Constructing Regional Input-Output Tables in Austria

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Paper presented at the 15th International Conference on Input-Output Techniques

Montreal, October 2002

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Abstract

The construction of regional input-output tables is often hampered by data scarcity. Various methods have been applied to derive such tables from their national counterparts using all available information about the sectoral structure of the regional economy.

In this paper a similar approach is followed in the construction of input-output tables for two Austrian NUTS II regions. Based on the 1995 national input-output table, which is the first national table consistent with the new European system of accounts (ESA 1995), make and use tables are estimated and a sector-by-sector input-output table is derived. Besides using different secondary regional data as well as estimates of regional final demand, the table construction relies on data from a survey on regional exports.

The first part of the paper describes the methodology followed to build the tables. The second part compares regional and national tables in order to analyze differences in the productive structure.

INTRODUCTION

Over the last five years considerable research efforts in Austria have been directed towards developing regional macroeconomic models to be implemented at the level of Austrian states. The research was motivated not only by academic interest but also by an increasing demand from policy makers for additional empirical insights helpful in evaluating past and current policies and in designing more effective and efficient new policies.
So far, two models for the states of Styria (see Fritz, et. al., 2000) and Upper Austria were finished with both models following an modelling framework that integrates econometric blocks of equations as well as Input-Output relationships obtained from IO tables for each the two regions. While the tables already constructed are for single regions only, the ultimate goal of the ongoing research is to set up a multi-regional table comprising all nine NUTS II regions in Austria, which should be combined with econometric parts to form a multi-regional model for the whole national economy.

This paper presents the current state of research within the field of compiling regional Input-Output tables, using the tables for Styria and Upper Austria as examples. In doing so, the paper will serve two distinct purposes. First, the current methodological approach will be outlined along with its special merits and drawbacks, mainly as far as the data availability is concerned. The second aim is to compare the two tables empirically by applying various measures and theoretical concepts on both the Make and Use matrices of the compiled tables as well as the quadratic forms of the IO-tables for Styria and Upper Austria. The empirical analysis is expected to further contribute to a more comprehensive understanding of possible drawbacks of the methodological approach at hand, at the same time offering insights into potential areas for improvement in moving towards a multi-regional table comprising all states of Austria.

The structure of the paper is as follows. First, the methodological framework of compiling the IO tables will be outlined along with a description of the merits and drawbacks of the available database. After briefly characterising the two regions under investigation in terms of their historical development, the second section will focus on various concepts in comparing the Make and Use tables as well as the quadratic forms (matrix of technical coefficients as well as Leontief Inverse). Finally conclusions are drawn and an outlook for future research is given.

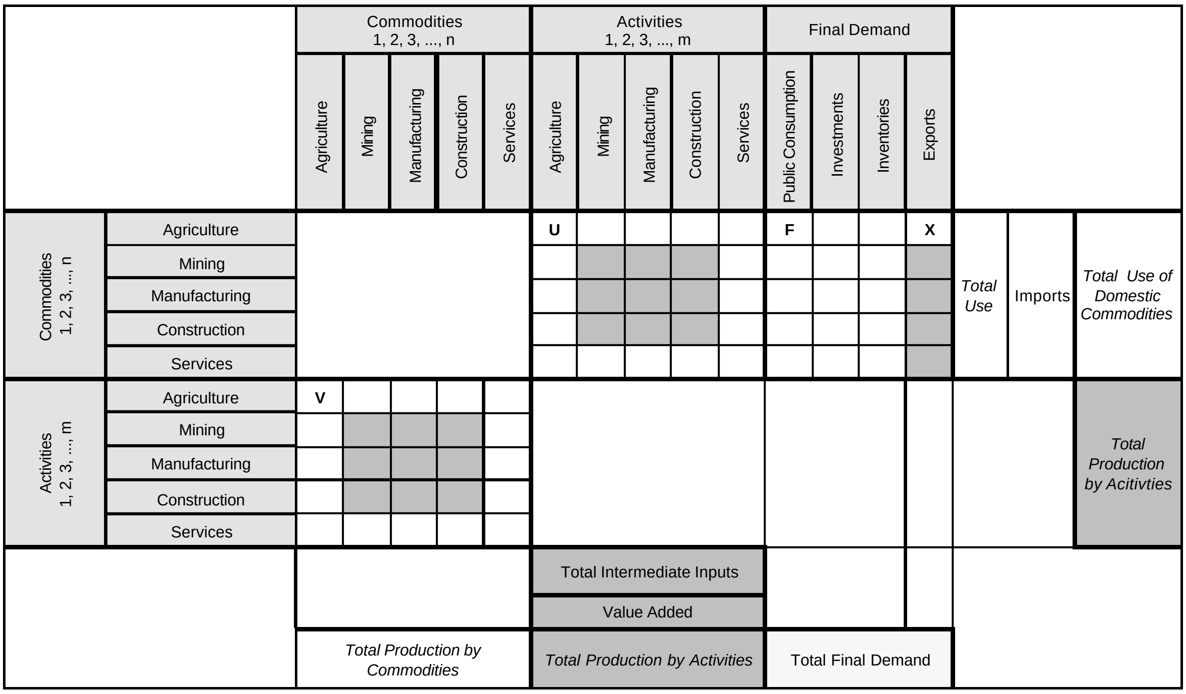
1 METHODS APPLIED IN THE CONSTRUCTION OF REGIONAL INPUT-OUTPUT TABLES IN AUSTRIA

In building regional input-output tables researchers almost always need to rely on information derived from the corresponding national input-output table. Data required for such an input-output table, e.g. on the use of intermediate goods by firms in different sectors or on goods consumed by households, is not readily available on a regional level. This is true in particular for data on regional exports and imports, which are neither collected by national statistical offices nor easily retrievable even by regional producers themselves. Moreover, surveys to fill the existing secondary data gaps are very costly. Therefore regional table construction activities have shifted away from survey-based tables to tables based on so-called non-survey or partial survey methods, which derive regional from national tables.

These methods to regionalize national tables differ in the amount of regional data used: The simplest non-survey methods merely rely on information concerning the basic sectoral structure of the region, e.g. measured by the sectoral employment distribution, and adjust national input-output tables by the means of regional location coefficients. Other methods (partial survey methods, hybrid methods) attempt to use more extensive regional data bases and often focus efforts to integrate this regional information on those sections of the table that are deemed most important in terms of regional multipliers or linkages.

Regionalizing the national input-output structure was also the approach followed in the construction of regional input-output tables in Austria that is described here. These tables are partial-survey in nature: They not only contain regional data from secondary sources but also primary data on regional exports from a large survey of regional firms. The two regional tables for Upper Austria and Styria that have been completed so far were derived from the national input-output table for 1995, the most current table that exists for Austria (see Statistics Austria, 2001). This national table, like the ones before, was constructed based on a make-use system, i.e. separate make and use matrices were built and then combined under specific assumptions in order derive a quadratic, sector by sector or commodity by commodity input-output table. Consequently, the derivation of regional input-output tables did not focus on the (quadratic) national input-output table but on the three matrices underlying that table: the make table, providing information on what type of commodities were produced by the different sectors in the economy; the intermediate use table, accounting for the use of (domestically produced or imported) commodities in the production process of these sectors; and the final use table, which contains the value of all commodities delivered to different final demand categories. The diagram below illustrates a make-use system and points out those sections of the different matrices for which regional data were available.[3]

Diagram 1: Regional make-use system



Note that in this system domestic commodities are not separated from imported ones. The vector of total use of domestic commodities is derived by deducting (estimated) regional imports from the total use of commodities. However, for constructing a regional input-output table the origin of the commodities used by intermediate and final demand is essential: Only those commodities must be included in the use tables that are produced by firms located in the region. The derivation of regional use matrices from their national counterparts thus proceeded in two steps: First, intermediate and final commodity use was estimated independent of the origin of these commodities, i.e. the make-use system as shown in the diagram above was completed. Based on this use structure, regionally produced goods were then distinguished from imported ones in order to isolate trade flows between regional producers and regional demand (including exports). After estimating regional make-use matrices, a regional input-output table was derived based on the industry-technology assumption.

Like the national table the 1995 regional tables for Styria and Upper Austria distinguish between 55 industries and commodities corresponding to 2-digit NACE[4] and CPA[5] codes or aggregates

[3] See the shaded areas in the diagram. Regional total final demand for different demand categories had to be estimated first while for the other sections secondary data were more or less directly integrated in the table.
[4] General Industrial Classification of Economic Activities within the European Communities
[5] Classification of Products by Activities

of these codes, especially with respect to service sectors. Moreover the tables contain data on 5 final demand categories: private and public consumption, total investment, changes in inventories, and exports.

In the remainder of this section of the paper the methods applied in constructing the regional tables will be described.

1.1 Regional make table

Since the number of activities and commodities included in the national table is rather small, secondary production activities, i.e. off-diagonal entries in the make table, have a rather small weight compared to primary activities: Almost 94% of the value of total production in Austria in 1995 accounts for primary activities. The high level of sectoral aggregation suggests that the regional deviation from the national make structure, i.e. the commodity shares in total output levels of activities, will be rather small. Divergent sectoral shares in total output will therefore mainly be responsible for observed differences between the regional and national make tables.

In deriving a regional make table, the first step consisted of regionalizing the national make structure. Thereafter the newly found regional matrix of commodity shares was to be multiplied by the vector of regional sectoral output levels.

In Austria, information on the types of commodities produced by different activities is easily available also on a regional level for manufacturing industries, mining, the energy sector as well as construction. For these industries such data is collected by Statistics Austria on a monthly basis. The data mainly covers companies with more than 20 employees and thus excludes very small firms but nevertheless accounts for a very large share of total output. For the regional make tables the data of the survey for 1997 had to be used since in the 1995 survey the old system of classification (the so called *Betriebssystematik 1968*) was still in place both with respect to activities and commodities. No adjustments of the data for any changes in the make structure that might have occurred in these two years were made. For agriculture and services no official data on output by type of commodities is collected, so for the construction of the national make table Statistics Austria had to draw on other data sources like company business reports or accounting reports by public authorities. Furthermore for these industries the make structure of previous national tables often served as a benchmark for the current table and was only updated.

To what extent the current make structure relies on updates of previous tables' commodities shares in total output and how such an update was carried out remains unknown. Information on any additional data sources used has not been disclosed in detail in the official input-output table publications either. Regionalisation of the national make structure therefore had to concentrate on those sections of the table for which survey data where available: This includes mining, manufacturing, energy and construction, both in terms of activities as well as commodities, and, only with respect to commodities, business related services, which are often supplied by manufacturing companies. For these activities / commodities, the shares as derived from the survey data determined the regional make structure. For agriculture and service activities as well as for other services provided by manufacturing sectors, especially wholesale and retail trade services as well as transport services, national commodity shares had to be applied.

Even for those sections of the make matrix for which a regionalisation of the structure was in principle supported by regional data, it still remained unknown what kind of adjustments of the survey data were carried out by Statistics Austria in order to derive the final national make table. Therefore a comparison between the commodity structure of the national make table as published and the regional make structure as derived directly from the survey data had to be interpreted with great care since deviations may falsely point to structural differences when they really are the results of data adjustments made in the process of table construction. Unfortunately, a comparison of national and regional make structures derived directly from the data was not possible since data on the production of commodities by activities are only available on a regional level; on the national level total output can be obtained either by activities or by commodities but the corresponding matrix of commodities x activities was not available.

The estimation of the regional make structures was completed by reconciling the commodity shares derived from the data with all other commodity shares taken from the national make table in order to assure that the sum over all shares for each activity equalled one. Finally, using this make structure together with data on regional total output levels by activities, regional make tables were compiled.

1.2 Regional intermediate use table

Differences between the regional and the national use structure – without taking account of the origin of the commodities - may be caused be either technological differences in the production processes or differences in the sectoral composition below the 2-digit level of aggregation.

Information on the regional characteristics of the use of intermediate commodities is scarce: Mining and manufacturing are the only sectors covered by a survey on the use of materials in the production process carried out by Statistics Austria. Other inputs besides materials are excluded: information on service inputs as well as expenditures on office supplies and maintenance (which also include materials) is missing. Moreover, the sample size of the survey is rather small and restricted to larger companies (more than 20 employees, more than 100 Mio. Austrian Schilling in annual revenues, i.e. around 7,2 Mio. Euro). Even though these sample characteristics impair the use of the data in a regional context, it was the only source of information available for the regionalisation of the national intermediate use structure. The first survey of this kind was conducted in 1997; consequently, it had to be assumed that the 1997 use structure is applicable to 1995. For services, both with respect to activities as well as commodities used in the production process, national input shares were assumed to equal regional input shares in total intermediate inputs. The same assumption was used for the input structure of the agricultural sector.

In deriving the regional table of intermediate use the same procedure was employed as in the case of the make table: first the national intermediate use structure was regionalized where possible; then the resulting matrix of commodity shares was multiplied by the vector of sectoral total intermediate inputs, for which regional data were available.

Even though in the construction of the national intermediate use table by Statistics Austria the survey data was the most important source of information on material inputs, for other expenditures on materials (office supplies, maintenance) the statistical office had to rely on other sources undisclosed to the public. For this reason and due to other adjustments of the survey data, on which no information is available, for some activities and commodities the national material input shares derived directly from the survey data differ considerably from the respective input shares of the intermediate use table. Therefore, in order to estimate a regional intermediate use structure, the survey data on regional material input shares could not be adopted directly. Instead, regional and national input shares derived from the survey data were first compared; then the input shares of the national use table were adjusted proportional to the deviations found in the survey data.

The plausibility of observed regional differences of the input structure was examined sector by sector in order to reduce the risk of confusing purely statistical and structural deviations. In particular, shares of material inputs were compared at a lower level of sectoral aggregation (3-digit NACE) in order to explore if differences at the 2-digit level could be traced back to different sectoral output shares below that level. In addition, the consistency of observed deviations was verified with respect to the type of commodities produced by each activity at a very low level of aggregation (6-digit CPA). In the Upper Austrian textile industry, for instance, the regional survey data showed a high amount of inputs of chemical products compared to both the Austrian materials input data as well as the national use table. By examining the detailed commodity composition of regional textile production, it was found that mainly textiles made of synthetic fibers were produced in Upper Austria; the different use structure thus seemed plausible.

After regionalizing the input structure and testing its plausibility, the full regional matrix of intermediate input shares was multiplied with the vector of regional total intermediate input levels by activities in order to complete the regional intermediate use table. Since all input values contained in the regional intermediate use table were based on purchaser prices, these values had then to be transformed into producer prices. For that transformation, data on trade and transport margins as well as commodity taxes and subsidies were needed but not available on a regional level. Margins, taxes and subsidies for each commodity were thus taken from the national table and related to their respective input values. These ratios were then applied to carry out the price transformation of regional input values.

1.3 Regional final use table

Data on final demand on the regional level are hard, if not impossible to come by. Therefore, national values for final demand had to be regionalized using information which was available on both the national and the regional level. We utilized sectoral value added, sectoral output and population data for this purpose. In devising the regionalisation algorithms, care was taken to make sure that they lead to regional values which are consistent with the national values. This implies that, should regional values for all Austrian provinces be constructed according to this algorithm, they add up to the respective national values.

National private consumption was broken down to the regional level assuming, for each commodity, identical ratios of private consumption and per-capita value added. The structure of regional private consumption is therefore the same as the national structure. The level of private consumption, however, is derived assuming that the ratio of consumption to value added is the same on the regional as well as the national level.

National consumption shares could not be applied to either retail or restaurant and hotel services since the input-output tables were to be based on the principle of domestic consumption as opposed to residential consumption. Whereas the latter would encompass consumption by regional residents independent of the place of consumption, the former includes all consumption activities taking place in the region irrespective of the residency of the consuming parties. The application of the domestic consumption principle necessitated the adjustment of the values of final consumption for these two commodities such that no exports existed. These changes were not very large and amounted to about 5% of private consumption in the retail sector and about 10% in the tourism sector. Nevertheless, this intervention constitutes a breach with the consistency proposition mentioned above which requires the regional tables for all 9 Austrian provinces to add up to the national table. Unfortunately, this problem can only be solved in the course of actually designing I-O tables for all 9 Austrian provinces.

The regionalisation of investment demand was based on output figures. To capture structural differences, a ratio of investment to output was calculated for each activity. Based on these investment ratios and regional sectoral output values, a region's total investment demand was calculated and then distributed over all commodities using national shares in total investment. Similarly, changes in regional inventories were approximated for each activity assuming the same ratios of change in inventories to output as for the national level.

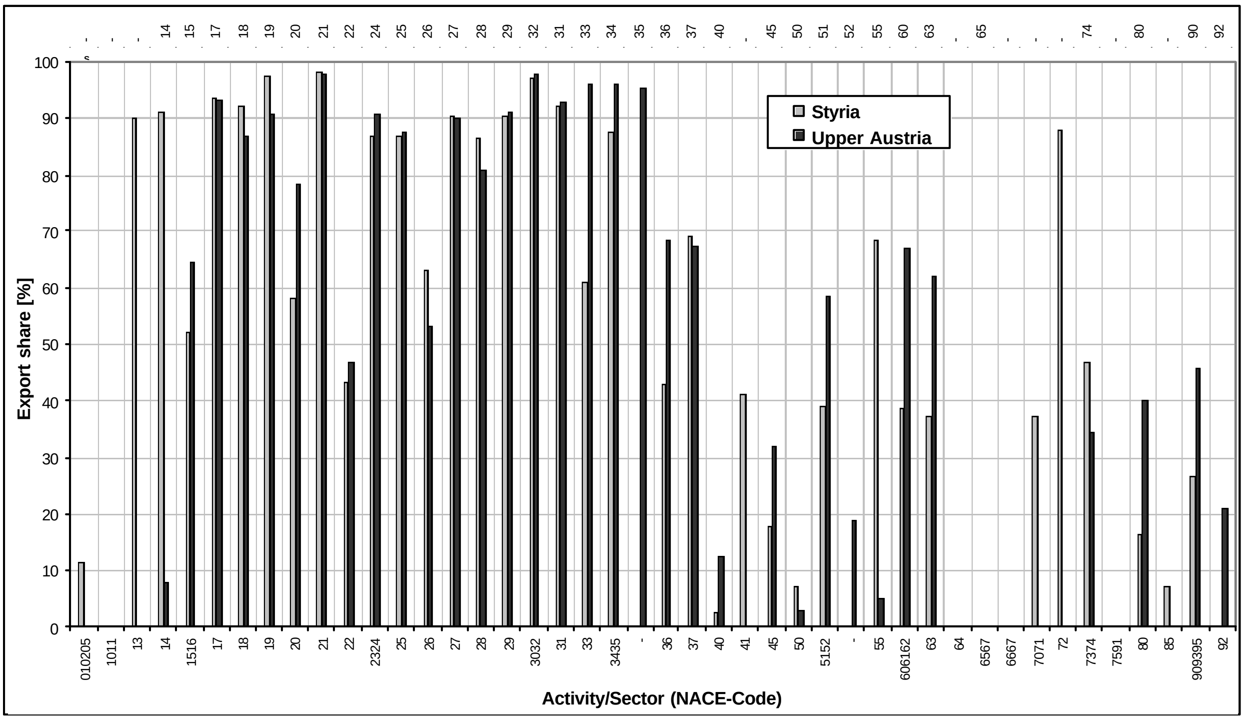
For public consumption, the ratio of government consumption and total value added was calculated on the national level; total regional value added was then multiplied with this ratio, giving rise to an estimate for regional total public consumption. Again, national public consumption shares were applied in order to allocate total public consumption to the different commodities.

Data on regional exports and imports are of course not collected by any statistical office. For this reason, surveys among regional firms were conducted. Firms were asked about their estimate of the ratio of regional exports to total revenues and the results were used to calculate sectoral export ratios. Information on imports was not collected since, based on the experience from previous surveys, firms have reasonable knowledge about the location of their customers and are therefore able to estimate the volume of regional exports, but are usually uninformed about the exact origin of their imports. The survey included firms in most of the 55 sectors; wholesale and retail trade as well as hotels and restaurants services were excluded since based on the principle of domestic consumption they do not export at all. No exports were also assumed for some other services like public administration, health and educational services. For other services for which survey data were not collected or firms could not provide information a reasonable assumption on export ratios had to be made. The export ratio for the agricultural sector was also based on an assumption. Since exports may vary according to different firm sizes, with larger firms being expected to have higher export ratios, the survey data were weighted according to four size classes. In this, the weights were based on the ratio of each size class's revenue to total revenues of an activity. Using the regional market shares matrix, the resulting sectoral exports were finally converted into exports of commodities.

The surveys were conducted by telephone. Besides questions pertaining to the export shares, they asked for information about the firms' revenue and the number of employees. In quite a few cases, firms were reluctant to come up with this information. In these cases, secondary data sources like commercial business databases or company internet homepages were used to fill the gaps. Overall, some 1.5% of all firms provided the necessary information (e.g., for Upper Austria, this amounts to close to 400 out of some 30.000 firms), even though the share of total output of firms included in the survey is much higher. Expert judgment and plausibility checks were used to fill data gaps and convert the survey results into regional export demand.

The diagram below presents the results from the surveys in Styria and Upper Austria.

Figure 1.1: Export shares in Styria and Upper Austria

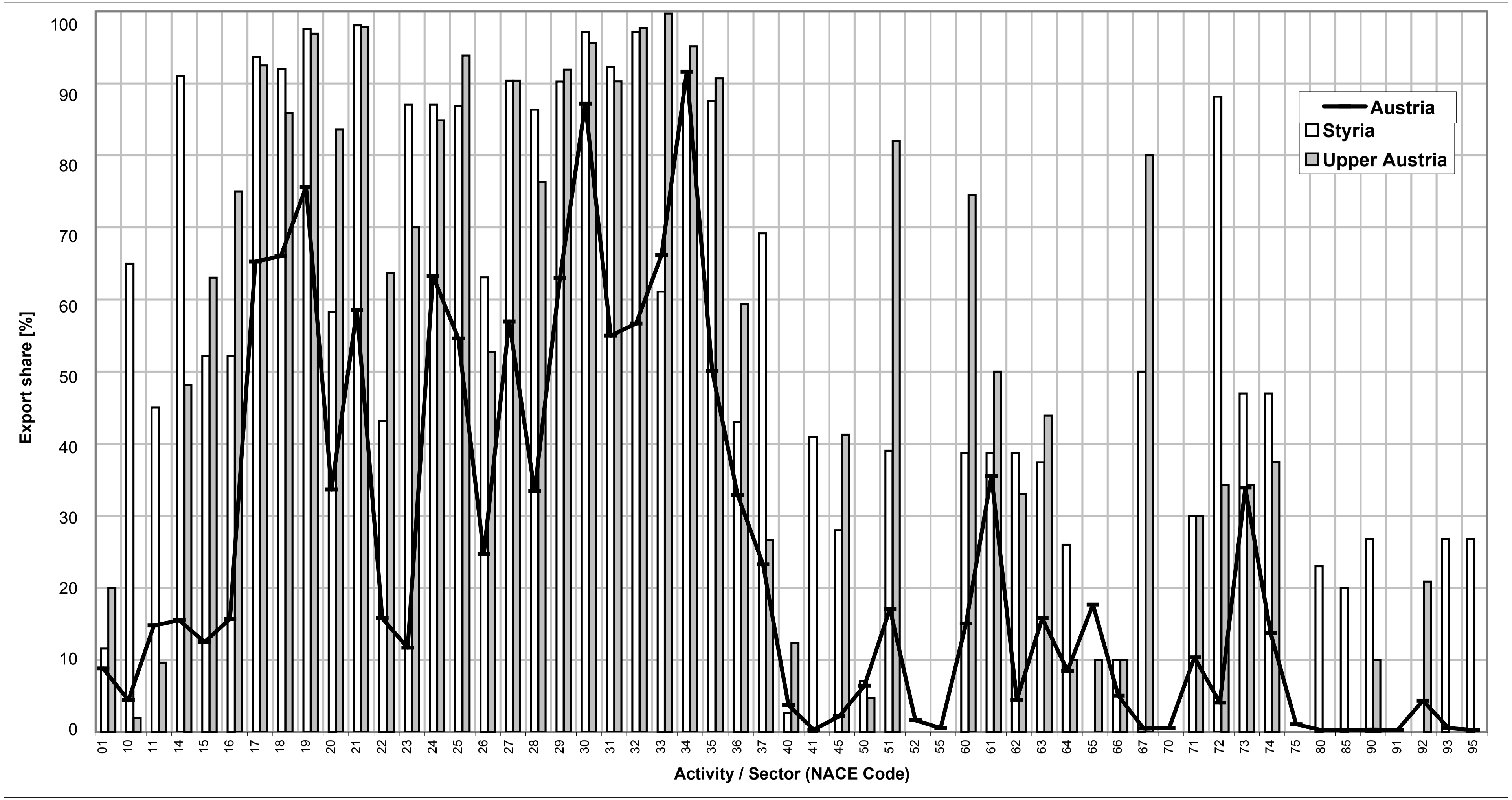


Both provinces exhibit similar export patterns. The largest difference appears for sector NACE 14 (other mining and quarrying) and can be explained by the characteristics of this sector: In Styria, this sector is composed primarily of quarrying, whereas in Upper Austria, mining of gravel and salt are of major importance. Mining of gravel, though, is largely pursued by construction firms. These tend to be more locally oriented in their range of production. Also, as a bulky low-cost commodity, gravel does not travel well.

The figures for sectors 52 and 55 (retail and tourism) were the result of misclassifications of firms during the sampling process; as their export share should be zero (due to the application of the principle of domestic production, see above), these values were not included in the regional input-output tables.

The following figure depicts, for all 55 activities, the export shares which were finally used in the regional input-output tables. For the sake of comparison, the national values are presented alongside.

Figure 1.2 Export shares as incorporated in the regional IO tables; comparison with national values



As the national economy should be more a closed system than the economy on a regional level, export shares are expected to be somewhat lower for Austria than for the constituent regions. This can be confirmed for most activities by the survey results.

1.4 Regional intermediate and final use tables for regional commodities

One of the key challenges in building a regional input-output table concerns the separation of commodities used by intermediate and final demand according to their origin: Commodities produced by firms located in the region must be isolated from commodities imported from other regions or from abroad.

In a first step, total regional commodity imports were calculated based on the condition that total commodity use in the region had to equal total commodity supply:

$$u_i + f_i + x_i = q_i + m_i \,. \qquad (1.1)$$

In this equation, u_i denotes total intermediate use of commodity i, f_i total final use of i and x_i, m_i exports and imports of i. q_i denotes the production of commodity i by regional firms and is the inverted vector of the column sums of the regional make table. Since only imports are unknown in this equation they can be calculated for each commodity i. These commodity imports also serve as an important control variable since negative imports may not appear in the table.

For each commodity i an import ratio iq_i was calculated:

$$iq_i = (m_i - lm_i)/(u_i + f_i - x_i - l_i) \,. \qquad (1.2)$$

Inventories (lm_i) and exports were excluded from this ratio: For inventories, it was assumed that the share of imported commodities in total inventories was equal to the corresponding national share. It was further assumed that imported goods were not re-exported.

Applying this import ratio to the intermediate and final use tables derived above, i.e. assuming identical import ratios across all commodity uses, values for imported and domestically produced inputs were calculated:

$$
\begin{aligned}
um_{ij} &= u_{ij} \cdot iq_i \\
ud_{ij} &= u_{ij} - um_{ij} \\
fm_{ik} &= f_{ik} \cdot iq_i \\
fd_{ik} &= f_{ik} - fm_{ik}
\end{aligned} \qquad (1.3)
$$

In equation (1.3) um_{ij} denotes the value of imported inputs of commodity *i* in the production of activity *j*, ud_{ij} the corresponding value of regional inputs and u_{ij} the value of total inputs *i* used up in the production of activity *j*. Similarly, fm_{ik} and fd_{ik} denote the value of imported and regionally produced commodity *i* used up by final demand category *k*, respectively. The total use of commodity *i* by final demand category *k* is denoted by f_{ik}.

The resulting tables for regional intermediate and final use of regionally produced commodities form the basis for further adjustments of the import ratios of individual inputs. The high level of aggregation implies that very different types of commodities are condensed in one 2-digit commodity which increases the probability of large differences in import ratios beneath the 2-digit level of aggregation. For instance, a commodity used by intermediate demand may have characteristics very different from another commodity belonging to the same 2-digit code but being consumed by private households. Consequently, their import ratios may differ quite substantially across activities and final use categories.

Adjustments of the import ratios of single commodities were not carried out in a systematic way but relied on how much additional information, often purely qualitative in nature, was available on individual sectors of the regional economy. Since it is known, for instance, that tobacco leaves are the main agricultural input to the tobacco industry but are not cultivated in Upper Austria, the import ratio for the use of agricultural commodities in the tobacco industry was changed to 1. National commodity import ratios served as an important additional piece of information for the adjustment of regional import ratios: For many inputs the national import ratio was close to 1 or rather high which provided evidence for a high regional import ratio as well, especially if knowledge on the regional economy suggested that the region was not specialized in producing that commodity.

Any changes made to import ratios of individual inputs of a certain commodity required adjustment of the import ratios of all other inputs of that commodity in order to keep the overall volume of imports for each commodity constant. These changes were made proportional to the amount of imported inputs, i.e. commodity import ratios were changed by the same amount.

1.5 Regional sector-by-sector input output table

Having completed the regional make table and both regional use tables a quadratic, sector-by-sector input-output table was derived based on the industry-technology assumption. This implied multiplying the market shares matrix with the matrix of input coefficients. In accordance with the European System of National Accounts 1995, the national table, on the other hand, was constructed based on the commodity-technology assumption. Unfortunately, as is well known, applying the latter assumption often results in a high number of negative input-output coefficients due to data deficiencies as well as the inadequacy of the commodity-technology assumption for parts of the non-characteristic production (Statistik Austria 2001, p. 47). Since correction of these negative coefficients requires various adjustments of the input-output data which are not described in the official publications of the Austrian national input-output table and therefore cannot be duplicated, the industry-technology assumption is applied instead in the case of the regional input-output tables.

2 EMPIRICAL COMPARISON

The introduction of this section aims at providing the reader with a short overview over the two regions compared in this paper. Upper Austria and Styria are the third and fourth largest states in Austria, measured by their total population, and are of great economic importance as well. Together they account for 28% of Austria's total value added (1999) and 32% of national employment (2001, without self-employed). The states can also be seen as the country's manufacturing strongholds: no less than 40% of all manufacturing workers are employed in firms located in Upper Austria or Styria.

The relative economic performance of the states differed over the last 25 years: Up to the end of the 1980s Upper Austria was the more dynamic region among the two, in terms of value added its economy expanded at rates above the national average. Styria on the other hand was mostly lagging behind and developed at a slower pace than the national economy. This picture, however, changed in the 1990s, less to the worse of Upper Austria than to the better of Styria, which experienced above average growth differentials. Upper Austria slowed down somewhat at the beginning of the 1990s but could regain its dynamic development later on. A similar pattern turns up when one looks at employment figures: Up to the early 1990s Styria lay markedly below the national employment growth levels while Upper Austria could be found above. Then the Styrian economy turned around and both states have experienced above-national growth rates ever since; Upper Austria has expanded its employment (again without considering self-employed) rather considerably especially in the last three years.

Their recent economic performance is thus an indication that Styria and Upper Austria were rather successful in coping with the economic challenges that certainly arose in the past. Both states had to undergo significant structural changes in the last two decades, not to the least caused by their large share in Austria's nationalised manufacturing industry which concentrated on basic manufacturing activities: metals and metal products, machineries as well as mining (Styria) and chemicals (Upper Austria). Due to various (economic, political) reasons, the nationalised industry plunged into a deep crisis in the 1980s, which finally led, after reorganization and restructuring efforts had failed, to the split up and partial privatization of the large conglomerates. Some of the once highly competitive regions locating these firms were thus drawn into a negative economic spiral, Upper Styria became known as an old industrial region.

The stylized facts that describe the changes in the sectoral composition in both regions can be summarized as follows:

As expected, when looking at sectoral employment data regional service activities became increasingly important over the years at the expense of manufacturing: while in 1980 only 51% (Styria) and 45% (Upper Austria) of total employment was service based, in 2001 almost up to two thirds of all dependent employees (66% in Styria, 62% in Upper Austria) could be assigned to the service sector. Manufacturing employment, on the other hand, declined from 42% to 27% (Upper Austria) and 35% to 23% (Styria). The trends towards services and away from manufacturing as observed in the two regions were quite similar in extent to the corresponding national trends. This also implies that Upper Austria and Styria kept their above average economic orientation towards manufacturing; employment in market-oriented services in particular still remains relatively low, even when compared to a national share excluding the metropolitan region of Vienna. A relatively large share of the Styrian work force is engaged in public services, including health and education.

Those manufacturing activities which were once carried out by the large nationalised firms are still economically relevant for the regions. This concerns, for instance, metals (in both regions) and also chemicals (in Upper Austria). Other industries lost importance, which is most of all true for the textile industry (esp. in Upper Austria), characterised by low cost / low skill labour requirements. Some industries, actively supported by regional economic policy, have strived: Both regions are proud to have established so called automobile clusters: large multinational automobile producers located in the regions (DaimlerChrysler in Styria, BMW in Upper Austria) and are now surrounded by supplying firms. Sectors producing technology-oriented products (like electronics) are still underrepresented in Upper Austria, while taking an average employment share in Styria. In general, within manufacturing the activities have shifted towards final products away from basic activities, more so in Styria than in Upper Austria.

The remainder of this section deals with an empirical comparison of the regional tables themselves and with respect to the national total. To do so various concepts including similarity indices or the Multiplier Product Matrix (MPM) will be applied to Make, Use as well as quadratic matrices. The general idea is to enable an assessment concerning the ability of the outlined approach in regenerating regional structures and to draw conclusions about the magnitude of these differences between the regions as well as with respect to the national average.

2.1 Comparison of the regional make tables

Not surprisingly, like in the national make table, most entries in these regional tables are found along the main diagonal. While in the Austrian make table 93,6% of total output is generated by primary activities, these account for 93,3% in the Upper Austrian make table and 94,7% in the Styrian one, reflecting the high level of aggregation. The Styrian table appears to be more similar to the national table: The total sum of absolute deviations of the regional from the national commodity shares is 281 as compared to 344 in the Upper Austrian table.

The differences between the national and the regional make tables are further examined by using regional make structures and national total output levels of activities to calculate (hypothetical) total commodity values and compare those with actual total commodity values from the national make table. The results show that for some commodities hypothetical output values deviate by as much as 40% from their true national output levels. In the Upper Austrian table for seven out of the 29 commodities for which regional shares were available the hypothetical output values deviate by more than 10% from their actual values. Again, the evidence points towards a closer similarity of the Styrian table, where only three commodity output values exceed the ten percent range of deviation.

In the following empirical applications pairs of Input-Output tables and their respective sectors will be compared with the help of similarity indices. In this present application the index of LeMasne is used. Given sector *j* in region 1 and 2 the index is defined as (see Antille et. al., 2000):

$$\mathrm{S}_{\mathrm{j}}^{\mathrm{R_1-R_2}} = 100 \cdot \left(1 - 0{,}5 \sum_{j=1}^{n} \left| a_{ij}^{*R_1} - a_{ij}^{*R_2} \right| \right), \qquad (2.1)$$

where $a_{ij}^{*R_1}$ and $a_{ij}^{*R_2}$ correspond to some normalized input-output coefficient (e.g. taken from the matrix of technical coefficients) of each one of the two tables compared, that is:

$$a_{ij}^{*} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}}, \qquad (2.2)$$

and hence:

$$\sum_{i=1}^{n} a_{ij}^{*} = 1. \qquad (2.3)$$

From (3.1) it becomes obvious that the LeMasne index will take values between 0 and 1, with the latter indicating perfect similarity and vice versa. Alternatively to comparing each sector, the index will also be applied to the matrices as a whole or parts of the matrix (such as manufacturing or service sectors), with the normalisation involving the corresponding elements of the respective matrix.

Table 2.1: LeMasne Index of overall make tables

	Styria – Upper Austria	**Styria - Austria**	**Upper Austria – Austria**
Overall LeMasne Index	**93,5**	**95,2**	**94,1**

Table 2.1 above confirms the prior results in that the Styrian table is found to be slightly more similar to the national table than is the Upper Austrian. The analysis reveals that the regional tables are less similar when compared to each other than when compared to the national table. Detailed results for the index on the sectoral level are shown in the appendix (see table A.1).

Summing up, the comparison of national and regionalized make tables seems to justify that even given the high level of aggregation (which reduces the degree of secondary production and thus potential differences in the make structures considerably) and the restrictions imposed on regionalisation by the limited amount of regional information available such regionalisation should be carried out.

2.2 Comparison of regional intermediate use tables

The differences between the national and the (derived) regional intermediate use tables (based on purchaser prices) were examined by comparing hypothetical total values of intermediate commodities, which were calculated based on national total input values by activities and regional intermediate use structures, with actual total values of intermediate commodities. In Upper Austria, for 10 out of 27 commodities whose input shares were regionalized the hypothetical total input values deviate by more than 10% from the actual values; in Styria this applies to 9 commodities. For only one commodity in Upper Austria and 3 commodities in Styria no deviation is observed at all. On average, the deviation of the hypothetical from the actual totals is 11% in Upper Austria and 10% in Styria. The results from applying the LeMasne index are tabulated below.

Table 2.2: LeMasne Index of overall use tables

	Styria – Upper Austria	**Styria - Austria**	**Upper Austria - Austria**
Overall LeMasne Index	**84,4**	**90,8**	**88,7**

Similar to the results obtained for the make table, Table 2.2 shows that, compared to Upper Austria, the Styrian use structure is more similar to the national structure. Given that the coefficients in the intermediate use table are more dispersed across the cells of the table than is the case for the make structure, the values of the LeMasne index are generally lower than before.

Again, the observed differences between the regionalized and the national intermediate use structures seem large enough to justify the regionalisation efforts.

2.3 Comparison of the overall regional input-output-tables for Styria, Upper Austria and the national table for Austria

2.3.1 The multiplier product matrix (MPM)

In order to look at the regional differences of interindustrial linkages in the regions of Styria and Upper Austria and the national level of Austria, coefficients derived from the so-called Multiplier Product Matrix (**MPM**) are investigated. The **MPM** can be defined via the row ($B_{i\bullet}^{R_n}$) and column sums ($B_{j\bullet}^{R_n}$) of the Leontief inverse matrix ($\mathbf{B}^{\mathbf{R_n}}$) as follows:

$$\mathbf{MPM}^{\mathbf{R}_n} = \frac{1}{V^{R_n}} \begin{pmatrix} B_{1.}^{R_n} \\ B_{2.}^{R_n} \\ \vdots \\ B_{55.}^{R_n} \end{pmatrix} \begin{pmatrix} B_{.1}^{R_n} & B_{.2}^{R_n} & \cdots & B_{.55}^{R_n} \end{pmatrix}, \quad (3.4)$$

where the superscript R_n denotes the respective region (with n being either Austria as a whole or Styria and Upper Austria respectively). V^{R_n} is the global intensity of the Leontief inverse in region R_n, that is, the sum of all coefficients in $\mathbf{B}^{\mathbf{R_n}}$:

$$V^{R_n} = \sum_{i=1}^{55} \sum_{j=1}^{55} b_{ij}^{R_n} \ . \qquad (3.5)$$

Comparison of the overall global intensity for 1995 in all three tables under investigation reveals, that Upper Austria (70,8) seems to be slightly more interconnected than Styria (68,0). The global intensity for Austria as a whole is – of course due to the relatively more closed national economy – much higher than the ones derived from the regional tables. The following table depicts the results.

Table 2.3: Global intensities, overall input-output tables

	Austria	**Styria**	**Upper Austria**
Global Intensity	80,6	68,0	70,8

Given the applied method and the data used in generating the tables it does make sense to investigate manufacturing (including agriculture) and service sectors separately, since the differences in the service sectors basically stem from regionalizing final demand, while real regional data is used in determining the intermediate demand structure of manufacturing sectors.

Table 2.4: Global intensities in manufacturing and service sectors

	Austria	**Styria**	**Upper Austria**
Manufacturing, Primary sector	46,1	37,7	41,0
	57%	56%	58%
Services	34,5	30,3	29,8
	43%	44%	42%

Not surprisingly, the differences between the two regional tables are found to occur mainly in the manufacturing sectors, while the intensities in the service sectors are quite similar. The distribution of the effects accruing to manufacturing and services (compare the percentage points stated below the values of the global intensity) appears to be very stable across all three tables.

Furthermore, following Sonis and Hewings (1999), the coefficients of the MPM can be illustrated in graphical form in order to reveal the *economic landscape* of a region at a certain point in time. Comparing these landscapes for 1995 yields the figures shown below. In order to obtain these landscapes, the sectors of the Austrian input-output table are reorganised along both rows and columns such that the largest coefficient is placed in row one and column one. The sectors of the regional tables are then reshuffled based on this national ranking of sectors.

Figure 2.1: Economic landscape for Austria in 1995

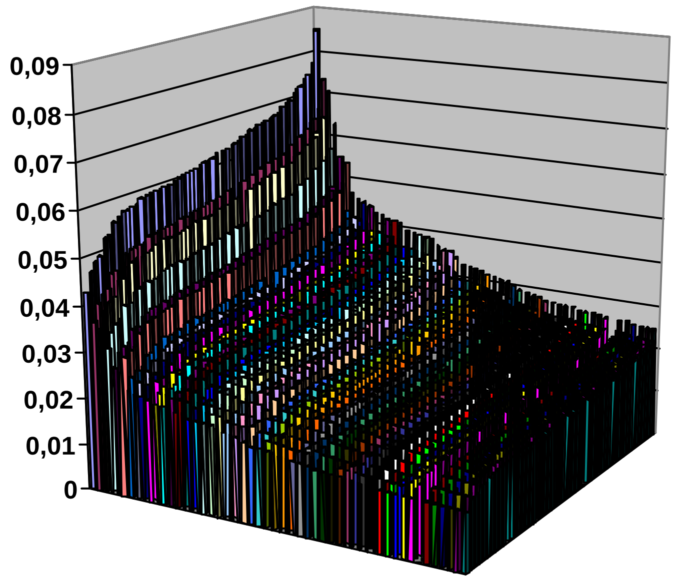


Figure 2.2: Economic landscape for Styria in 1995

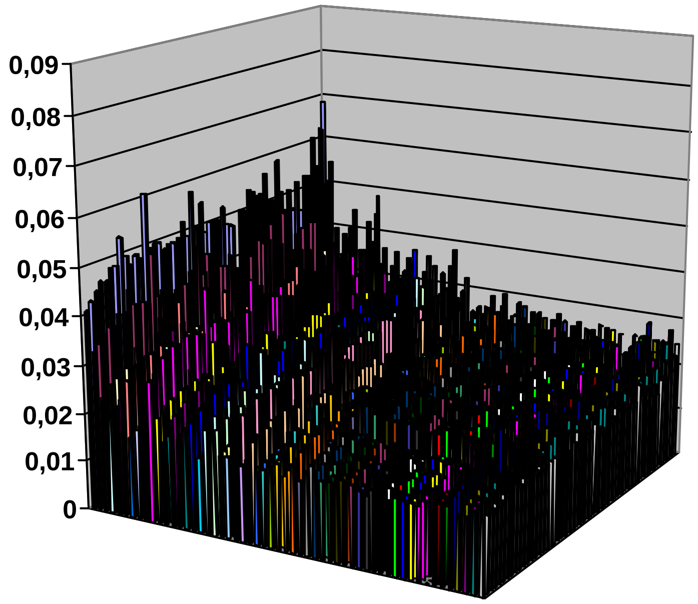
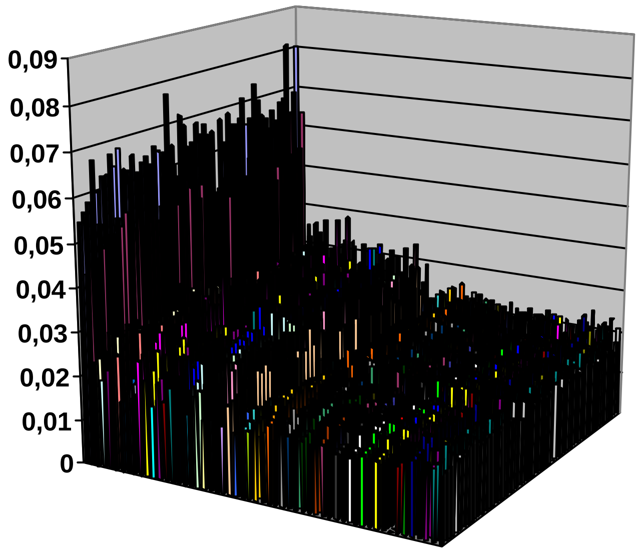


Figure 2.3: Economic landscape for Upper Austria in 1995



The landscapes depicted in Figure 2.2 and Figure 2.3 for Styria and Upper Austria, respectively, reveal that the sectoral linkages within the Styrian economy seem to be more evenly dispersed as opposed to the ones in Upper Austria. Hence, the latter shows a larger difference between the maximum and minimum linkages, indicating a greater degree of specialisation in Upper Austria. The landscapes also reveal, that – in general – sectors showing strong intermediate linkages on the national level also appear to be among the ones more closely linked on the regional levels (note that – after imposing the national structure – the coefficients in the regional level decline from left to right).

2.3.2 Comparison by means of the similarity index

The square matrix of technical coefficients – derived from the make and use tables applying the industry-technology assumption – can again be investigated using the LeMasne index already defined above. The results obtained from comparing the overall matrices are shown in Table 2.5 below, while those for applying the index to each sector are stated in the appendix. Table 2.5 also provides a distinction between manufacturing sectors (including agriculture) as well as services.

Table 2.5: LeMasne Similarity index for the matrices of technical coefficients

	Styria - Upper Austria	Styria - Austria	Upper Austria - Austria
LeMasne Index overall	62,3	70,2	59,9
LeMasne Index Manufactring	53,6	70,2	54,5
LeMasne Index Services	77,9	70,6	67,2

The computed indices tabulated above confirm the results obtained earlier with the make and use tables. Hence, the regional matrix of Styria is found to be much more similar to the one on the national level (with an index value of 70,2) than is the table for Upper Austria (index value of 59,9). Not surprisingly (given the way the regional tables under consideration are set up) these differences can be attributed mostly to the manufacturing sectors, who show marked differences when comparing the two regions with the national level as opposed to the service sector which is almost identical.

CONCLUSIONS

Efforts in compiling regional input-output tables in Austria are severely hampered by constraints with respect to regional data. While data on the manufacturing industries is relatively rich, data on service sectors are not available on the regional level and are generally very scarce even on the national level. Since these data gaps could not be fully compensated by collecting survey data, a hybrid approach to input-output modelling was pursued.

Nevertheless, the empirical comparison of two regional input-output tables for two Austrian states has shown that the regionalisation methodology applied results in tables exhibiting considerable differences in their structures. In particular it was found that linkages between sectors of the Styrian economy resemble the national average linkages more closely than those observed in the Upper Austrian table. Both with respect to the make as well as the use side of the constructed tables the Styrian structure is more similar to the national structure. Moreover, the regional linkages of Upper Austrian manufacturing industries are slightly higher and appear to be concentrated on fewer sectors.

As a next step in the ongoing research the outlined method for compiling regional input-output tables will form the basis for the construction of a multi-regional input-output system for Austria. This multi-regional table will comprise all nine Austrian states which offers additional opportunities for regionalisation, consistency with the national table places further constraints on the individual regional input-output structures.

LITERATURE

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Statistics Austria (2001): Input-Output Tabelle 1995. Vienna.

APPENDIX

Table A.1: LeMasne Similarity index for each manufacturing sector, make matrix

2 digit Nace – code	Styria - Upper Austria	Styria - Austria	Upper Austria - Austria	2 digit Nace – code	Styria - Upper Austria	Styria – Austria	Upper Austria - Austria
10	94,9	94,9	100,0	26	96,7	97,0	97,4
11	69,9	80,3	79,9	27	96,4	97,5	97,5
14	92,0	94,0	89,0	28	84,3	91,7	89,9
15	98,3	99,2	98,4	29	97,6	97,0	98,2
16	100,0	88,5	88,5	30	93,8	93,8	100,0
17	93,2	93,1	94,9	31	95,0	94,0	95,5
18	91,4	96,9	93,7	32	87,0	88,7	89,9
19	99,4	99,5	99,3	33	99,4	96,4	96,5
20	97,4	97,4	95,8	34	95,6	95,7	97,9
21	99,5	98,3	97,9	35	99,7	94,7	95,0
22	99,3	97,8	97,9	36	93,8	95,5	97,0
23	87,4	100,0	87,4	37	72,1	96,8	72,4
24	85,0	93,5	90,6	40	97,7	97,8	96,4
25	95,8	93,7	95,4	45	100,0	98,2	98,2

Table A.2: LeMasne Similarity index for each manufacturing sector, use matrix

2 digit Nace – code	Styria - Upper Austria	Styria - Austria	Upper Austria - Austria	2 digit Nace – code	Styria - Upper Austria	Styria – Austria	Upper Austria - Austria
10	100,0	100,0	100,0	26	79,9	86,2	87,4
11	100,0	100,0	100,0	27	82,8	86,7	94,3
14	95,2	92,2	93,3	28	88,4	92,6	94,7
15	90,9	95,1	93,4	29	93,7	95,0	91,9
16	79,8	100,0	79,8	30	100,0	100,0	100,0
17	50,4	90,4	57,0	31	79,4	91,9	82,3
18	89,8	86,5	91,8	32	79,0	78,7	81,2
19	60,2	62,0	90,0	33	74,4	76,8	92,6
20	87,5	90,9	92,2	34	50,6	80,6	68,2
21	86,9	93,6	88,3	35	79,9	100,0	79,9
22	86,1	96,7	84,2	36	71,6	72,4	82,1
23	93,4	100,0	93,4	37	100,0	100,0	100,0
24	85,5	82,9	86,4	40	97,1	98,1	98,4
25	91,4	92,4	92,3	45	86,1	100,0	86,1

Table A.3: LeMasne Similarity index for each sector, matrix of technical coefficients

2 digit Nace – code	Styria - Upper Austria	Styria - Austria	Upper Austria - Austria	2 digit Nace – code	Styria - Upper Austria	Styria – Austria	Upper Austria - Austria
01	89,9	77,5	78,4	**41**	92.1	79.7	78.6
10	86,9	76,5	77,3	**45**	86.5	76.2	77.7
11	75,4	74,7	76,8	**50**	83.7	70.6	68.7
14	81,7	77,0	72,4	**51**	85.2	74.8	71.1
15	93,4	79,1	77,3	**52**	81.3	72.1	61.5
16	82,1	64,9	68,9	**55**	91.0	83.4	82.7
17	64,9	65,9	55,7	**60**	85.8	76.5	75.6
18	82,3	68,4	69,5	**61**	88.8	65.9	71.6
19	64,9	60,8	69,0	**62**	86.0	68.3	69.8
20	72,6	82,4	69,1	**63**	89.5	59.0	52.3
21	70,5	72,4	56,6	**64**	82.6	75.1	67.3
22	73,6	70,6	53,8	**65**	88.7	73.2	75.6
23	86,0	56,0	58,2	**66**	77.8	73.4	81.6
24	74,1	68,8	63,6	**67**	83.1	74.9	78.9
25	69,9	77,1	62,8	**70**	92.6	85.9	82.2
26	76,8	75,7	77,6	**71**	82.2	72.2	73.4
27	79,1	74,9	78,4	**72**	68.3	65.0	80.8
28	81,2	73,6	75,7	**73**	80.5	67.0	68.7
29	82,5	74,8	77,7	**74**	88.1	72.4	70.2
30	83,5	70,1	67,2	**75**	90.9	77.4	76.6
31	78,6	74,6	70,4	**80**	88.1	78.0	73.6
32	79,4	67,8	70,1	**85**	87.3	78.1	75.2
33	78,6	70,0	70,2	**90**	91.8	86.5	83.9
34	54,0	52,4	78,8	**91**	89.0	75.5	73.4
35	81,1	72,1	72,8	**92**	86.0	82.1	84.7
36	84,7	73,6	73,6	**93**	84.7	76.1	72.0
37	86,6	73,8	69,7	**95**	100.0	100.0	100.0
40	90,5	88,0	87,4				

Table A.4: Industry classification including NACE 2-digit codes

Products of agriculture, forestry and fishing	01	Water; distribution services of water	41
Coal and lignite; peat	10	Construction work	45
Crude petroleum, natural gas, metal ores	11	Trade and repair services of motor vehicles etc.	50
Other mining and quarrying products	14	Wholesale and comm. trade serv., ex. of motor vehicles	51
Food products and beverages	15	Retail trade serv., repair serv., exept of motor vehicles	52
Tobacco products	16	Hotel and restaurant services	55
Textiles	17	Land transport and transport via pipeline services	60
Wearing apparel; furs	18	Water transport services	61
Leather and leather products	19	Air transport services	62
Wood and products of wood	20	Supporting transport services; travel agency services	63
Pulp, paper and paper products	21	Post and telecommunication services	64
Printed matter and recorded media	22	Financial intermediation services (ex. insurance serv.)	65
Coke, refined petroleum products	23	Insurance and pension funding services	66
Chemicals, chemical products	24	Services auxiliary to financial intermediation	67
Rubber and plastic products	25	Real estate services	70
Other non-metallic mineral products	26	Renting services of machinery and equipment	71
Basic metals	27	Computer and related services	72
Fabricated metal products	28	Research and development services	73
Machinery and equipment n.e.c.	29	Other business services	74
Office machinery and computers	30	Public administration services etc.	75
Electrical machinery and apparatus	31	Education services	80
Radio, TV and communication equipment	32	Health and social work services	85
Med., precision, opt. instruments; watches, clocks	33	Sewage and refuse disposal services etc.	90
Motor vehicles, trailers and semi-trailers	34	Membership organisation services n.e.c.	91
Other transport equipment	35	Recreational, cultural and sporting services	92
Furniture; other manufactured goods n.e.c.	36	Other services	93
Recovered secondary raw materials	37	Private households with employed persons	95
Electrical energy, gas, steam and hot water	40		