had grown exactly at the aggregate national growth rate, while the proportional shift results from the deviation of the sectoral from the aggregate growth rate at the national level. The differential shift finally measures the difference between sectoral growth at the regional and at the national level which indicates the relative competitive advantage or disadvantage of the regional sector at hand. Summing over all sectors present in the region provides the equivalent decomposition of the regional economy's aggregate growth rate.

Applying the simple shift-share equation is associated with various problems concerning the method itself and its (weak) theoretical foundations. One of the main points of criticism concerns the interdependence of proportional and differential shifts. For instance, applying the simple shift-share equation to compare the competitiveness of a regional industry with the same industry in another region, where both industries are growing at the same rate but have different levels of employment, will result in different differential shift components. Hence the competitiveness of a region cannot be measured independent of its given sectoral structure.

Consequently numerous adoptions and extensions of the basic method have been proposed in the literature. One alternative approach, first discussed in the late 1970's but implemented only years later, is the so called dynamic regression shift-share analysis (Berzeg 1978, Stockman 1988, Patterson 1991, Costello 1993, Marimon - Zilibotti 1998, Möller 2000). Here the shift-share identity is transferred into a stochastic, linear equation which can be estimated using standard econometric methods. The independence of the components is ensured by imposing several restrictions on the independent variables of the regression equation. The sectoral composition of the regional economy thus has no influence on the measurement of regional competitiveness.

This shift-share regression model used in our empirical analysis of regional development in Austria is taken from Marimon and Zilibotti (1998). The model decomposes regional sectoral growth, the dependent variable in the regression equation into sectoral, temporal and regional components, which appear as (partly interactive) dummy variables. It can be written as follows:

$$e(i,n,t) = \beta_{h(i)}h(i) + \beta_{m(i,n)}m(i,n) + \beta_{b(t)}b(t) + \beta_{f(i,t)}f(i,t) + \beta_{g(n,t)}g(n,t) + u(i,n,t) \quad (1)$$

$$i = 1,...,I; n = 1,...,N; t = 1,...,T;$$

Here,

- *e(i,n,t)* is the growth rate of employment or any other indicator of economic activity (e.g. value added, productivity) of industry *i* in region *n* at time *t*;
- *h(i)* is a time invariant trend component of industry *i* shared by all provinces; positive coefficients of *h(i)* indicate sectoral growth rates above, negative coefficients below the aggregate national trend;
- *m(i,n)* is a time invariant effect specific to industry *i* and region *n*;
- *b(t)* is an indicator for national cyclical movements in growth, i.e. cyclical effects which are not specific to a sector or a region;
- *f(i,t)* records sector-specific cyclical effects without any regional differentiation;
- *g(n,t)* is a component of cyclical movements specific to a certain region and observed across all sectors;
- *u(i,n,t)* is the disturbance term.

The model presented above suffers from perfect multicollinearity between the regressors and can therefore not be estimated in a straightforward manner. A common solution to this problem is to define some regressors as numeraires; here we could impose zero restrictions on the coefficients of a time period, a region or an industry. Marimon and Zilibotti (1998) propose a different strategy and define a set of restrictions on the coefficients of the independent variables. These restrictions are selected such that all different effects are orthogonal to each other and thus independent. Anyhow, they remain arbitrary to a certain degree and are therefore open to criticism. The restrictions are listed below:[8]

Restrictions R1: $$\sum_{n=1}^{N} \beta_{m(i,n)} = 0, i = 1,...,I \quad (2)$$

Restrictions R2: $$\sum_{i=1}^{I} \beta_{f(i,t)} = 0, t = 1,...,T \quad (3)$$

Restrictions R3: $$\sum_{t=1}^{T} \beta_{f(i,t)} = 0, i = 1,...,I \quad (4)$$

Restrictions R4: $$\sum_{t=1}^{T} \beta_{g(n,t)} = 0, n = 1,...,N \quad (5)$$

Restrictions R5: $$\sum_{n=1}^{N} \beta_{g(n,t)} = 0, t = 1,...,T \quad (6)$$

Restrictions R6: $$\sum_{t=1}^{T} \beta_{b(t)} = 0 \quad (7)$$

[8] There are 2T+2I+N+1 restrictions of which two are not independent. As Marimon und Zilibotti (1998) demonstrate 2T+2I+N-1 restrictions are required to exactly identify the model

These restrictions are to be interpreted as follows:

R1: Coefficients $ß_{m(i,n)}$ measure the deviation in regional growth of industry *i* from the national (i.e. average) growth path of the same industry;

R2: Temporary industry-specific deviations from the trend in industry *i* at time *t* average out over all industries.

R3: For each industry *i*, these deviations are also assumed to average to zero over time.

R4: Deviations of the regional from the national business cycle average to zero over time.

R5: For each region *n*, regional cyclical deviations cancel out over time as well.

R6: National cyclical movements are defined as temporal deviations from the national growth trend.

The system of equations can be estimated using standard ordinary least squares. However, Möller (2000), estimating a similar shift-share regression model for Germany, discusses a potential estimation problem known in the literature as "shipbuilding-in-the-midlands": Small absolute changes in insignificant regional industries may correspond to high relative changes; this introduces heteroscedasticity into the model. This problem is very relevant in our case since growth rates in some industries of very small states (Burgenland, Carinthia, Vorarlberg) do show high levels of variation. Consequently, as suggested by Möller (2000), weighted OLS is applied. The weights are equal to the shares of regional industries in total national value added (employment) at the starting year.

The estimation results can be used to calculate a hypothetical time series of the selected indicator for regional economic activity. The hypothetical or "virtual" growth rate e_{virt} for each industry *i* over the period $t=1,...,T$ can be written as:

$$e_{virt}(i,t) = \beta_{h(i)} + \beta_{b_{(t)}} + \beta_{f_{(i,t)}} \tag{8}$$

These growth rates are calculated using the estimates of the coefficients of those dummy variables that are not region-specific; therefore they are equal over all regions. Based on these growth rates hypothetical absolute indicator values for each region and each regional sector can be estimated:

$$E_{virt}(i,n,t) = e_{virt}(i,t) \cdot E_{virt}(i,n,t-1) \tag{9}$$

The generation of the hypothetical indicator time series is based on the actual indicator values for $t = 0$. In our case growth rates for the period between 1977 and 2001 are included in the regression, thus the actual 1976 value of the indicator is used to calculate its hypothetical value for 1977; the 1978 value is then based on the hypothetical value of the previous year.

Summing over all sectoral hypothetical values provides the hypothetical indicator for the region as a whole. This time series reflects the regional development to be expected if all regional factors (deviation of the regional from the national development of a sector, region-specific business cycles) had been excluded.

Comparing the hypothetical development of a sector or the whole region with the actual development allows assessing the positive or negative influence of the region-specific factors. For this purpose the indicators *W(i,n,t)* and *W(n,t)*are calculated as ratio of the actual and the hypothetical value of the indicator for every time period t.

$$W(i,n,t) = E_{act}(i,n,t) \div E_{virt}(i,n,t)$$
$$W(n,t) = \sum_{i=1}^{I} E_{act}(i,n,t) \div \sum_{i=1}^{I} E_{virt}(i,n,t) \quad (10)$$

Values of *W(i,n,t)* above 1 show that the regional sector developed better than predicted on the basis of national effects: the actual time series lies above the hypothetical one. The same interpretation holds with respect to *W(n,t)>1*: if the level of economic activity in the region in the absence of any idiosyncratic regional effect at time t is below the actual level of regional economic activity, it can be concluded that region-specific factors exerted a positive influence.

Is employment chosen as indicator, for instance, values of *W(i,n,t)* above 1 imply that industry *i* of region *n* was performing better with respect to employment than the same industry at national level. The regional industry either experienced higher employment growth or a below-average reduction in employment.

Toulemonde (2001, p. 515) notes that for the region as a whole, contrary to the traditional shift-share analysis, results are not biased by structural preconditions. If a region a time t = 1 is specialized in fast growing industries, its growth performance will outmatch that of other regions; however, its actual growth path may still lie below its hypothetical, implying that the region, given its favorable sectoral structure should have grown faster than it actually did. It failed to explore its economic potential.

Traditional shift-share analysis not only measures a competitive growth component but also a structural effect. Applications of shift-share regression models, however, have so far focused exclusively on the competitive component. One way to use our model results for measuring a structural growth component is to calculate another time series of a virtual indicator.

Using the "virtual" growth rate e_{virt} a new series $E^{Nat}_{virt}(i,n,t)$ is generated in the same way as described above in equation (9); the starting values for this series, however, are not the actual values of the regional variable in the starting year. Instead, regional value added (employment) totals are multiplied with national industrial shares such that the time series reflects the regional development to be expected excluding all regional factors and given the national industrial mix.

The deviation of $E_{virt}(i,n,t)$ from $E^{Nat}_{virt}(i,n,t)$ shows the growth impact of the regional industrial structure independent of the region's level of competitiveness; for this purpose, the indicator *S* is calculated:

$$S(n,t) = \sum_{i=1}^{I} E^{Nat}_{virt}(i,n,t) \div \sum_{i=1}^{I} E_{virt}(i,n,t) \quad (11)$$

In order to estimate our model we use information on value added and employment from a comprehensive regional data base for the period 1976 to 2001 compiled in the course of the development of an econometric multiregional input-output model for Austria. The database draws on regional and national data collected by Statistics Austria. Since the European System of National Accounts and the NACE classification has been applied by Statistics Austria only for post-1994 data, the data for the years between 1976 and 1994 had to be reclassified. Data for 23 industries are included in the regression; the industries correspond to 2-digit NACE classes or aggregates of 2-digit classes. Agriculture is excluded.

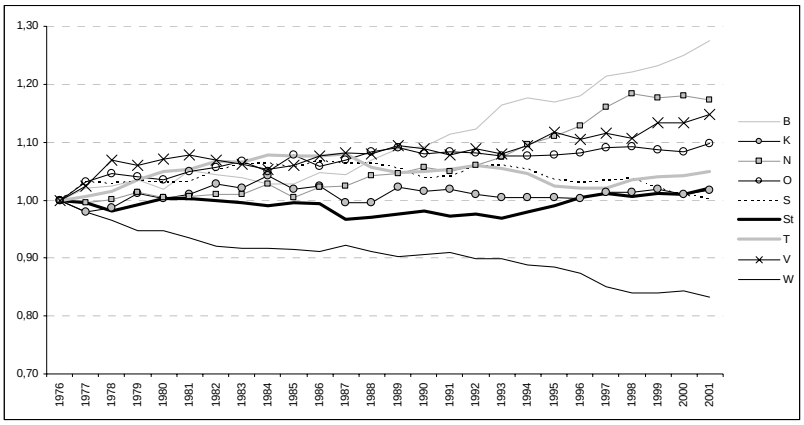
3 Results

The time series of *W(n,t)*, the ratio of actual to virtual values for value added and employment, respectively, show distinct differences between the states (see diagrams 5 and 6 below):

In the east, Vienna has a significant competitive disadvantage, while the other two eastern states, Burgenland and Lower Austria, are among the most competitive in Austria: they are ahead of all other states in terms of value added; in terms of employment, Burgenland is outperforming the other Austrian states, Lower Austria is also above the Austrian national trend. Both states sustain their competitive edge through all the years since 1976; after the late 1980's/early 1990's their indicator values are increasing even faster than before.

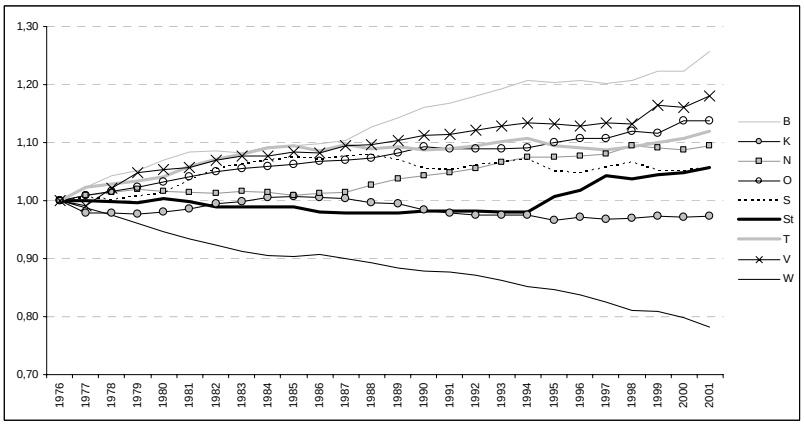
In the south, Carinthia and Styria are both slightly below the Austrian average, but differ with respect to the trend of competitiveness: Styria's economy seems to have made a turnaround in its economic development in the early 1990's: both $W(n,t)^{value\ added}$ and $W(n,t)^{employment}$ are increasing from values below 1 to values above 1; the upward move is larger in terms of employment where the indicator values rise up to 1.05. Carinthia stays close to a value of 1 for $W(n,t)^{value\ added}$, but $W(n,t)^{employment}$ moves further away from the national average in a downward direction.

Diagram 5: Actual to virtual value added by states, 1976 – 2001[9]



Source: own calculations.

Diagram 6: Actual to virtual employment by states, 1976 – 2001[9]

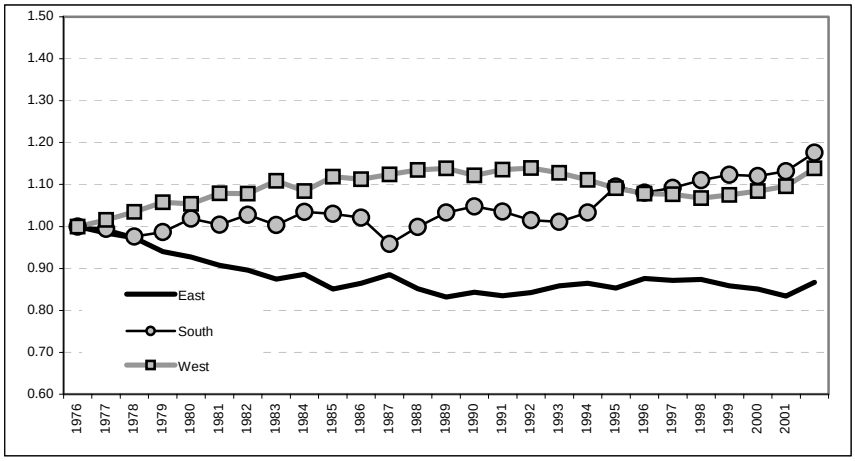


Source: own calculations.

[9] Abbreviations: W=Vienna, T=Tyrol, V=Vorarlberg, B=Burgenland, St=Styria, S=Salzburg, K=Carinthia, N=Lower Austria, O=Upper Austria.

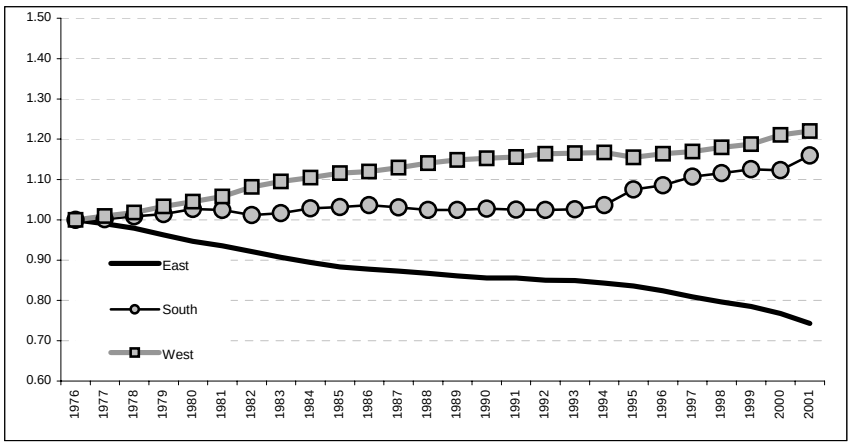
The results confirm that the superior economic development of the western states in Austria is rooted in competitive advantages: all western states are above the national average with Vorarlberg and Upper Austria being ahead of the others. Tyrol and Salzburg seem to have lost ground somewhat starting in the late 1980's. The largest difference in the degree of competitiveness between the three regions is observed for manufacturing (see Diagrams 7 and 8): due to Vienna's sustained decline of the manufacturing sector, the east is far behind the other two regions, even though Burgenland and Lower Austria – where supposedly some of the manufacturing companies leaving Vienna relocate to – prove to be competitive with respect to manufacturing as well. Manufacturing employment is declining even faster than value added so productivity increases. In the south, manufacturing competitiveness has recuperated in the late 1990's when Styria's automobile industry started to expand.

Diagram 7: Actual to virtual manufacturing value added by regions, 1976 – 2001



Source: own calculations.

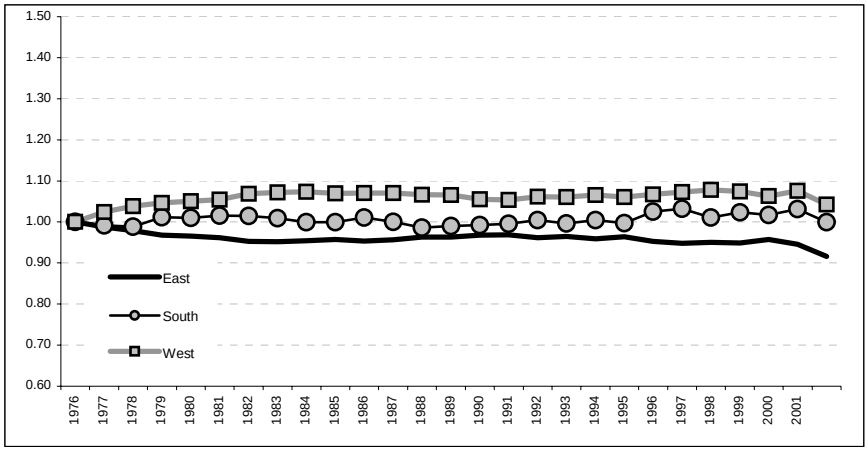
Diagram 8: Actual to virtual manufacturing employment by regions, 1976 – 2001



Source: own calculations.

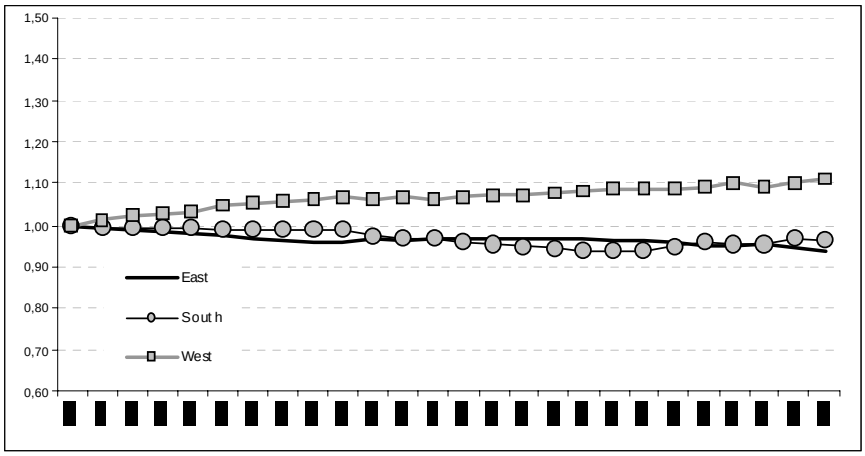
The west is ahead of the other two regions with respect to market oriented services as well (see Diagrams 9 and 10); this may reflect the strong position of the tourism sector in the western states. Again, the gap in competitiveness of the east goes back to Vienna; Burgenland and Lower Austria maintain their competitive advantages in this sector as well. While expanding manufacturing companies are expected to find superior locations outside metropolitan regions, Vienna's weak position with respect to market oriented services is not to be expected. Mayerhofer (2003) compares the economic performance of Vienna during the last thirty years with that of other metropolitan regions in Europe. He finds Vienna to be among the top European cities with respect to value added growth, but not with respect to employment, and discusses explanations for why employment has more or less stagnated. For instance, Vienna as the capital city was hit hard by a stagnating or even shrinking public administration sector. Furthermore, Austria's accession to the European Union negatively affected industries that had benefited from a rather closed domestic market; a large share of these industries is located in Vienna.

Diagram 9: Actual to virtual value added of market services by regions, 1976 – 2001



Source: own calculations.

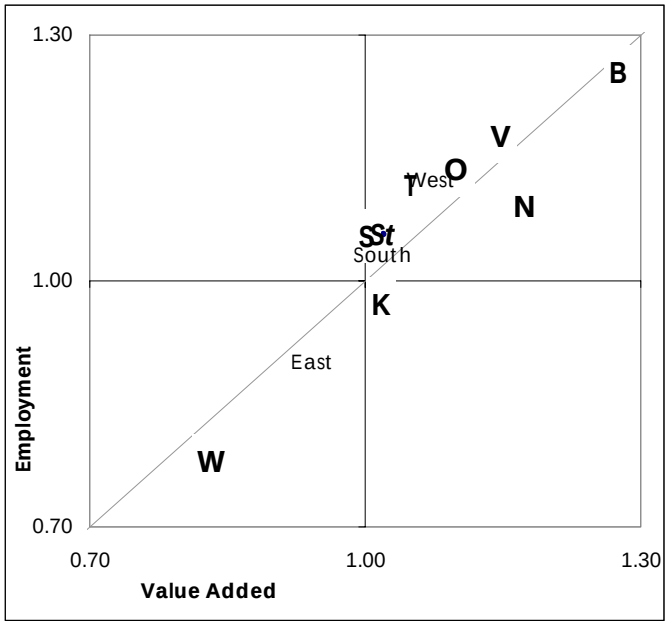
Diagram 10: Actual to virtual employment of market services by regions, 1976 – 2001



Source: own calculations.

The competitive position of the Austrian states and regions is further illustrated in Diagram 11: Here, the ratios of actual to virtual value added and employment for the year 2001, the last year in the sample, are plotted against each other. Points along the 45° line depict equal values of $W(n,t)^{value\ added}$ and $W(n,t)^{employment}$. Accordingly, in the area above (below) that line employment has evolved better (worse) than value added (after controlling for structural factors) and thus productivity has deteriorated (improved). The diagram demonstrates that all states except Vienna and Carinthia are positioned in the positive quadrant of the diagram, i.e. their economies have competitive advantages with respect to both value added and employment. Among those states, the competitive advantage of Burgenland and Lower Austria is more pronounced for value added than for employment, while all other states are approximately equally competitive for employment and value added. Salzburg and Styria are close to the origin, implying that their competitive edge is rather low. Carinthia's economy, as was already mentioned above, is somewhat lagging behind especially in terms of employment. Vienna, Austria's only metropolitan region, is exhibiting a rather large competitive gap which is more distinct for employment than for value added. As for the regions, the west is clearly ahead of the south, both regions showing a more dynamic development with respect to employment than with value added. Even though Burgenland and Lower Austria have grown comparatively well, Vienna's gap in competitiveness is responsible for the east to fall behind the other two regions, being positioned in the lower left quadrant with both values of *W* below 1. The regional development is more favorable for value added than it is for employment.

Diagram 11: Actual to Virtual Value Added and Employment by states, 2001[10]



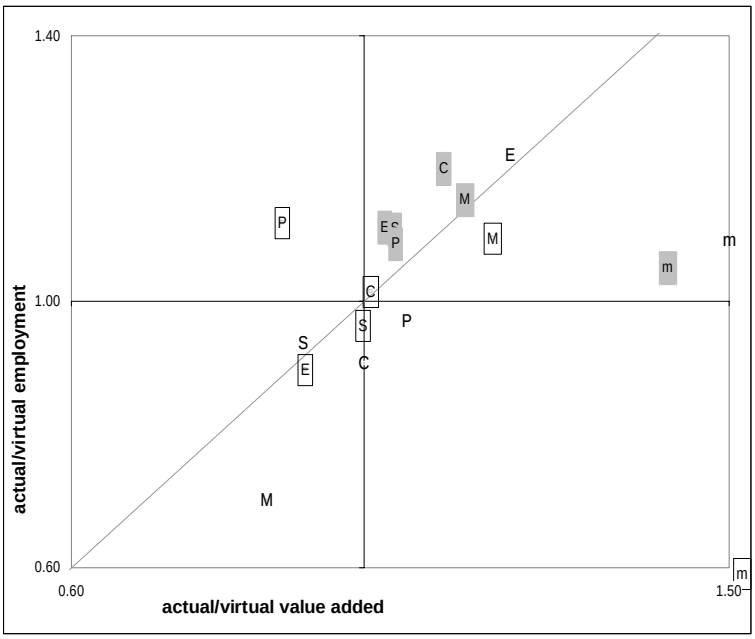
Source: own calculations.

A deeper understanding of the regional differences competitive performance is gained when looking at *W(i,n,t)* for regional aggregate sectors (see Diagram 12).

[10] Abbreviations: W=Vienna, T=Tyrol, V=Vorarlberg, B=Burgenland, St=Styria, S=Salzburg, K=Carinthia, N=Lower Austria, O=Upper Austria

In the east, only the energy sector is in the quadrant with above average competitiveness for both employment and value added; public services achieve above-average performance only for value added; all other sectors are underperforming with respect to both indicators. In the west, all sectors are highly competitive. In the south this applies only to manufacturing; market services and construction are close to the origin, the energy sector shows a below-average development in employment and value added.

Diagram 12: Actual to virtual value added and employment by regions and sectors, 2001



no frame: East; frame: South; grey: West; M = manunfacturing, E = energy, P = public services, S = market services, C = construction

Source: own calculations.

For assessing the impact of the industrial mix on the regional economies, the indicator S is calculated for employment as described above; 1976 serves as the base year for determining the national industrial structure.

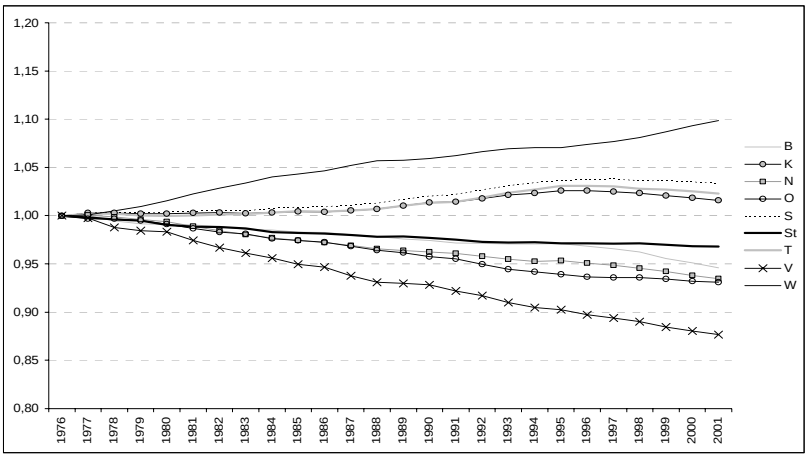
Diagram 13 shows that four out of nine states benefit from a favorable industrial structure: Vienna, whose sectoral mix provides far better growth prospects than that of all other states, Salzburg, Tyrol and Carinthia. One of the reasons for the favorable structural mix of the last-mentioned three states is their large share of employment in the tourist sector (see Table 5A in the Appendix): at more than 11%, tourism in Tyrol and Salzburg in 1976 accounted for more than twice the national average of 4.6% (at less than 8%, Carinthia is somewhat behind in this respect). Although the tourism sector in the other states grew somewhat more quickly, it still outgrew the other sectors in Tyrol, Salzburg, and – just – in Carinthia. For Vienna, structural advantage is based mostly on market and non-market services, where throughout the whole period, Vienna could maintain its structural edge (although even in these sectors, growth rates were the lowest for all 9 states, growth rates for the other sectors, especially manufacturing, were even lower in comparison with the other states).

On the other hand we find Vorarlberg to have by far the worst sectoral preconditions for employment growth. As Table A5 in the appendix shows, this is mainly due to the extremely important textiles&clothing sector: in 1976, a whopping 21% of all employees in Vorarlberg could be found in this sector, against only 4.6% for the national average. Although by 2001 this number has fallen to 7.5%, the share relative to the Austrian average,

at 1.2%, has actually grown (in 1976, the Vorarlberg share was less than 5 times the Austrian share; by 2001, this multiple has grown to more than 6).

For seven states, structural and competitive components of growth are adversely related when *W* and *S* are compared over the whole period: superior structural conditions are associated with a poor level of competitiveness for Vienna, Salzburg and Carinthia; Vorarlberg, Burgenland, Upper and Lower Austria achieve high levels of competitiveness even though their industrial structures are rather unfavorable. In Tyrol, structural and competitive components are positive, while in Styria the opposite holds. Using the national structure of 2001 for calculating the indicator *S* we observe little change in the structural indicator time series as compared to including the 1976 structure; this holds also for the relative position of the different states.

Diagram 13: Virtual national employment to virtual regional employment by states,



Source: own calculations.

4 Conclusions

Our empirical results demonstrate that the statistical shift-share regression approach delivers consistent and plausible results. They confirm that the economic development of Austrian states which is characterized by an east to south to west growth differential is accompanied by similar differences in regional competitiveness. However, in the east it is only Vienna that suffers from a low level of competitiveness while Burgenland and Lower Austria are among the most dynamic Austrian states. Vienna's gap in competitiveness has changed very little since 1976, even though economic transformation in East Europe and Austria's integration in the European Union fundamentally changed the exogenous economic conditions its economy is facing. The low level of competitiveness applies not only to the manufacturing sector, which is expected to move from metropolitan areas to areas where land and labor cost are lower and thus to show lower growth in Vienna, but also to market-oriented services. Burgenland and Lower Austria, on the other hand, could increase their competitive advantages from the late 1980's onwards; more empirical evidence is needed, however, to convincingly relate this observation to European integration or East Europe's opening.

The results also point to the fact that regions with low shares of dynamic industries, i.e. regions suffering from structural disadvantages, often perform better than regions characterized by structural advantages. This may be interpreted as a catching up process of these regions in particular with respect to faster growing service industries. Again, more evidence is needed to further interpret these results.

Shift-share analysis, no matter if calculated in the conventional, static way or estimated via regression equation, is limited to measuring deviations of the regional level of competitiveness from the national, average level. It does not provide any further information on the factors behind regional competitiveness and is thus just the first step in the analysis. Nevertheless, the time series of the indicator W may prove to be useful in this extended analysis; for instance, W may be regressed on factors expected to influence regional competitiveness.

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6 Appendix

Figure A1: Map of Austria and the nine regions included in MULTIREG

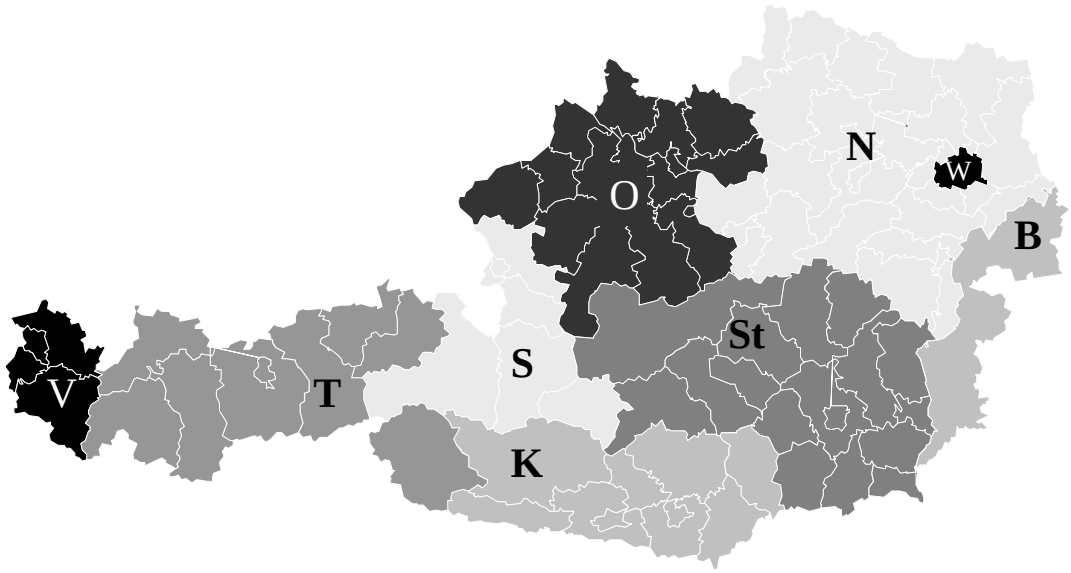

Table A1: Summary statistics on the nine regions included in MULTIREG

Code	Region		Model Region	population 2000	GRP 2000 [Mio €]	GRP/pop [1000 €]
B	Burgenland		East	277,962	4,467	16.1
K	Kärnten	*Carinthia*	South	563,207	11,549	20.5
N	Niederösterreich	*Lower Austria*	East	1,542,393	30,901	20.0
O	Oberösterreich	*Upper Austria*	West	1,379,524	31,605	22.9
S	Salzburg		West	517,096	13,785	26.7
St	Steiermark	*Styria*	South	1,202,275	24,418	20.3
T	Tirol	*Tyrol*	West	669,710	16,189	24.2
V	Vorarlberg		West	349,421	8,658	24.8
W	Wien	*Vienna*	East	1,608,656	52,840	32.8
A	Österreich	*Austria*		8,110,244	194,413	24.0

Table A2: average annual growth rates in employment, 1976-1990

Employment 1976-1990	Agriculture	Mining	Manufacturing	Energy	Construction	Market services	Non-markt services	Total
Burgenland	-1.4	-4.3	0.2	0.9	0.2	2.7	2.7	1.7
Carinthia	-1.6	-3.7	-0.5	0.0	-0.7	1.3	2.1	0.8
Lower Austria	-1.9	-4.1	-1.2	0.0	-0.2	2.7	2.1	0.8
Upper Austria	-3.6	-5.3	-0.4	-0.1	0.2	2.5	2.6	1.1
Salzburg	-2.0	-4.3	0.3	0.6	0.0	1.8	2.1	1.3
Styria	-3.8	-7.1	-0.7	-0.3	-0.7	1.3	2.1	0.4
Tyrol	-2.2	-5.0	0.6	-0.5	0.4	2.1	1.9	1.5
Vorarlberg	-1.9	-4.2	-0.2	0.2	0.1	1.8	3.2	1.0
Vienna	-3.8	-5.7	-2.2	2.3	-1.0	0.9	1.5	0.3
Austria	-2.7	-5.4	-0.8	0.4	-0.3	1.7	2.0	0.8
East	-2.5	-4.2	-1.6	1.2	-0.6	1.5	1.7	0.5
South	-3.1	-6.4	-0.7	-0.1	-0.7	1.3	2.1	0.5
West	-2.7	-5.0	-0.1	0.0	0.2	2.2	2.4	1.2

source: own calculations

Table A3: average annual growth rates in employment, 1990-2001

Employment 1990-2001	Agriculture	Mining	Manufacturing	Energy	Construction	Market services	Non-markt services	Total
Burgenland	5.6	0.1	-0.8	0.1	2.5	2.9	0.9	1.4
Carinthia	-1.9	-4.2	-0.1	-2.9	0.3	1.5	1.0	0.8
Lower Austria	-0.1	-2.9	-1.5	-2.4	-0.3	2.6	2.0	1.0
Upper Austria	-0.5	-3.3	-0.9	2.6	2.8	2.1	1.3	1.0
Salzburg	-0.3	-4.4	-1.3	-2.6	-0.3	2.1	1.3	1.0
Styria	-0.8	-4.1	0.0	-1.0	1.2	1.8	2.9	1.4
Tyrol	-0.6	6.9	-0.1	-1.2	-0.1	1.7	2.0	1.2
Vorarlberg	-3.7	2.9	-0.8	-0.5	0.5	2.0	1.8	0.9
Vienna	1.4	14.8	-3.5	0.3	-0.7	1.0	0.8	0.2
Austria	-0.2	-2.4	-1.2	-0.7	0.5	1.8	1.5	0.9
East	0.9	-1.7	-2.3	-0.7	-0.3	1.6	1.2	0.6
South	-1.2	-4.2	-0.1	-1.7	0.9	1.7	2.3	1.2
West	-0.8	-1.0	-0.8	0.1	1.2	2.0	1.5	1.0

source: own calculations

Table A4: average annual growth rates in value added, 1976-1990

Value added 1976-1990	Agriculture	Mining	Manufacturing	Energy	Construction	Market services	Non-markt services	Total
Burgenland	1.6	-4.2	3.3	2.6	0.1	4.5	1.9	2.7
Carinthia	1.5	-2.7	3.2	2.1	-0.1	3.4	2.3	2.5
Lower Austria	1.0	-2.5	2.4	3.6	1.0	4.2	2.3	2.7
Upper Austria	3.0	-4.3	3.1	3.4	0.9	4.4	2.3	3.1
Salzburg	2.0	3.4	3.3	4.7	0.1	3.4	2.9	3.0
Styria	1.3	-4.9	2.9	3.8	0.0	3.3	1.7	2.3
Tyrol	2.7	-3.6	3.9	3.5	2.0	3.1	1.8	2.8
Vorarlberg	3.4	-5.6	2.9	4.0	0.5	3.6	2.2	2.8
Vienna	1.6	-10.7	1.2	3.7	0.1	3.0	2.2	2.5
Austria	1.7	-3.9	2.7	3.6	0.6	3.4	2.2	2.7
East	1.2	-3.6	1.9	3.7	0.5	3.3	2.2	2.6
South	1.4	-4.2	3.0	2.8	0.0	3.3	1.9	2.4
West	2.9	-3.8	3.2	4.0	0.9	3.7	2.3	3.0

source: own calculations

Table A5: average annual growth rates in value added, 1990-2001

Value added 1990-2001	Agriculture	Mining	Manufacturing	Energy	Construction	Market services	Non-markt services	Total
Burgenland	1.2	-2.6	4.1	4.4	4.5	3.8	1.5	3.2
Carinthia	3.4	0.8	2.5	0.6	2.1	2.7	1.1	2.2
Lower Austria	2.3	-4.5	4.2	3.1	2.1	3.6	1.7	3.1
Upper Austria	1.7	-3.9	2.4	2.5	3.6	3.4	0.6	2.5
Salzburg	3.1	-4.0	2.3	0.0	1.6	2.4	1.0	2.0
Styria	4.4	-1.7	3.5	3.6	3.6	3.2	-0.3	2.6
Tyrol	3.5	-5.2	2.3	2.1	2.0	2.2	1.6	2.1
Vorarlberg	4.1	-0.2	2.2	2.9	1.9	2.8	1.4	2.4
Vienna	2.3	3.4	0.7	3.7	2.2	2.2	0.9	1.9
Austria	2.6	-2.7	2.7	2.7	2.6	2.7	0.9	2.4
East	2.1	-3.6	2.8	3.5	2.3	2.6	1.2	2.4
South	4.1	-0.8	3.3	2.1	3.1	3.0	0.1	2.5
West	2.3	-3.8	2.3	1.7	2.7	2.8	1.0	2.3

source: own calculations

Table A6: regional employment structure, 1976

	Sector																						
BL	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**Total**
B	1.3	5.6	11.3	1.9	0.1	0.6	0.9	1.5	2.2	0.9	1.7	0.1	2.6	1.7	10.7	12.8	3.5	2.8	2.8	2.7	1.3	**27.5**	3.5	100.0
K	1.0	3.4	3.7	**3.2**	1.0	0.9	1.9	2.1	2.7	2.2	2.6	0.2	1.7	**2.3**	11.7	13.8	7.7	5.6	2.3	2.9	2.7	20.3	4.1	100.0
N	1.3	**5.7**	5.9	1.9	1.1	1.0	**4.9**	2.3	6.5	3.4	2.0	0.7	2.6	1.4	**12.2**	13.5	2.7	4.7	1.8	1.9	2.2	16.9	3.5	100.0
O	0.7	4.1	4.6	1.4	1.3	0.7	3.8	2.3	**11.5**	**4.3**	2.5	**3.0**	**4.2**	1.1	8.6	12.9	2.3	4.5	1.9	2.3	2.5	16.3	3.1	100.0
S	0.5	3.8	2.9	2.2	0.9	**2.0**	1.2	1.1	3.7	2.9	0.8	0.6	2.0	1.7	9.8	16.5	11.1	6.6	2.3	2.9	2.8	17.6	4.1	100.0
St	**2.4**	4.0	2.6	2.0	**1.9**	0.9	0.5	2.3	9.2	3.2	2.6	2.3	1.7	1.7	9.4	15.4	3.6	4.8	2.5	2.3	2.9	18.0	3.8	100.0
T	0.3	2.9	4.7	1.7	0.2	0.8	1.3	**3.1**	3.2	2.0	0.7	0.6	1.9	1.8	11.3	13.9	**11.2**	**7.0**	2.5	2.8	2.4	19.5	4.4	100.0
V	0.3	3.7	**20.8**	1.7	0.6	1.0	1.5	0.9	4.8	2.2	2.1	0.7	1.8	1.8	8.8	12.1	8.9	4.4	1.4	2.5	2.2	12.5	3.2	100.0
W	0.0	3.7	2.2	0.4	0.6	1.9	2.7	0.5	2.2	1.8	**5.5**	1.3	1.1	0.9	8.4	**19.1**	2.7	4.9	**3.8**	**5.0**	**6.5**	20.0	**5.1**	100.0
Total	0.8	4.1	4.6	1.5	1.0	1.2	2.6	1.7	5.6	2.7	3.0	1.4	2.1	1.4	9.7	15.4	4.6	5.0	2.6	3.1	3.6	18.3	4.0	100.0

source: Statistics Austria, own calculations

Table A7: regional employment structure, 2001

	Sector																						
BL	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**Total**
B	**0.5**	**4.1**	2.1	1.3	0.2	1.2	1.2	0.8	2.0	0.6	2.9	0.1	2.3	1.3	**9.9**	14.8	6.3	3.5	2.0	3.4	3.9	**30.1**	5.3	100.0
K	0.3	2.1	1.5	**1.7**	0.4	0.4	1.4	1.7	2.2	3.5	2.9	0.1	1.4	1.4	8.9	15.6	7.9	4.5	2.1	3.5	6.8	24.7	5.2	100.0
N	0.4	3.2	1.3	1.2	0.5	0.9	2.5	1.2	4.0	2.9	1.7	0.4	1.8	0.8	9.1	**18.8**	4.8	6.5	2.1	2.6	6.0	22.3	5.1	100.0
O	0.2	3.1	1.0	1.5	0.7	0.6	**3.2**	1.4	**5.4**	**4.7**	2.0	2.4	**2.9**	1.1	9.1	16.6	3.5	4.5	1.7	2.8	7.3	20.7	3.7	100.0
S	0.1	2.6	0.8	1.6	0.6	**1.3**	1.1	0.8	1.8	1.9	1.5	0.7	1.6	1.0	7.0	18.5	12.0	**6.7**	1.8	3.7	7.7	20.6	4.7	100.0
St	0.4	2.3	1.1	1.5	**1.1**	0.5	0.8	1.4	4.8	2.7	3.1	**2.8**	1.6	1.1	7.7	14.9	5.0	3.9	1.9	2.8	7.3	26.0	5.1	100.0
T	0.2	2.1	1.0	1.6	0.2	0.7	1.8	**2.7**	2.5	2.1	1.2	0.4	1.4	1.0	8.3	15.0	**13.0**	6.5	1.7	3.4	6.0	22.6	4.7	100.0
V	0.2	3.5	**7.5**	1.1	0.8	0.7	1.5	0.6	5.2	2.8	3.0	0.7	1.7	**1.4**	7.4	15.0	9.4	4.9	1.3	3.4	5.5	18.6	3.8	100.0
W	0.0	1.6	0.3	0.2	0.3	1.1	1.4	0.2	0.8	0.9	**3.2**	0.8	0.4	1.1	6.3	16.8	4.5	5.4	**2.3**	**5.7**	**14.2**	26.1	**6.4**	100.0
Total	0.2	2.5	1.2	1.1	0.6	0.8	1.8	1.1	3.2	2.5	2.4	1.2	1.6	1.1	8.0	16.6	6.2	5.3	2.0	3.6	8.4	23.5	5.1	100.0

source: Statistics Austria, own calculations

Table A8: average annual growth rates in employment, 1976-2001

	Sector																						
BL	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**Total**
B	-2.4	0.3	-5.0	0.0	**2.9**	**4.2**	**3.0**	-0.9	1.2	-0.1	**3.8**	2.2	**1.0**	0.5	1.2	2.1	**3.9**	**2.5**	0.2	**2.5**	**6.2**	1.9	**3.3**	**1.5**
K	-3.9	-1.2	-2.8	-1.8	-2.8	-2.2	-0.4	0.0	-0.1	**2.7**	1.2	0.0	0.0	-1.3	-0.3	1.3	0.9	-0.1	0.4	1.5	4.5	1.6	1.8	0.8
N	-3.6	-1.3	-5.0	-1.0	-2.1	0.2	-1.8	-1.7	-1.0	0.3	0.3	-1.9	-0.5	-1.1	-0.2	**2.3**	3.3	2.2	**1.4**	2.3	5.0	2.1	2.5	0.9
O	-4.5	-0.1	-4.8	**1.2**	-1.5	0.5	0.3	-0.7	-1.9	1.4	0.1	0.2	-0.4	1.1	**1.3**	2.1	2.7	1.1	0.7	1.9	5.5	2.0	1.8	1.1
S	-4.3	-0.3	-4.0	0.0	-0.4	-0.5	0.9	-0.3	-1.6	-0.6	3.6	**2.3**	0.2	-0.9	-0.1	1.7	1.5	1.3	0.2	2.2	5.4	1.8	1.7	1.2
St	-5.8	-1.3	**-2.7**	-0.1	-1.3	-1.1	2.9	-1.2	-1.7	0.3	1.7	1.8	0.7	-0.6	0.1	0.8	2.2	0.1	0.0	1.7	4.7	2.4	2.2	0.9
T	0.1	0.1	-4.6	1.0	1.1	0.3	2.7	**0.9**	0.4	1.6	3.3	0.1	0.2	-0.8	0.2	1.7	2.0	1.1	-0.2	2.2	5.2	2.0	1.7	1.4
V	-1.1	**0.8**	-3.0	-0.7	1.9	-0.7	1.1	-0.2	**1.3**	2.0	2.3	1.4	0.5	-0.1	0.3	1.9	1.2	1.4	0.9	2.1	4.7	**2.6**	1.7	1.0
W	**2.8**	-3.1	-8.0	-2.7	-2.4	-1.8	-2.4	-3.4	-3.8	-2.2	-2.0	-1.9	-3.2	**1.4**	-0.9	-0.3	2.4	0.7	-1.7	0.8	3.4	1.3	1.1	0.2
Total	-4.1	-1.1	-4.3	-0.3	-1.4	-0.8	-0.6	-0.8	-1.4	0.5	0.0	0.2	-0.4	-0.1	0.0	1.2	2.1	1.0	-0.2	1.5	4.3	1.9	1.8	0.8

source: Statistics Austria, own calculations

Table A9: Description of the 23 economic sectors used in the paper:

Sector	NACE codes	Description
1	10-14	mining
2	15,16	food, tobacco
3	17-19	textiles, clothing, leather
4	20	wood and wood products
5	21	pulp, paper, paper products
6	22	publishing and printing
7	23-25	coke, petroleum products, chemicals, rubber
8	26	other non-metallic mineral products
9	27,28	basic metals; basic and fabricated metal products
10	29	machinery
11	30-33	electrical and optical equipment
12	34,35	transport equipment
13	36,37	other manufacturing, recycling
14	40,41	electricity, gas and water supply
15	45	construction
16	50-52	wholesale and retail trade
17	55	hotels and restaurants
18	60-63	transport
19	64	post and telecommunications
20	65-67	financial intermediation
21	70-74	real estate, renting, and business activities
22	75,80,85	public administration, education, health and social work
23	90-95	other community, social and personal services

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