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

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Introduction

Regional development in Austria has for long been characterized by an east-west divide: Eastern and also southern states bordered the former communist countries of Eastern and Southeastern Europe and thus suffered from the political, social and economic barrier established by the iron curtain until the end of the 1980's. Their location at the periphery of Western Europe, in addition to other factors (e.g. large shares of nationalized heavy industry) may explain why these states experienced slower economic growth than the westerly regions of Austria, which were more integrated in the dynamic European economic core (Germany, France, etc.): Between 1970 and 2001 average employment growth in the east[3] was on average 0,4 percentage points lower than in the south and around 0,9 percentage points lower than in the west.[4] However, the growth gap narrowed over time: in the 1990's the average annual employment growth rate was 0,2% in the east, 0,3% in the south and 0,4% in the west. In terms of nominal value added, from 1976 to 2001 eastern und southern states were growing at about the same pace, while annual growth rates in western states were on average about 0,5 percentage points higher.[5]

However, spatial aggregation into three regions conceals differences in economic performance within these regions: In the east, Burgenland, a peripheral state characterized by a very low degree of industrialization and a high share of agriculture, increased its employment level faster than most other states in Austria during the last thirty years ; in the 1990's, in the east Burgenland and Lower Austria were on top of all other Austrian states in terms of employment growth, while the metropolitan region of Vienna was lagging behind. In the west, it was mostly Tyrol which performed above the Austrian national average.

When comparing the aggregate economic development of countries or regions over time the question arises to what extent observed differences in growth can be explained by nation- or region- idiosyncratic effects or by a different sectoral composition. In other words, are growth advantages mainly due to favorable structural preconditions, i.e. above average shares of dynamic industries, or rather due to locational factors that firms in various sectors benefit from? Are lagging countries / regions haunted by a disadvantageous industrial structure or an insufficient endowment of growth drivers such as human capital, innovative capacity etc.?

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

[3] The 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.

[4] Source: Hauptverband der Sozialversicherungsanstalten, own calculations.

[5] Source: Statistic Austria, own calculations.

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 spatial unit of analysis are the nine states which make up the Austria nation. Utilizing Marimon and Zilibotti's shift-share regression model annual value added and employment growth as indicators for regional competitiveness are decomposed into regional, sectoral and temporal components for the period between 1976 and 2001; subsequently differences between the states with respect to these variables are analyzed by constructing virtual regional economies.

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

- Competitive 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.

The following section of the paper describes the shift-share regression model and the calculation of virtual time series. 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.

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 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:

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

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

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:[6])

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

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

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

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

[6]) 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.

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

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

From these restrictions the following interpretation can be deducted:

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, Kärnten, Vorarlberg) do show high variation. Consequently, as suggested by Möller (2000), weighted OLS is applied. The weights chosen equal the shares of regional in total national value added.

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:

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

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:

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

The generation of the hypothetical indicator time series is based on the actual indicator values for t = 0. For instance, if growth rates for the period between 1983 and 2001 are included in the regression, the actual 1982 value of the indicator is used to calculate its hypothetical value for 1983; the 1984 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.

$$W(i,n,t) = E_{act}(i,n,t) \div E_{virt}(i,n,t)$$

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

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 much faster than it actually did. It failed to explore its economic potential.

The regional data base

Long time series, especially with respect to output or value added, are not easily available at a regional and sectoral level. We use information on value added and employment from a comprehensive regional data base compiled in the course of the development of an

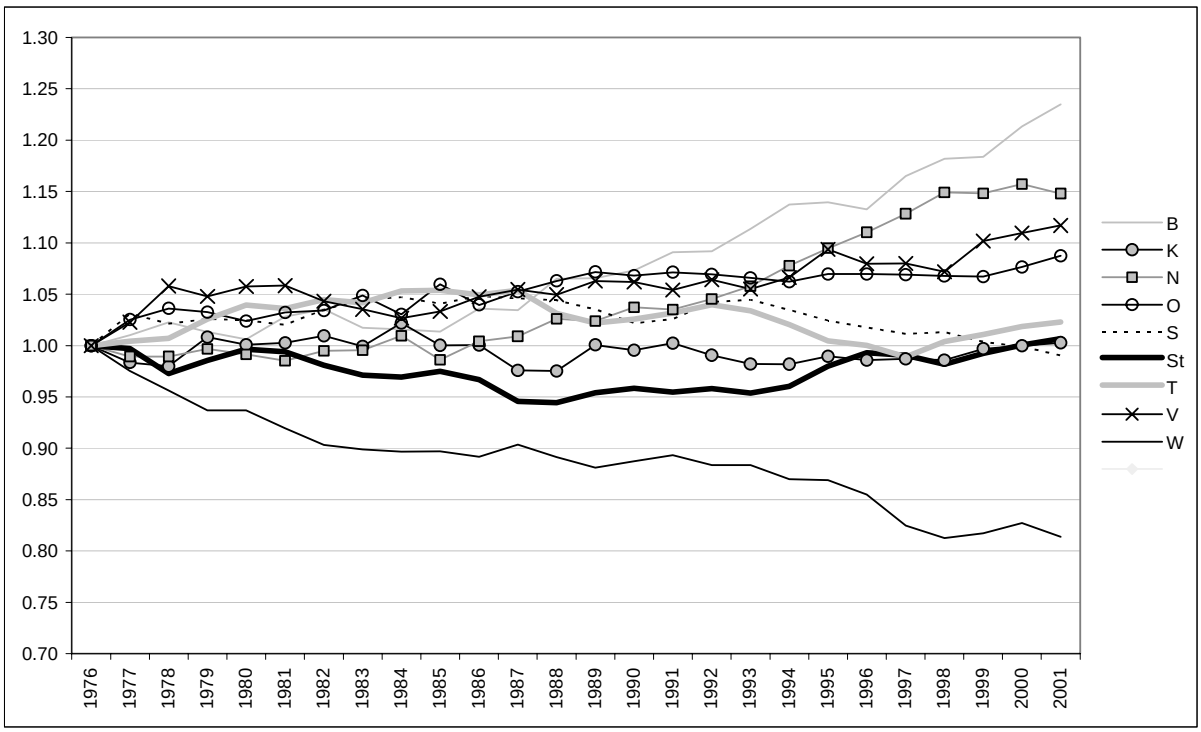
econometric multiregional input-output model for Austria.[7] The database draws on regional and national data collected by Statistics Austria. Annual data on xxx industries for the period 1976 to 2001 are included in the regression. The industries correspond to 2-digit NACE classes or aggregates of 2-digit classes. Since the European System of National Accounts and the NACE classification has been applied by Statistics Austria only for post-1994 data, sectoral information for the years between 1976 and 1994 had to be reclassified and adjusted.

Results

The time series of the ratio of actual to virtual values for value added and employment show distinct differences between the states (see diagrams 1 and 2 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.

Diagram 1: Actual to Virtual Value Added, 1976 – 2001



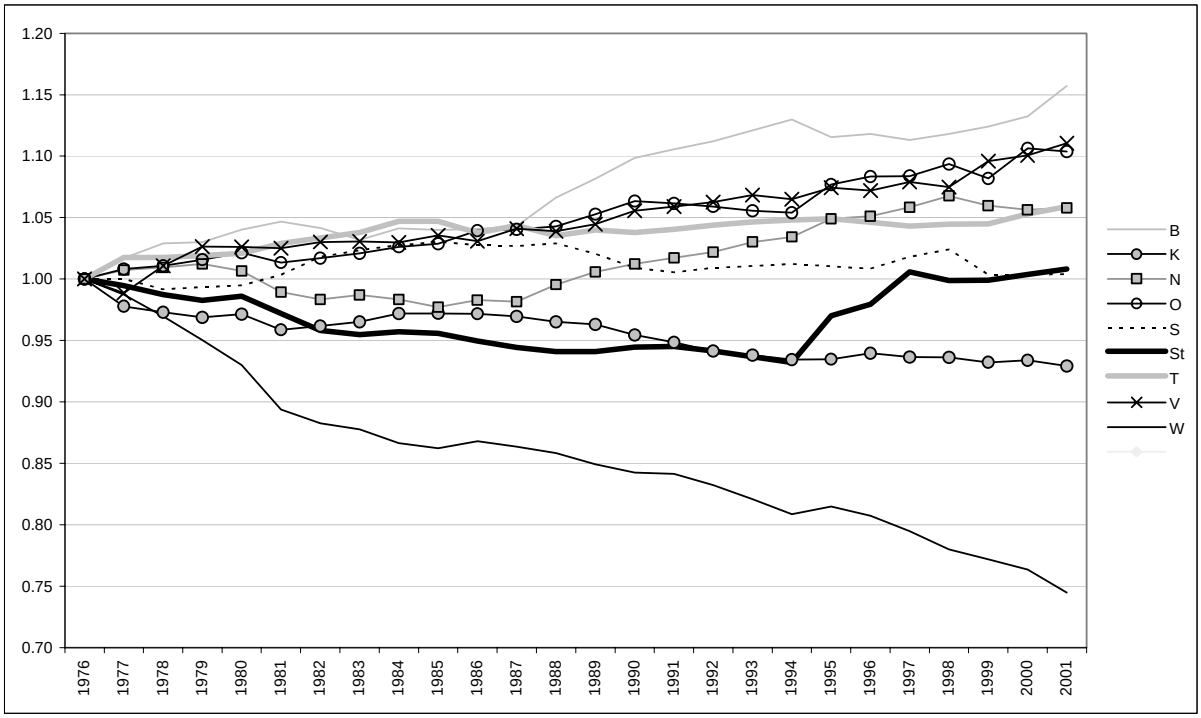
In the south, Carinthia and Styria are both slightly below the Austrian average, but differ with respect to the trend of competitiveness: Styria's economy seems to have made a turnaround

[7] We are much indebted to Raimund Kurzmann for generating the regional time series.

in its economic development in the early 1990's: both $W(n,t)^{value\ added}$ and $W(n,t)^{employment}$ are increasing from 0.95 up to a value of approximately 1. Carinthia stays close to a value of 1 for $W(n,t)^{value\ added}$, but moves further away from the national average in a downward direction.

The results also show 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.

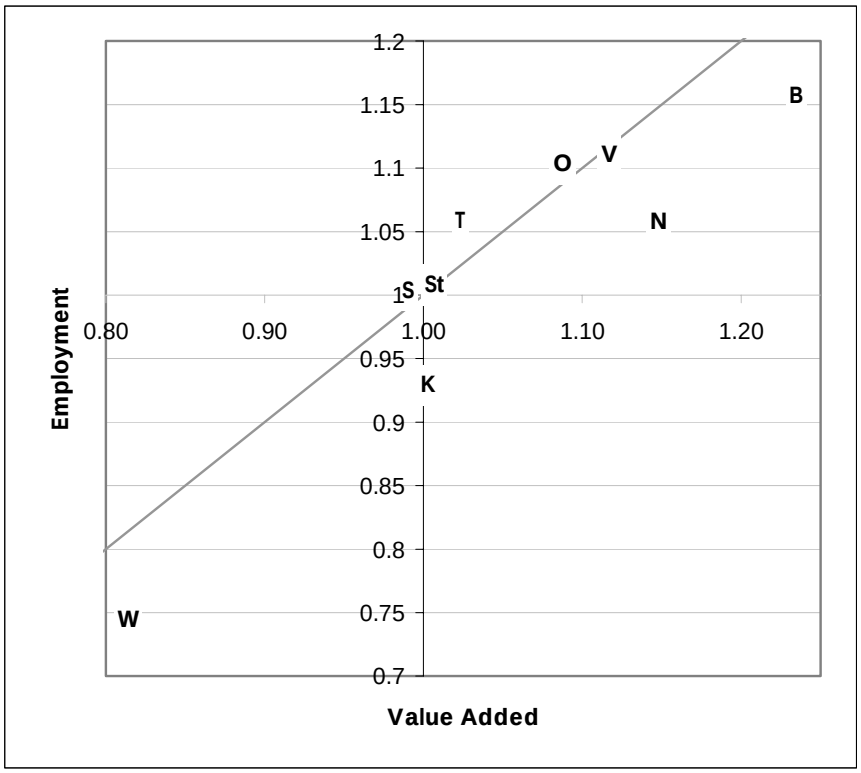
Diagram 2: Actual to Virtual Employment, 1976 – 2001



The competitive position of the Austrian states is further illustrated in diagram 3: 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. We see that all states except Vienna and Carinthia are positioned in the first 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 with respect to value added and employment. Salzburg and Styria are close to the origin, implying that their competitive edge is rather insignificant.[8]

[8] However, no statistical test was performed to see if W for Salzburg and Styria was significantly above 1.

Diagram 3: Actual to Virtual Value Added and Employment 2001[9]



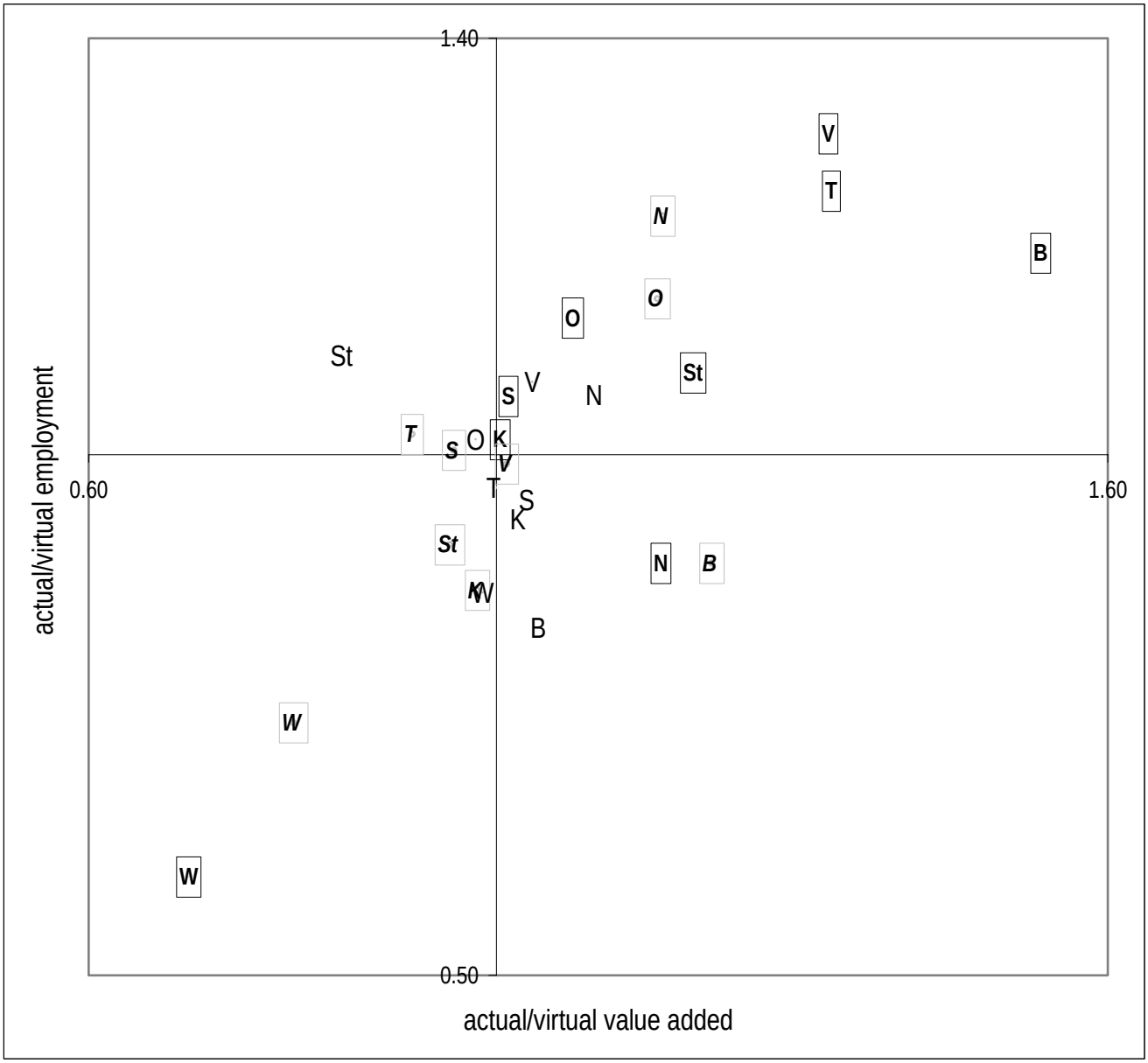
Carinthia's economy, as was already mentioned above, is lagging behind especially in terms of employment. Vienna, Austria's only metropolitan region, is exhibiting a rather large competitive gap which is more distinct for employment than for value added.

A deeper understanding of the regional differences competitive performance is gained when looking at *W(i,n,t)* for regional aggregate sectors (see diagram 4).

Manufacturing has shown a superior performance in terms of both employment and value added in Vorarlberg, Tyrol, Burgenland, Upper Austria and Styria, and to a much smaller extent also in Salzburg. At the same time in most of these states the service sectors are not performing too well, Upper Austria being the exception. On the other hand, lower Austria's high degree of competitiveness according to these results is mainly based on services, in particular market-oriented services. The most competitive sector in Carinthia is manufacturing; surprising the fact that even though the Carinthian economy strongly relies on tourism, neither market-oriented nor public services show any competitive advantage. The same applies for other touristic states like Tyrol, Salzburg or Vorarlberg: None of these states shows up in the analysis of having a very dynamic market-oriented service sector.

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

Diagram 4: Actual to Virtual Value Added and Employment 2001 for Aggregate Industries2



no frame: public services
light frame, italic letter: market-oriented services
dark frame, bold letter: manufacturing

Vienna, overall the least competitive state, is lagging behind in all three sectors; only public services are close to the national average in value added and employment development; market oriented services – for which Vienna as metropolitan region is supposed to offer superior locational conditions – far below the national average as is manufacturing, which is less surprising for an urban region.

Conclusions

The empirical results presented in this paper on the comparative competitiveness of Austrian states are only preliminary. The shift-share regression, which was applied to consistently separate sectoral, regional and temporal effects in regional growth of employment and value added, provided very rich results. We were able to present only a small fraction of these results here. More work on analyzing and interpreting the regression results is needed to present a comprehensive picture of regional development. Furthermore, while data on regional employment are relatively easy to come by, this is not the case concerning output or value added data. Not even national statistics in Austria deliver a consistent time series on regional output with reasonable sectoral detail.

Our future work will therefore concentrate not only on further analyzing the shift-share regression results and complement these results by additional information on the economic development of the Austrian states but also on improving the regional data set used.

Our preliminary regression results, however, demonstrated that the statistical shift-share regression approach delivered consistent and plausible results. It confirmed 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. Thus, independent of any structural differences between the states higher growth is accompanied by a higher degree of competitiveness.

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